Evolving IT Sourcing Strategies in the German Automotive Industry:

A Blueprint for Managing Transition

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I. Abstract

This thesis examines how and why the German automotive industry is changing IT sourcing strategies in response to the implications of digital transformation. Due to megatrends such as decarbonisation and digitalisation, the industry is undergoing its greatest transformation in its existence. The future success of the industry depends heavily on the level of digital innovation, for which IT sourcing is becoming a strategic function to provide critical capabilities and resources. The industry has made a strategic shift and recognised software as a key technology that will dictate long-term success in global markets. Transformation processes have begun to span the areas of digital processes and automation, connected cars, and mobility services to facilitate software-enabled automotive companies. This is leading to new IT sourcing models in a variety of configurations.

This research is based on the constructivist perspective, with its associated interpretative research methodology. The thesis centres on a single-case study of the German automotive industry as a whole, where a change in the ratio between insourcing and outsourcing has a significant impact on in-house employment and third-party business operations.

The approach is qualitative and started with an online survey for framing areas of discussion for the subsequent 19 semi-structured interviews with IT managers and sourcing experts. The analysis of the findings resulted in 15 emerging themes and the development of a blueprint for the transitioning of IT sourcing management, requiring a redistribution of IT responsibilities between Business and Corporate IT.

The blueprint contributes to both theory and practice. The principles for a reallocation of IT sourcing responsibilities and the resultant organisational consequences are set out. The blueprint can be set alongside existing models of sourcing transition, and acts as a guide for practitioners in the automotive sector charged with overseeing change in sourcing management in the digital era.

II. Declaration of Original Content

I declare that the work in this thesis was carried out in accordance with the regulations of the University of Gloucestershire and is original except where indicated by specific reference in the text. No part of the thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas. Any views expressed in the thesis are those of the author and in no way represent those of the University.

Signed:

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IV. Dedication

This thesis is dedicated to my parents for their love, patience and tireless support. They provide me with courage and constant energy to fulfil all my goals in life.

"Ein weiser Bär hat stets ein Marmeladen Sandwich unter seinem Hut versteckt - nur für den Notfall."

Paddington

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VIII. List of Abbreviations

AI	Artificial Intelligence
AWS	Amazon Web Services
BMWi	Bundesministerium für Wirtschaft und Klimaschutz
BoM	Bill of Material
CAD	Computer Added Design
CAM	Centre of Automotive Management
CEO	Chief Executive Officer
CF	Conceptual Framework
CFO	Chief Financial Officer
CIO	Chief Information Officer
CISO	Chief Information Security Officer
CDO	Chief Digital Officer
CMO	Current Mode of Operation
CPS	Cyber-Physical Systems
CRM	Customer Relation Management
CSO	Chief Software Officer
CTO	Chief Technology Officer
EAM	Enterprise Architecture Management
ECU	Electronic Control Unit
EDM	Enterprise Data Management
E/E	Electric / Electronic
ERP	Enterprise Resource Planning
FMO	Future Mode of Operation
FTE	Full-time Equivalent

HPC High-Performance Computer

HR Human Resource

IaaS Infrastructure as a Service

IIoT Industrial Internet of Things

IP Intellectual Property

iPaaS Integration-Platform-as-a-Service

IT Information Technology

ICT Information and Communications Technology

ITO Information Technology Outsourcing

IS Information Systems

KBV Knowledge-Based View

LoC Lines of Code

MaaS Mobility as a Service

OEM Original Equipment Manufacturer

PaaS Platform as a Service

RBV Resourced-Based View

R&D Research and Development

ROs Research Objectives

RPA Rapid Process Automation

RQs Research Questions

SaaS Software as a Service

SLR Systematic Literature Review

TCE Total Cost of Economics

TCO Total Cost of Ownership

VDA Verband der Automobilindustrie

1 Introduction

With decarbonisation and digitalisation, the German automotive industry is facing the most far-reaching transformation process in its existence (BMW, 2020). The industry's success to date has largely been based on technical competencies and innovative strength in the field of the combustion engine as well as competencies in efficient production processes, which will gradually lose importance. Electromobility and digitalisation are fundamentally changing the car (Volkswagen, 2021b). In the future, software for highly automated / autonomous driving and permanently internet-connected vehicles will account for a large share of the value creation of automotive mobility services (Boes & Ziegler, 2021; Müller, 2021; Volkswagen, 2021b). Therefore, the automotive industry is changing from a hardware-centric to a software- or data-driven industry. Software is thus becoming the central competency of automotive companies (Bosler et al., 2018; Cacilo & Haag, 2018). As a consequence, the German automotive industry will undergo a transformation from the traditional automotive companies into modern software providers, specialising in vehicle-related computer programmes and mobility services within the next ten years. With well-developed vehicle software, there is the possibility of catching up with leading IT nations such as the United States and China (Centre of Automotive Management [CAM], 2020a).

This industry has to acquire new external knowledge by different means to open up market access, gain speed, reduce development risks, and to capture the potential of the emerging technologies and digital transformation (Bauer et al., 2020). This primarily concerns software development for connected and autonomous driving, artificial intelligence as well as cloud technology and the Industrial Internet of Things (IIoT). Hence, this industry faces tremendous challenges when formulating a digital business / transformation strategy, re-defining its core competencies and the generation of knowledge about digital technologies and their deployment within the companies (Dremel et al., 2017). The businesses have to find a new balance between the digital trends and new business models and their established skills and assets that relate to the physical world (Czernich et al., 2021; Seiberth & Gründinger, 2018).

IT sourcing plays a key role in acquiring the digital capabilities that enable businesses to manage digital transformation (Rueckel et al., 2020). Each business needs to have a realistic assessment of what skills are available or can be developed internally, and for which skills or technologies external partners and complementary actors are required, and what these partnerships should look like.

The industry assumes that businesses are increasingly dependent on world-class IT competencies in order to remain competitive in the context of decarbonisation / electromobility and digitalisation (Rueckel et al., 2020). In consequence, businesses are being forced to review their IT sourcing strategies to meet digital transformation requirements (Gerster & Dremel, 2019). On the basis of re-defined core competencies, businesses have to examine to what extent previous strategies for insourcing or outsourcing are still valid, where new priorities must be set and which changed forms of IT sourcing are becoming more relevant. Considering the importance of IT sourcing for the digital transformation of the German automotive industry, this research study focuses on the conditions for evolving IT sourcing strategies and proposes a blueprint for managing transition to meet the new requirements for effective IT sourcing in the digital era.

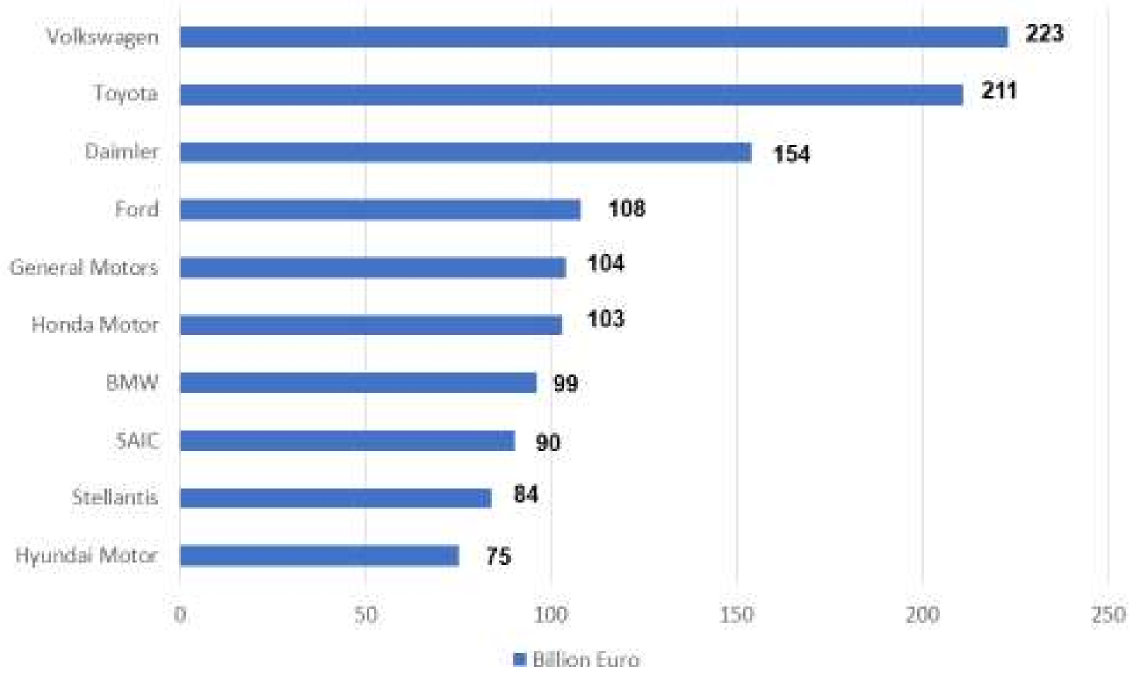
When referring to “IT” (information technology) in this study, the broader definition of IT is adopted, which encompasses technologies, systems and services. Information technology, in its narrow definition, refers to the technological side of an information system, including hardware, databases, networks and other devices (Brautsch & Wynn, 2013). The term is also used interchangeably with IS (information systems) as well as to describe the management of an entire IT organisation (Krcmar, 2015).

This chapter provides the relevant background information to frame the research problem and articulate the research motivation and objectives. The following section addresses the market and competitive profile of the German automotive industry and provides information on where the shaping factors and challenges for the future business models of OEMs and suppliers will be found. This leads to the research motivation and objectives of this study. Finally, the thesis structure is presented.

1.1 The German Automotive Industry

The German automotive industry consists of original equipment manufacturers (OEMs) and a three-tier supplier network. In 2020, a total of 968 German automotive companies were active in the German automotive industry in almost 80 countries (Statista, 2021c). The term OEM is used synonymously with 'vehicle manufacturer' in the automotive industry. The German based OEMs Volkswagen, Daimler and BMW were among the Top 10 car manufacturers worldwide by turnover in 2020. Figure 1 provides the turnover and ranking of the world's largest car manufacturers in 2020 and Table 1 provides a short introduction of these companies.

Figure 1: Turnover and ranking of the world's top car manufacturers in 2020



Source: BMW (2021); Daimler (2021b); Gevestor (2021); Volkswagen (2021c)

Table 1: Profile of the world's top car manufacturers in 2020

OEM	Introduction
Volkswagen AG	With a total turnover of €223 billion, Volkswagen AG is the car manufacturer with the highest turnover worldwide. The group acts as the parent company and unites under its umbrella not only the VW brand but also the Audi, Skoda, Seat and Bentley brands as well as the Lamborghini, Bugatti and Porsche sports car brands. The truck manufacturers Scania and MAN are also majority-owned by the VW Group, as is the motorbike manufacturer Ducati.

Toyota	In terms of pure sales units, the Japanese car manufacturer Toyota is currently ahead of Volkswagen with around 9.53 million vehicles sold, but in terms of turnover Volkswagen is in first place. The Toyota brands include Lexus, Scion, Daihatsu and Hino (commercial vehicles). Cooperations exist with Fuji Heavy Industry (Subaru), among others, in which Toyota holds 16.5 % of the shares.
Daimler AG	Daimler AG is known for its Mercedes-Benz car brand, Maybach and AMG as well the small car series Smart. However, Daimler produces not only luxury and compact cars, but also trucks and buses, which include the brands Mercedes, Freightliner, Mitsubishi Fuso truck, and the Setra bus brand. At the beginning of 2022, Daimler was split into two independently listed companies and the former Daimler AG was renamed Mercedes-Benz Group AG. The world's largest truck manufacturer will operate as Daimler Truck Holding AG. This step is intended to underline the different focus of both companies on future drive technologies as well as on digitalisation.
Ford	Ford is the largest US manufacturer, with the F-150 pickup truck dominating the market in the USA. Ford generated sales of €108 billion in 2020, almost exclusively with the core brand. The only sub-brand remains the noble Lincoln, which is mainly used in North America and Asia.
General Motors	From 1931 to 2007, General Motors was the world's largest car manufacturer, but then fell behind Toyota and VW. After 101 years on the market, GM was insolvent in 2009. At present, GM is considered rehabilitated and profitable again with more than 10 million cars sold worldwide (2020 sales: €104 billion). The company's brands include Chevrolet, Buick, GMC, Corvette, the premium brand Cadillac and the Chinese brands Baojun, Jiefang and Wuling. The German subsidiary Opel was sold to the French PSA Group (Peugeot, Citroen) in 2017.
BMW AG	BMW sold almost 2.3 million vehicles with a turnover of €99 billion in 2020. The USA in particular is not only a sales market, but above all a production location. The most important and largest BWM plant is located in Spartanburg, South Carolina, USA. The company currently exports more vehicles from the USA to the rest of the world than Ford and General Motors combined. In terms of value of goods in the United

	States, the BMW Group has thus occupied the top spot in the list of automotive exports for years.
SAIC Motor Corporation	In Europe, SAIC Motor Corporation (Shanghai Automotive Industry Corporation) is still an unknown brand, but in Asia the group is gaining ground and is currently the largest Chinese manufacturer of automobiles and motorbikes. In recent years, SAIC has been able to take over a number of brands, including around 49% of Ssangyong and the former British car brand MG. In China, SAIC is also a cooperation partner of VW and General Motors and had sales of €90 billion in 2020.
Stellantis	Stellantis is a new name on the automotive market, which was only finalised at the beginning of 2021. However, the groups behind Stellantis are: PSA (which includes Peugeot, Opel and Citroën) and Fiat Chrysler Automobiles. With its 14 brands, Stellantis is in 4th place in terms of the number of vehicles sold - but due to its main focus on the low-price segment, it is only good enough for 9th place in terms of total turnover, with €84 billion.
Hyundai Motor Company	The South Korean car manufacturer Hyundai Motor Company is part of the Hyundai Kia Automotive Group and was founded in 1967. With a turnover of €75 billion, the company is ranked 10th among the best car manufacturers. Sister company Kia contributes €42 billion to the overall group. Along with **Tesla**, the group has been considered one of the rising companies in the automotive industry in recent years.

Source: BMW (2021); Daimler (2021b); Gevestor (2021); Volkswagen (2021c); Grundhoff (2022)

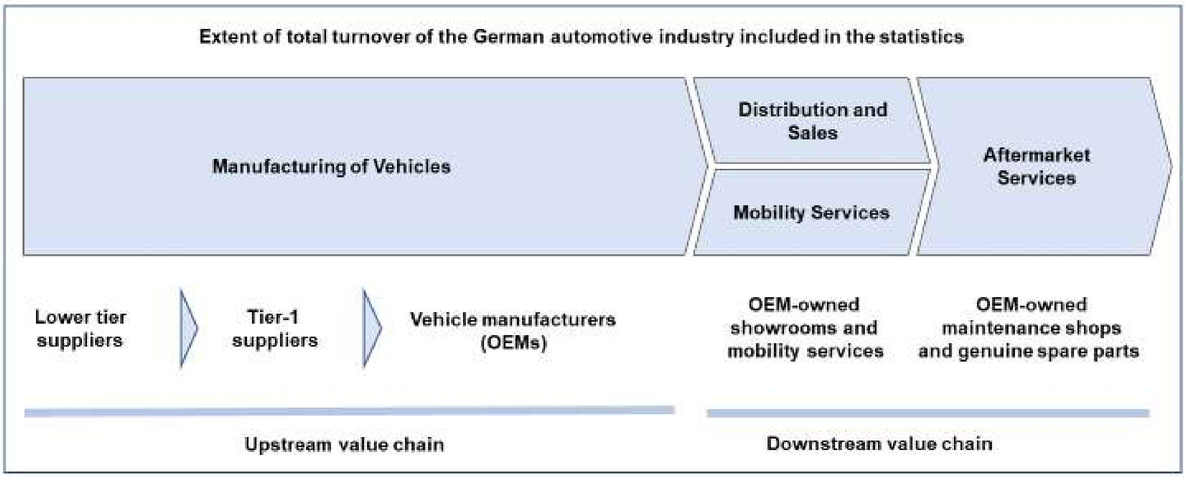
1.1.1 Value Chain of the German Automotive Industry

The value creation of OEMs is closely linked to their upstream supplier network and downstream aftermarket services (Figure 2), which are seen as an integral part of the German automotive industry and are attributed to the turnover of the automotive industry (Seiberth, 2015).

OEMs rely heavily on tier-1 suppliers with their offering of design and technology as well as product development of complete vehicle modules and systems, such as axles, engines and powertrains (Seiberth, 2015). Many tier-1 suppliers depend on subcontractors, namely tier-2 suppliers, for individual components. These in turn can depend on tier-3 suppliers for the supply of standard parts and raw materials, such as press, cutting, welding, forging or casting work (Riasanow et al., 2017).

The OEMs are at the end of the value creation process and distribute the final products to customers through a sales network of their own or franchised dealerships (Lempp & Siegfried, 2022). Thus, car manufacturers are primarily active in powertrain production, body manufacturing and final assembly, as well as aftermarket services, such as production of genuine spare parts, repair and maintenance services, as well as mobility services, such as banking, insurance, leasing and other services (Seiberth, 2015).

Figure 2: Value chain of German automotive industry

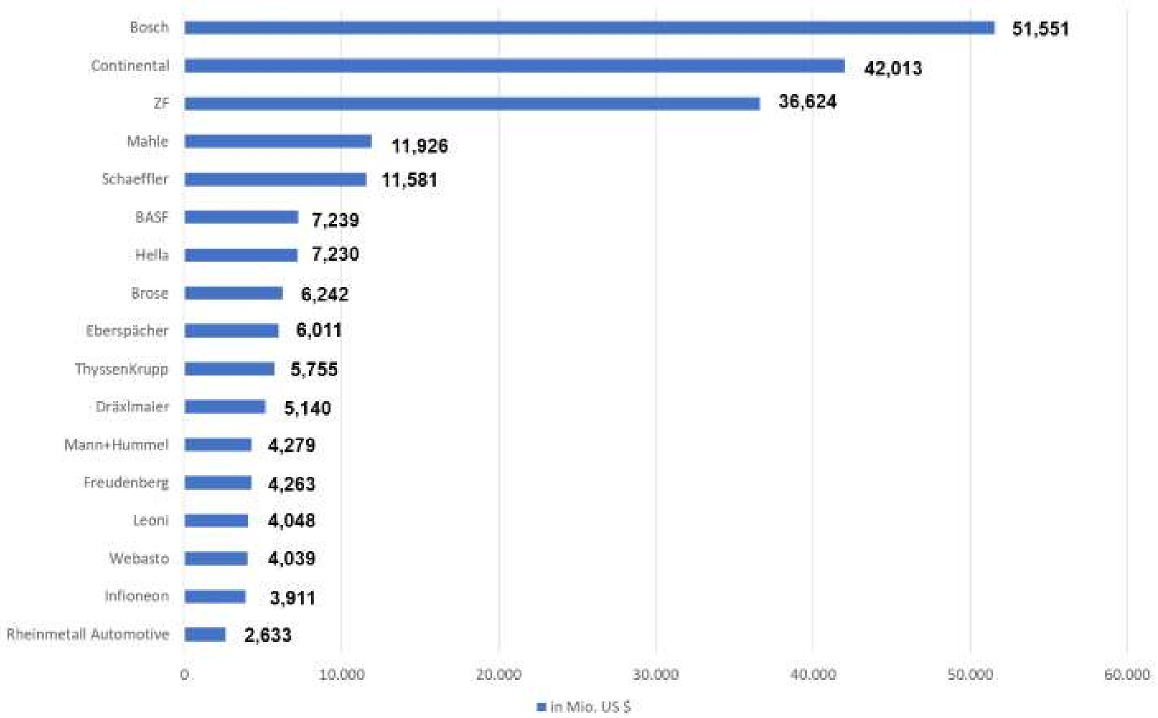


Source: The author

The automotive supplier industry is anything but homogeneous (Seiberth, 2015). Here, family businesses meet global corporations, chip manufacturers meet steel processors, businesses with dozens of global locations meet small specialists who are working on the future of mobility with 100 employees. Even sectors that superficially have little to do with car manufacturing are involved in, and benefit from, the production of vehicles (Puls & Fritsch, 2020). These include capital goods, material and parts supplies from, among others, the chemical industry, the textile industry, mechanical engineering and the electrotechnical industry as well as the steel and aluminium industry. In addition, engineering firms, IT providers and others depend directly or indirectly on the automotive economy (Puls & Fritsch, 2020). There are also many actors in the downstream sector that are exclusively dependent on vehicles as well, such as mobility service platforms for private or commercial car sharing, rental providers, and petrol stations. Overall, the German automotive industry is a highly complex value creation model, strongly networked and highly professionalised (Puls & Fritsch, 2020).

The supplier industry is dominated by the 100 largest companies with a total turnover of around €800 billion in 2020 (Berlin, 2021; Statista, 2021d), while Bosch, Continental and ZF were among the world's ten largest automotive suppliers in 2020 (Appendix 10.1, Figure 41) and are the three largest German automotive suppliers. Figure 3 provides the 2020 turnover in automotive business of selected German tier-1 automotive suppliers, in million $US.

Figure 3: Turnover of selected German automotive suppliers 2020



Source: Berlin (2021)

The tier-1 suppliers, at least, are just as internationalised as the car manufacturers (Jaroschinsky & Opitz, 2018; Verband der Automobilindustrie [VDA], 2020). For example, according to Berlin (2021), Bosch includes 129 production and research and development (R&D) sites worldwide for automotive only. Supplier companies now generate the majority of the value added in the automotive industry - about 70 per cent - in the German industry. The close integration of OEMs with suppliers from various industrial and service sectors, as well as the global network of production and distribution facilities, is considered unique worldwide and represents a competitive advantage over the international competition (Bundeswirtschaftsministerium für Wirtschaft und Klimaschutz [BMWi], 2021a).

In the past, one of the key strengths of the German automotive industry has been its innovation leadership. According to the Expert Commission on Research and Innovation (2022) of the Federal Government of Germany, German corporations are still in first place in Europe for their R&D investments, but in an international comparison, only the large car manufacturers VW, Daimler and BMW, along with the industrial corporation Bosch, make it into the world's top 20. According to the Commission, Volkswagen's R&D spending in 2020 was €13.9, Daimler's €8.4, BMW's €6.3 and Bosch's €6.0 billion. However, the Commission also comes to the conclusion that Germany has considerable weaknesses in the development of digital technologies. There is a serious risk of losing out in this key technology. Currently, digital technologies from Alphabet (Google), Amazon, Apple, Meta (Facebook) and Microsoft are the driving force in all industries.

1.1.2 Economic Situation of the German Automotive Industry

For the first time since the financial crisis of 2009, the global passenger car production by German automakers dropped by 17 per cent to 13.3 million units in 2020 (VDA,2021b; VDA, 2021c). The production of passenger cars in foreign countries dropped by 14 per cent to 9.8 million units in 2020 and the German domestic production of passenger cars decreased by 25 per cent to 3.5 million units in 2020 (Figure 4). However, the German automakers have a 20.2 per cent share of the world market. Three out of four passenger cars manufactured in Germany are sold abroad and one in five new passenger cars in the world bears the logo of a German group brand (VDA,2021b; VDA, 2021c). The main factors contributing to the setback in 2020 were the nearly worldwide production stand-still due to the coronavirus pandemic and the slowness of the subsequent ramping-up again.

Figure 4: Production of passenger cars

Production of passenger cars in units	2019	2020	+/- 19/20 in %
Worldwide production of passenger cars	79,095,000	66,076,000	-16
Global passenger car production by German automakers	16,043,355	13,326,336	-17
Share of global production in %		20.2 %	
Production of passenger cars in foreign countries by German automakers	11,379,606	9,810,848	-14
Domestic production of passenger cars	4,663,749	3,515,488	-25
of which Export from domestic production (ex-factory)	3,487,321	2,646,644	-24
Export rate in %	74.8 %	75.3 %	

Source: VDA (2021b); VDA (2021c)

Even without the pandemic, the number of passenger cars produced in Germany has declined steadily in the last decade, while foreign production by German carmakers in the same period has increased significantly, to 11.4 million vehicles in 2019 (VDA,2021b; VDA, 2021c). Compared to 2009, foreign production has more than doubled (BMWi, 2019). The main reason for this is the very high cost of labour in Germany, which stems to a large extent from the significant additional wage costs (VDA, 2021c). The rising production abroad also shows the trend that production follows demand and is increasingly produced in local markets (BMWi, 2019). These foreign linkages also apply to tier-1 suppliers, as they also do a larger part of their business abroad for cost reasons or follow the OEMs to foreign locations. Accordingly, it is primarily lower-tier suppliers that sell the majority of their products domestically (BMWi, 2019).

The overall economic situation of the automotive industry in 2020 was seriously affected by the coronavirus pandemic. Global supply chains were disrupted, and by April manufacturing in Germany was largely at a standstill. Nearly 60 per cent of the auto industry's workforce was on short-time work. Compared to 2019, total turnover in Germany in 2020 decreased by 13% to €378.2 billion. At €296.4 billion, more than three quarters of the total turnover is accounted for by OEMs (Figure 5). At €242.8 billion or roughly 64 per cent, around two-thirds of turnover in

Germany is generated from foreign customers, demonstrating the industry's high dependence on exports (VDA, 2021c). The industry also plays an important role in the European market. According to VDA (2021c), almost half of the EU automotive industry's value creation came from Germany and more than 30 per cent of the cars built in the EU were produced in Germany.

Figure 5: Turnover of the automotive industry in Germany

Domestic turnover of the German automotive industry: Sales with domestic and foreign customers in billion EUR	2019	2020	+/- 19/20 in %
Total Turnover	436.2	378.2	-13
of which			
Domestic Sales	153.4	135.4	-12
Export out of Germany	282.7	242.8	-14
of which			
OEMs	343.9	296.4	-14
Supplier	80.0	70.7	-12
Trailer and Bodies	12.1	11.0	-9

Source: VDA (2021b); VDA (2021c)

On average in 2020, the German automotive industry had around 809,000 regular employees and in addition, another 900,000 are indirectly dependent on the automotive industry (VDA,2021a). This industry is the country's largest employment sector and provides a total of 2.2 million jobs, or about seven per cent of the jobs subject to social insurance contributions in Germany (Figure 6).

Figure 6: Employment in the German automotive industry

Employment in the German automotive industry: Average employment per year	2019	2020	+/- 19/20 in %
Total Automotive Industry	832,840	808,936	-3
of which			
OEMs	484,061	470,046	-3
Supplier, Trailer and Bodies	348,779	338,890	-3

Labour cost in the German automotive industry in EUR	2019	2020	+/- 19/20 in %
Labour costs per hour	55.05	56.15	+2

Source: VDA (2021a)

In addition to the jobs in the automotive industry, this also includes the jobs for 643,000 employees in the secondary market; for example, for spare parts (aftermarket) and in trade, as well as 654,000 employees at suppliers in other sectors and in the service sector (BMWi, 2021a). Therefore, any form of disruption in the German automotive industry has a significant impact on employment in Germany.

1.1.3 Megatrends in the German Automotive Industry

The German car industry can look back on a golden decade. In the 2010s, businesses achieved one sales record after another (Puls & Fritsch, 2020. However, the 2020s will be marked by a longer-term structural change. The industry is currently characterised by two potentially disruptive megatrends: decarbonisation and digitalisation. Two fields of innovation are of outstanding importance: Electromobility and alternative drives on the one hand, networking and automated driving on the other (Müller, 2021). The decarbonisation of the transport sector and the associated switch to alternative drive systems or fuels is taking place in parallel with advancing digitalisation, with effects on vehicle production and mobility offerings (Grimm et al., 2020). In 2016, Daimler created the acronym C.A.S.E. for the technology and market trends faced by the automotive industry: Connectivity, autonomous driving, shared & services, and electric (Simonazzi et al., 2020). Digitalisation is often seen as the trigger for these trends (and sometimes used synonymously), leaving the German automotive industry to face ground-breaking decisions for the future (Puls & Fritsch, 2020). Each of the trends and technologies has the power to turn the entire industry upside down and destroy the existing business models. These changes are forcing Germany's flagship industry to invest considerable resources in new knowledge, research and development. Additionally, a number of these challenges must be met simultaneously (Cacilo & Haag, 2018).

1.1.3.1 Decarbonisation

The Paris Agreement on Climate Change has set an ambitious and clear goal for international climate protection by limiting the global temperature increase to well below 2°C. With regard to achieving the climate goal and other sustainability goals, for example in the area of resource conservation, the pressure to change existing economic structures is growing (Grimm et al., 2020). The "Green Economy" (Umweltbundesamt, 2021, p. 1) serves as a model for change, a way of doing business that is in harmony with nature and the environment. The transport sector is one of the largest global emitters of fossil CO2 with a share of approximately 25 % and thus represents an important field of action in the achievement of climate protection goals (Jannsen et al., 2019). The German automotive industry supports the EU Commission's goal of making Europe the first continent in the world to be climate neutral by 2050 at the latest. The industry is therefore already moving forward and investing more than €150 billion in climate-neutral drive systems, electromobility and digitalisation by 2025 (Müller, 2021). The two factors with the greatest impact on emissions over the entire life cycle of products in the automotive industry are the electric initiative for the powertrain of cars and renewable energy strategies for the entire value chain (Müller, 2021; Volkswagen, 2021b).

In accordance with the latest decisions of the European Commission (2021) and the publication of the European Commission's "Fit for 55" climate package, manufacturers of new cars are obliged to redesign their offerings by 2035 in such a way that no more new cars with internal combustion engines are sold in the EU (VDA, 2021d). The year 2035 was set because cars are driven for an average of 15 years. If the automotive industry wants to be climate-neutral in 2050, the combustion engine must therefore be phased out by 2035 (VDA, 2021d). By 2030, emissions are to be reduced by 55 per cent compared to 2021. Market monitoring suggests that by 2030, mass-scale production and use of electric vehicles will take place in all major markets and will be dominant in the subsequent decades (VDA, 2021c). Much of the customer enthusiasm (i.e., willingness to pay) for cars has historically been driven by mechanics. Powerful powertrains and chassis, combined with high-quality design, have characterised the most successful brands. In the coming years, this will be re-defined: Electromobility, combined with connectivity, autonomous driving experience and digital services will play the most important role (Boes & Ziegler, 2021).

However, for many scientists and practitioners, electromobility is not yet convincing in terms of climate politics and they urge a precise interpretation of the CO2 footprints represented by the industry (Boes & Ziegler, 2021; VDA, 2021d). The assumption is that the transition to electromobility will initially generate higher CO2 emissions in the supply chain and that the share of emissions will shift from the usage phase of the cars to manufacturing (Boes & Ziegler, 2021). The CO2 emissions in the production of an electric vehicle - from the mining of raw materials to the handover of the car to the customer - are about twice as high as for a vehicle with an internal combustion engine. This is due to the costly extraction of raw materials and the energy-intensive processes involved in battery production (Volkswagen, 2021b). Therefore, decarbonisation of the entire value chain is also of the utmost importance. The strategies relate, among other things, to the conversion of the entire supply chain to renewable energy, from climate-friendly battery production to CO2-neutral car manufacturing facilities (Volkswagen, 2021b).

Detailed vehicle-related data is rarely published, but one example is the 50/50 joint venture between Volvo Cars and Geely (a Chinese car manufacturer), in which the premium electric car brand Polestar was developed, which published data on the carbon footprint of the Polestar 2 (Boes & Ziegler, 2021). As cited by Boes and Ziegler (2021), the Polestar 2 leaves the factory with a carbon footprint of 26 tonnes. Compared to the Volvo XC40 compact SUV with an internal combustion engine, the Polestar 2 has a larger carbon footprint in the manufacturing phase, mainly due to the energy-intensive production of the battery. However, once the vehicle reaches the customer, further CO2 emissions are negligible if the battery is charged with "green energy." Only after a mileage of 50,000 kilometres does the fossil fuel-powered car produce more CO2 emissions overall than the Polestar 2. In contrast, electric cars are notionally assumed to be CO2-free, although this depends on the electricity supply network (Boes & Ziegler, 2021). The prerequisite is that the electricity comes from renewable energies. According to calculations by the German Association of the Automotive Industry (VDA, 2021e), an e-car will only be in the "green zone" after about 70,000 to 90,000 kilometres compared to a petrol car - depending on the current state of battery technology and electricity mix. Moreover, a Europe-wide charging infrastructure does not exist, and nationwide expansion is a longer way off. Germany in particular is lagging behind: with 1014 cars per charging point, it is only ranked 12th among the 31 European countries evaluated by the VDA (2021f).

Even IT itself, with its high energy consumption in the data centres, is also subject to the dictates of a "*green IT*" to achieve the goals of climate neutrality (Hammerschmidt, 2022). As an example, in a group like Daimler, IT has a significant energy consumption, about 100 gigawatt hours per year. This is roughly equivalent to the energy consumption of a city with 30,000 inhabitants. The largest share of this is accounted for by the data centres. This is why car manufacturers are relocating particularly energy-intensive data centres - for example, those that run complex simulations and other numerical applications (so-called high-performance clusters) - to the far north of Europe (Hammerschmidt, 2022). There, according to the calculation, less energy is needed to cool the high-performance computers (HPC) because of the already low outside temperatures. The businesses can also generally operate their facilities with electricity from locally available hydroelectric or wind energy. Following this concept, Audi, BMW, Mercedes, and Volkswagen, among others, have relocated their HPC data centres to Iceland or Norway.

1.1.3.2 Digitalisation

Digitalisation in the automotive industry combines the three major breakthrough innovations of the 20th century: vehicles, computers and the internet, and extends far beyond the automotive industry. With the internet and cloud computing, mass data is becoming available in a global information space (Cacilo & Haag, 2018). This becomes the platform for new data-based business models and the resulting force for change towards a new information economy (Boes & Ziegler, 2021). Digitalisation is leading to several structural changes in the German automotive industry and offers considerable future potential for processes, products and business models (Jannsen et al., 2019).

The first structural change concerns the so-called "Industry 4.0" or "Smart Factory", which is characterised by a progressive flexibilisation of production, and model cycles of five to eight years, which have been customary in the industry up to now, are expected to shorten significantly as a result (Grimm et al., 2020). This will lead to a comprehensive change in processes for vehicle manufacturers and suppliers, with significant increases in efficiency, which can be decisive in international competition (Grimm et al., 2020). The technical foundations are the IIoT with comprehensive networking and interaction between digital systems. This not only refers to IT hardware such as computers and smartphones, but to all imaginable digital devices and so-called cyber-physical systems, regardless of whether they are industrial plants, machines, vehicles, traffic control systems, entire buildings etc. The focus is on the development of so-called industrial cloud infrastructures to operate production facilities worldwide in an integrated mode and to develop value creation concepts together within an ecosystem of partners (Basl, 2018).

The second structural change triggered by digitalisation concerns the transformation of the vehicle from a predominantly electromechanical-hydraulic product into a software-defined one. A central computer – the so-called car operating systems or virtual driver - acts as the master controller for the engine, climate and navigation, replacing hundreds of conventional control units. The integration of vehicles into the IIoT enables an increasing dimension of connectivity and data-based vehicle automation, the so-called “connected car” (Lempp & Siegfried, 2022). The automotive industry, as well as businesses previously outside the automotive sector, are working at high speed on software solutions, artificial intelligence (AI) based driver assistance systems, and other technologies that will enable connected, highly automated and even autonomous driving. With the digital or connected car, a completely untypical reversal of the dominant relationship between hardware and software is being undertaken. Software now determines the car. Something that appears material on the outside and was therefore always constructed based on hardware becomes a software product (Grimm et al., 2020). Together with the trend towards electromobility, this is changing both the internal architecture of the cars and the interaction of the passengers with the vehicle systems.

The German automotive industry claims that the car will evolve into the most complex and sophisticated internet access (Volkswagen, 2021a). The virtual driver is considered the most complex software system in the world to date, actually an active neural network that is continuously improving its capabilities based on artificial intelligence. This would entail much more radical changes than the transition from the internal combustion engine to electric mobility (Volkswagen, 2021c). Volkswagen (2021a) regards the fully connected car as the European economy's last chance to gain a foothold in the digital economy.

The third structural change concerns mobility services, which are a central area of the future for the automotive industry. The "Mobility as a Service" (MaaS) describes the vision of a seamless, highly networked travel or mobility chain across different modes of transport (public transport, car sharing, micro mobility, etc.): From route planning, on-demand booking and payment to the operational handling of journeys. In addition, further networked services such as parking services, charging services or entertainment services can be added (CAM, 2020b). For car manufacturers, networked mobility services in combination with autonomous driving offer the opportunity of new data driven business fields as a replacement for the commercial cornerstones that are dissolving in the future and which are essentially based on car purchase or car ownership. In addition to existing mobility services, however, further innovative services will only become marketable with the trends of electromobility and autonomous vehicles (CAM, 2020b).

The future technologies for batteries and semiconductors determine the fourth structural change to which the automotive industry has to react. The prevailing view was that the Asian suppliers had such a technological lead that a European or German cell production was not worthwhile (Boes & Ziegler, 2021). Meanwhile, German car manufacturers were striving to control their own supply of power batteries as the most important part of an electric vehicle. Due to the sustained high demand in the international semiconductor markets, a supply crisis for electronic chips has increasingly emerged in 2021 (BMW, 2021; Stroh, 2021). The German automotive industry (and other industries as well) is currently almost exclusively dependent on US corporations, which in turn have their microchips manufactured by contract manufacturers in Asia, such as the world's largest contract manufacturer TSMC in Taiwan (Berlin, 2021). To become less dependent, the German automotive industry will therefore be forced to set up complex new business segments with their own production facilities for semiconductors and microchips in addition to battery cell production.

Consequently, digitalisation is leading to fundamental and new business models in the German automotive industry: software, mobility services as well as semiconductors / microchips and battery technology (Bauer et al., 2020). In addition, digitalisation and highly automated / autonomous driving pose new corporate risks in terms of cyber security and data protection, which the industry must address. However, these business models will predominantly focus on the new electric vehicles. Customers of classic combustion models will only have access to these technologies and services on a very small scale. The OEMs would have to make additional high investments to bring the combustion models up to the latest technical standards: as the end of the combustion engine draws nearer, companies are more likely to decide against these additional investments.

1.1.3.3 Digital Transformation

The German automotive industry is developing new strategies to accommodate a double transformation that is impacting the industry in this decade: transformation from combustion engine to electric and digitalisation (e.g. Müller, 2021; Volkswagen, 2021a). From one perspective, the market for internal combustion engines will decline over the next ten years. By contrast, high cash flows from the combustion business are paramount to finance the transition phase. By 2030, the global market for electric vehicles will have caught up with combustion engines in terms of sales. Revenue and profit pools of the business model will gradually shift by 2030, firstly from the combustion engine to the electric car, and later, when autonomous driving offers additional revenue, to software and services (e.g. Volkswagen, 2021a).

To tap into the revenue streams of the new mobility world, OEMs aim for industry-leading IT platforms with AI-based car operating systems and connectivity, which should be available from the middle of the decade for further highly automated / autonomous driving and control everything from the window regulator to the drive train to the infotainment. Wireless updates will constantly supply the software platforms with innovative services (Boes & Ziegler, 2021). Together with the car operating system, automotive clouds need to be developed to connect a car to other services and devices via the Internet. This includes back-end systems, other connected cars, the home, the office or parts of the infrastructure such as traffic control systems. With the automotive cloud, data is synchronised in real time. For example, the vehicle will be able to anticipate if there is a risk of aquaplaning in two kilometres because of rain. A completely new ecosystem will emerge around the car. Automotive value creation will take place in the cloud in future (Boes & Ziegler, 2021).

1.1.3.4 New Competitors

The German automotive industry is also confronted with new and strong competitors. For example, Tesla has become the world's largest manufacturer of electric cars and is outperforming the established manufacturers in terms of networking (Volkswagen, 2021a). Boes and Ziegler (2021) argued that Tesla - in addition to electrification - paved the way for another innovation in the automotive industry, whose potential for change could be even greater. For the first time, Tesla made permanent connection to the internet a basic condition of the entire vehicle conception in the Model S. The character of the Model S is not adequately described as a vehicle networked with the internet; it is a vehicle defined by the internet. This approach led Tesla, among other things, to centralise the software and electronics architecture in the vehicles so that they could be continuously supplied with software updates via the internet in a similar way to smartphones (Boes and Ziegler, 2021).

Volkswagen regards Tesla as the benchmark in terms of electromobility and points out that all figures demonstrate a clear productivity disadvantage of Volkswagen compared to Tesla (Volkswagen, 2021a). Tesla is currently building a new factory in Grünheide, east of Berlin and the German automotive industry regards it as likely to be the most advanced series production facility for electric vehicles in the world (Volkswagen, 2021b). Next to this, Tesla is building a Gigafactory for the production of battery cells. The company understands itself more as a technology group than as a car manufacturer. This includes not only software competency, but also a high level of battery and semiconductor competency (Boes & Ziegler, 2021). Tesla has long employed its own chip design team, develops its own semiconductors or has them manufactured by TSMC or other manufacturers. These technological competencies pay off in the current chip crisis and give Tesla more flexibility. The company can rewrite the chip software or convert chips if supply bottlenecks arise (Boes & Ziegler, 2021).

More far-reaching effects are to be expected from the activities of technology companies, which have been increasingly pushing into the automotive mobility sector with new business models for some years (CAM, 2020a; Grimm et al., 2020; Roos & Siegmann, 2020). The so-called "Big Five" tech firms: Alphabet, Amazon, Apple, Facebook, and Microsoft are now threatening (with the exception of Facebook) to overtake the traditional automotive companies with their Internet-oriented value creation concepts. This poses high risks for the German automotive industry. The advantage of these groups over the German companies is their high value on the capital market, in addition to their already established structures and competencies in software technology. Due to this, they can invest large sums in the development of virtual drivers / car operating systems and mobility services without having to be immediately profitable (BMWi, 2019). By comparison, these "Big Five" had a combined market capitalisation of around €9 trillion at the end of 2021. All 40 companies in Germany's largest share index, the DAX40, are worth a total of only €1.86 trillion (Statista, 2022; Wittenstein, 2021).

In contrast to the German automotive industry, these companies are highly competent in the field of high-performance chips, artificial intelligence and software for autonomous driving (Wittenstein, 2021). They are also the dominant providers of cloud infrastructures and platforms, such as Amazon's Web Services (AWS) or Microsoft's Azure, alongside Asian competitors such as Huawei and Alibaba (CAM, 2021). They offer cloud services to connect vehicles to the information space and thus make them accessible to further possibilities of use.

Moreover, over the last 10 years, a group of very competent and now experienced tech firms has been formed that are far more advanced than the German automotive industry in terms of autonomous driving systems and virtual drivers (CAM, 2020c). Table 2 highlights the profiles of some of the highest ranked ones.

Table 2: Leaderboard Automated Driving Systems 2021

Firm	Highlights
Waymo	Waymo is considered by many experts to be the leader in autonomous driving. Google's sister company took over the development of the "Google Driverless Car" in 2014 and soon focused on AI-based autonomous driving systems. The "Waymo Driver" is now in its fifth generation. Waymo has made great progress in the recent past, especially in sensor technology and its production. In Chandler, Arizona, Waymo offers a self-driving robo-taxi service that does not require a safety driver. Both Volvo and the Stellantis car companies rely on the Waymo Driver. The system is intended to serve as a platform for future self-driving level 4 vehicles from the carmakers.
Nvidia	Nvidia is one of the leading AI companies in the world and produces powerful AI chips that are installed in autonomous driving systems and driving assistance systems of well-known car manufacturers and dominate the industry. Daimler, for example, relies on Nvidia's system-on-a-chip "Orin" for the next generation of its electric vehicles. In addition to hardware, Nvidia has developed a relatively complete software stack that includes everything needed for autonomous driving, including signal processing, cognition, and driving controls.
Argo AI	Argo AI is largely financed by Volkswagen and Ford. After an investment of over two billion euros by VW, Argo AI opened a European headquarter in Munich. In 2023, the American start-up is also planning to move into its own test track at Munich Airport. Electro cars from Volkswagen will be equipped with an AI system for autonomous driving. Argo AI has already been able to conduct successful tests at autobahn speeds. This was achieved not least because of a breakthrough in lidar research. Argo AI recently presented the "Argo Lidar", which delivers the most accurate results at ranges of up to 400 metres.

Baidu	The Chinese Internet and AI giant Baidu offer comprehensive software with its Apollo system and uses lidar, radar and camera sensors together with cellular "vehicle-to-everything (C-V2X)" communication. All this comes together on a specially developed computing platform. Baidu sends autonomous taxis through Beijing without a safety driver. Baidu already offers a range of communication, mapping and streaming services for car manufacturers in the Chinese market. There is also already a strong partner network, including Volkswagen, Ford, BMW and the largest Chinese carmakers.
Cruise	Cruise, a robo-taxi company owned by General Motors. The company has been testing its vehicles in San Francisco for years and received permission in 2021 to send cars onto the streets of San Francisco without a safety driver. Microsoft intends to enter the autonomous driving vehicle business itself and participated in a $2 billion funding round for Cruise. With this long-term strategic partnership, the companies aim to bring together their software and hardware excellence, cloud computing capabilities, manufacturing expertise and partner ecosystem to transform transportation. Among other things, Microsoft wants to bring services from its Azure cloud platform into the partnership, on which Cruise will mainly rely in the future. In addition, the Japanese carmaker Honda also participated in the financing round.
Mobileye	This Israeli company has been manufacturing driver assistance systems for the automotive industry for twenty years and was recently taken over by the chip manufacturer Intel.
Zoox	Amazon, too, has a fleet of test vehicles for autonomous driving with its subsidiary Zoox and has large financial resources and the necessary data expertise.

Source: CAM (2020c); Findings; Guidehouse Insights (2021)

1.2 Research Motivation and Objectives

While the importance of German vehicle manufacturers and the automotive industry has hardly shifted in the past decades, a paradigm shift is emerging in light of these developments. For decades, carmakers and their suppliers set the technological pace in the automotive industry (Müller, 2021). New mobility providers, tech groups as well as emerging OEMs like Tesla or BYD (China), are fundamentally changing the situation in the automotive sector (Grimm et al., 2020). So-called car operating systems are becoming a question of survival for the industry (Roos & Siegmann, 2020). What role the classic German automotive industry and the "hardware", i.e., the vehicle, will play in the future and which players will dominate remain the central questions of the current decade.

The industry has long focused on the product car and consequently the core competencies of the car manufacturers were based on design, engineering, production and sales. The provision of IT services is largely outsourced and in particular, the software components for car IT are purchased from suppliers (Winkelhake, 2017). IT has generally not been regarded as a core competency (Söbbing et al., 2015). Many different forms of IT outsourcing have emerged, all associated with expectations that the business can better concentrate on its core business, focus on innovation, reduce costs and increase the effectiveness of IT (Farr & Lind, 2019; Krcmar, 2015). In turn, IT organisations in the German automotive industry have developed and implemented comprehensive process models for decision-making and the management of various forms of IT outsourcing (e.g. Brautsch & Wynn, 2013).

Table 3 shows IT budget figures for corporate IT, which are rarely published the German automotive companies. Only a few examples could be found in the literature, as specific IT data is in most cases not available in company reports (IDG, 2021). However, to get an indication of the dimensions of corporate IT outsourcing in the German automotive industry, a conservative calculation example is assumed: Outsourcing share of total IT budget at OEMs 75 % (based on findings); corporate IT budget amounts to approximately 2% of the group turnover. The group turnover of only the three OEMs, Volkswagen, Daimler and BMW, amounted to a total of €476 billion in 2020 (Figure 1). The result of this calculation example is a contract volume of €7.1 billion/year for IT outsourcing at the OEMs Volkswagen, Daimler and BMW.

Table 3: Corporate IT budget of selected German automotive companies

	Turnover 2020 in billion Euro	Corporate IT-Budget in million Euro in 2020	Corporate IT Budget in % of turnover in 2020
Bosch	77.7	1,500	1.9
Porsche	28.7	900	3.1
Mahle	11.09	Not specified	1.65
Infineon	8.03	300	3.7
Rheinmetall	6.26	Not specified	2.5

Source: IDG (2021)

However, with C.A.S.E. and digitalisation, IT is not only a business-critical resource for corporate IT, but also a central component of products, IIoT-based Smart Factories and platforms/ecosystems for mobility services (Weiß et al., 2018). Considering this widened business and technological scope, IT is becoming a central element of the digital transformation. Managing the overall digital transformation is unique in its approach, multi-disciplinary by nature and comprises a multitude of new challenges and requirements (Gerster & Dremel, 2019; Rueckel et al., 2020). The adoption of digital technologies requires considerable investment, which is associated with serious risks, particularly because of the rapid development cycles of digital technologies (Gerster & Dremel, 2019). Moreover, the development of new digital business models requires unprecedented capabilities. At the same time, businesses are faced with additional risks as they operate in new and unfamiliar markets and customer segments and sometimes act as first movers. Therefore, due to the addressed trends, businesses are considering new alternatives for IT sourcing and the management of knowledge, skills, competencies and related gaps (Paunov & Planes-Satorra, 2019). This points to the re-definition of core competencies, the increase of inhouse provision of IT services for competitive-differentiating business functions, while continuing to outsource IT commodities and all forms of gap-closing alliances to jointly realise competitive advantages that cannot be achieved individually.

Within this business and technology environment, the research study has the following research objectives:

RO1 To analyse the impact of digitalisation on the German automotive industry.

RO2 To research and analyse changes in IT sourcing strategy in the German automotive industry in the current and future business environments.

RO3 To identify and evaluate the significance of new competencies in the successful transitioning to new IT sourcing strategies in the German automotive industry.

RO4 To critically assess the future management of IT sourcing in the German automotive industry and the implications for Corporate IT.

In this study, the C.A.S.E. related themes of connectivity, autonomous driving, shared & services, and electric are subsumed under the term digitalisation, even if the terms decarbonisation, electrification and digitalisation are sometimes used interchangeably. There is agreement in the scientific literature and also among practitioners in the German automotive industry that these terms overlap; for example, decarbonisation and electrification lead to further acceleration of digitalisation (Daimler, 2021a; Simonazzi et al., 2020). This is also reflected in the fact that topics such as connectivity and autonomous driving focus mainly on the new generations of electric vehicle.

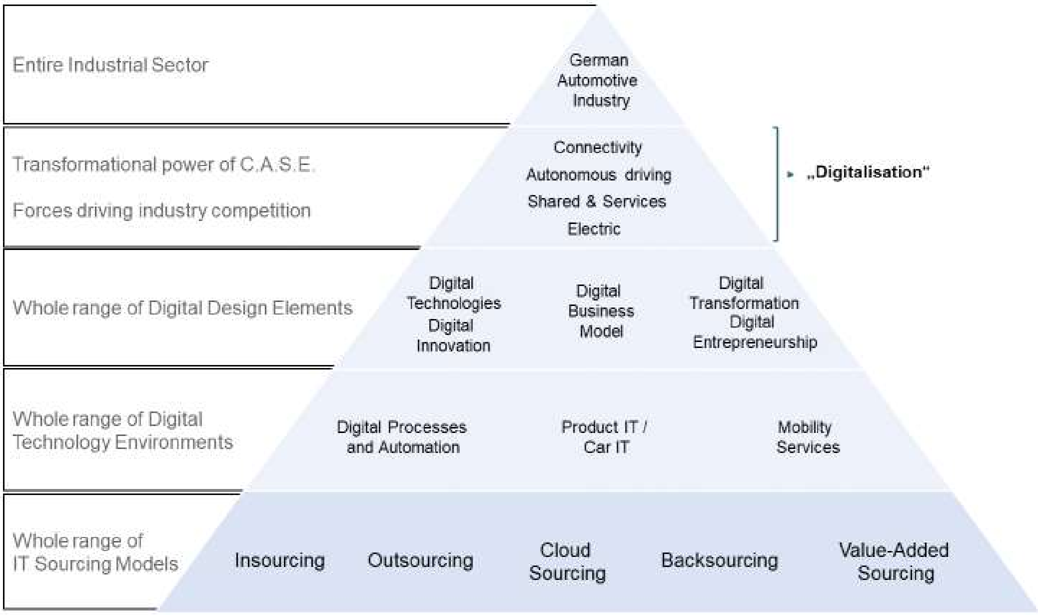
Prior to establishing the scope of this research project, a preliminary study on IT backsourcing in the German automotive industry was conducted, for which a systematic literature review was undertaken (Felser & Wynn, 2020a). The aim of the study was to analyse and understand to what extent digitalisation has influenced the German automotive industry's strategy regarding IT backsourcing and provide a new insight into the decision making and values created by IT backsourcing. The study explored a relatively unknown field: whether IT backsourcing can be regarded as a source of sustainable competitive advantage. The results were presented at a conference organised by the International Academy, Research, and Industry Association (IARIA), and subsequently published as a conference paper in an expanded version within a journal (Felser & Wynn, 2020a, 2020b). Among other things, the systematic literature review on IT backsourcing resulted in a shift to the current and wider-ranging scope of this research project, including all forms of IT sourcing and a wider range of industry dynamics through megatrends and digitalisation in the German automotive industry. In a third article, the first results from the current research project were published (Felser, 2021).

1.3 Summary of Contribution to Knowledge

Overall, as evidenced by the literature review, IT sourcing has been the focus of many studies, mostly with considerations of individual and isolated elements, such as motivations for outsourcing or backsourcing, many well-documented process models for IT outsourcing and decision-making, switching suppliers, risk management, re-integration of knowledge, business and IT alignment, and the like. Moreover, previous research in the domain of IT sourcing has largely focused on supporting business processes (mainstream business systems) by corporate IT. In contrast, the specific characteristic of this research study is the consideration of all relevant contextual factors to fully understand the scale and long-term dynamic impact of IT sourcing decisions by investigating an entire industry sector. The following aspects characterise the uniqueness of this study (Figure 7):

(1) The study considers the whole range of sourcing strategies and models, such as insourcing, outsourcing, cloud sourcing, backsourcing, and value-added sourcing;
(2) the study encompasses all digital technology environments, such as digital process and automation (traditionally mainstream business systems), product IT (car IT) and mobility services, where IT becomes a central component of the product or service;
(3) and within these environments, all digital design elements that directly or indirectly influence IT sourcing, such as digital technologies, digital innovation, digital business models, digital transformation, and digital entrepreneurship are considered;
(4) the study's scope includes two megatrends, namely digitalisation and decarbonisation / electromobility;
(5) and, indeed, an entire German industrial sector.

Figure 7: Unique consideration of factors influencing IT sourcing



Source: The author

This research makes a contribution to knowledge in five main areas which are summarised in Table 4 (section 8.3 details the contribution to knowledge and explains how this relates to the existing literature in the research area, as addressed in the literature review).

Table 4: Main contribution to knowledge

Impact of digitalisation on the German automotive industry
The study evidences the specific opportunities and threats of an entire industrial sector in Germany in the transformation from a previous business model with combustion engines to electromobility and digitalisation. Innovations are needed in the shortest possible time, which requires new software competencies to capture the business opportunities of connected cars, autonomous driving, connecting production plants with IIoT technologies, and future mobility services. The German automotive industry has to catch up with financially strong software companies that are using their technical capabilities to enter the automotive business. In consequence, the industry must undergo enormous technical, structural, organisational, and cultural changes ensuring its unique market position is continued in the future.

Alignment between business model and IT strategies
The study provided indications that traditional business-IT alignment is not suitable for digital business models in which business and IT merge. Automotive companies are becoming software-enabled companies, where IT is run as a business (e.g. car operating systems). The current organisational boundaries between IT and business are dissolving and business functions inevitable take ownership over some elements of IT. In these cases, it is evident that a digital business strategy with a merged IT strategy should be pursued and that IT strategy is no longer subordinate to business strategy, as assumed in traditional alignment models.
Adjustments of IT sourcing strategies in the German automotive industry
The study evidenced that speed, reactivity and flexibility in providing world-class IT are key. Rapidly building a flexible IT sourcing ecosystem with a variety of partners to fill competency gaps is becoming imperative. The findings demonstrate that digitalisation is changing the three-decade ratio between IT-insourcing and outsourcing in the German automotive industry. Based on the participants' estimates of current and future budget allocations, the change in IT sourcing between 2021 and 2026 is projected. This will determine shifts and new priorities in IT sourcing for the next five years, also pointing to the central motives for value-added sourcing.
Proposed blueprint for transitioning of IT sourcing management
The emergent themes require a new direction in organisational structures for the future management of IT sourcing in particular, an in corporate IT in general. Therefore, the developed blueprint emphasises a new cooperation between Business and Corporate IT and the subsequent re-positioning of IT responsibilities between Business and Corporate IT. The blueprint empowers business functions with all the IT competencies they need for their value creation, empowers Corporate IT with the competencies and authority for enterprise-wide IT governance and consolidates a fragmented IT (corporate IT, product IT, car IT, production IT, shadow IT and the like) and embeds it in a group-wide set of rules for IT sourcing.
Entrepreneurial competencies for future IT sourcing management
In the context of this study, digital entrepreneurship emerged as a significant new competency in making IT sourcing decisions. The study illustrated that there is a general misconception in the academic literature that new digital technologies are the drivers of digital transformation. The most important impact of digitalisation is that it will lead to transformational entrepreneurship for IT sourcing management in the large and cumbersome organisations of the German automotive industry. The management of relationships of a joint value proposition by many actors will be the key for success.

Source: The author

1.4 Thesis Structure

Following this introductory chapter, the next chapter provides a traditional narrative literature review to assess existing knowledge as well as to gain an understanding of underlying theories and concepts relevant to the field of research. A first section concerns the theoretical background of digitalisation and its related themes, such as digital technologies, digital innovation, digital business models, digital transformation and digital entrepreneurship. Another section concerns the theoretical background of the various IT sourcing concepts. Of relevance to both these areas of knowledge is a review of alignment between the overall digital transformation strategy and IT sourcing strategies in the German automotive industry. This leads to a review of the changing roles of IT functions and corporate IT organisations in the industry.

Chapter three outlines the conceptual framework in order to meet the research objectives and answer the research questions. The conceptual framework also provides the primary guidance and logic to support the qualitative data collection with the respective areas of discussion within a case study.

In chapter four, the adopted research methodology with its constructivist perspective and its associated interpretative research methodology is discussed. The chosen paradigms are closely linked to a mainly qualitative research strategy following an inductive / iterative research process. Data collection is based on a single case study, representative of the German automotive industry as a whole.

Chapter five presents the results of 19 semi-structured interviews from the case study. The target group consisted of IT executives from OEMs, suppliers and other IT sourcing experts. As an intermediate stage and in preparation for the in-depth expert interviews, an online survey was conducted, drawing on the findings from the extant literature review to frame the major areas of discussion for guiding the interviews.

Chapter six addresses the textual data analysis of case study evidence. This exploratory study focused on thematic analysis, revealing 15 emergent themes which demonstrate the impact of digitalisation on the industry, evolving IT sourcing strategies and the need for digital entrepreneurship in order to organise the transition to a future IT sourcing management in particular and the overall redistribution of IT responsibilities between business and corporate IT in general.

Chapter seven, in turn, proposes a blueprint for a general redistribution of traditional IT roles and especially a re-assignment of responsibilities and tasks for IT sourcing. IT sourcing tasks and responsibilities for competition-differentiating innovations are shifted to IT competence centres based in business functions where IT is run as a business. IT governance functions remain with Corporate IT but with a new scope, expanded responsibility and authority to enforce the function across the group. Corporate IT also retains responsibility for IT sourcing for shared services.

Finally, chapter eight summarises and concludes the outcomes of the present research project, which is considered to add significant and valuable knowledge to the discipline in which the research was conducted. The chapter answers the research questions and outlines the contribution to knowledge and practice. Limitations of the study as well as directions for future research are discussed as well. The chapter closes with final comments and reflections on the overall journey of this thesis.

2 Literature Review

2.1 Introduction

The aim of this traditional literature review is to discuss existing literature regarding the nature of evolving IT sourcing strategies in the German automotive industry. Although there are various ways of conducting a literature review, the most prominent ones are the systematic literature review and the traditional narrative literature review. Whereas in some areas a systematic approach is preferred, literature reviews in management research have been predominantly narrative (Bell et al., 2018). However, when making a decision about the most appropriate mode for a literature review, not only the intention of the review has to be considered, but also the applied methodology and the research philosophy.

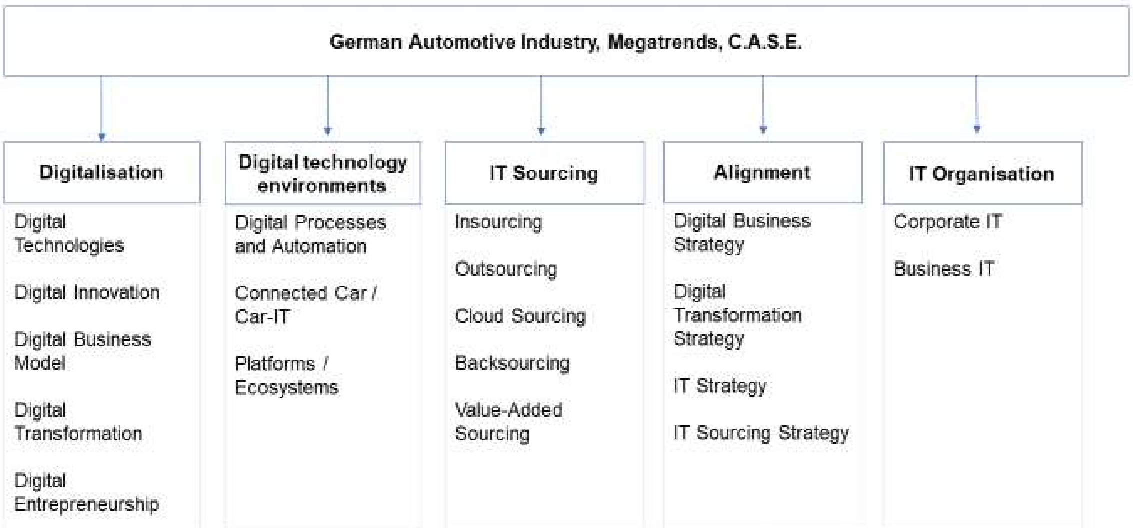
The intention of this literature review was to read the different contributions that have been made to the research topic and acquire a greater level and degree of understanding (Hart, 2018). Therefore, the literature review is "a means of gaining an initial impression" (Bell et al., 2018, p. 97) of current and future sourcing strategies in the German automotive industry, driven by megatrends, such as digitalisation. Bell et al. (2018) also concluded "that the narrative review may be more suitable for qualitative or inductive researchers, whose research strategies are based on an interpretative epistemology" (p. 97). The intention to gain an impression in the areas of interest is in agreement with the case study approach chosen as the applied methodology for this research, because the researcher wanted to acquire a rich and deep understanding of the context of the research with a wide-ranging scope, or, as Yin (2018) concluded, "review previous research to develop sharper and more insightful questions about the topic" (p. 13).

Narrative reviews have frequently been criticised for their bias, failure to establish replicable conditions and non-adherence to the evidence-based approach (Tranfield et al., 2003). Several researchers, such as Fink (2019) and Hart (2018), state that a narrative review includes the implicit bias of the researcher, whereas a systematic review encompasses a comprehensive and exhaustive literature search and provides an audit trail of the researcher's decisions, approach and conclusions. The main reasons for these concerns are that the limitations of the narrative literature review can lead to a partial choice of materials: that such reviews can tell any story the researcher wants to tell (Briner & Walshe, 2014). However, systematic literature reviews have limitations as well. Due to the rigorous search strategy based on the strict use of search terms, there is a risk of leaving out articles crucial for the provision of a sound knowledge base in a wider-ranging scope (Bell et al., 2018). As a result, during the review process, important issues might not be discovered because they were not initially considered relevant.

As a constructivist researcher with the associated interpretative research methodology, and being aware of the influence of her values, and thus being biased by her interpretation of reality, as well as by her social background, the implications of the narrative literature review were not a cause for concern for the author of this research. The use of the narrative literature review is consistent with the overall research methodology of this study. Thus, reflexivity is an essential part of the research journey, with the ability to critically rethink the level of understanding achieved concerning the phenomena studied (Finlay, 2008).

The starting point for using search engines were terms relating to the research objectives. The literature found was then expanded / narrowed with contextual keywords (Figure 8). Several alerts in online libraries were arranged and the literature review was finalised after the process of data analysis was finally completed.

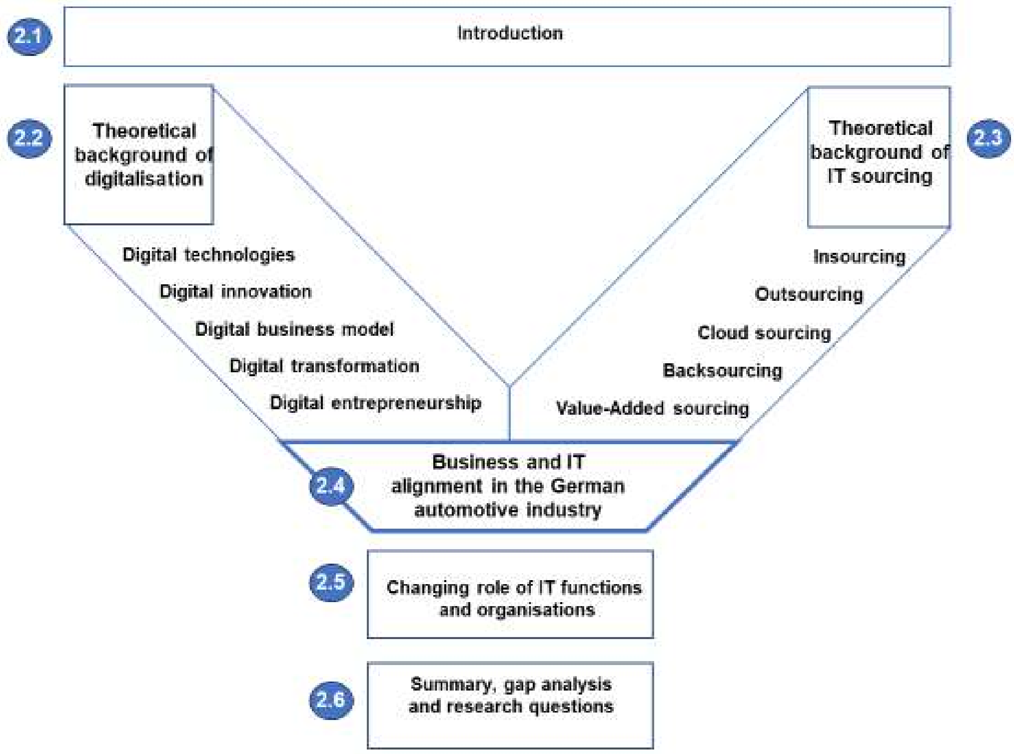
Figure 8: Themes and terms relating to the research context



Source: The author

The narrative literature review is structured in six sections in order to address the aim of the study and the relevant contextual themes (Figure 9). After this introductory section, the following section aims to review the literature concerning the general understanding and theoretical background of digitalisation and its related themes, such as digital technologies, digital innovation, digital business models, digital transformation, and digital entrepreneurship. Then, the general understanding and theoretical background in the literature concerning the various IT sourcing concepts is reviewed. The following section connects the two previous sections and reviews existing knowledge concerning the fit (alignment) between overall digital transformation and IT sourcing strategies. This, in turn, leads to a discussion of the literature concerning the changing roles of IT functions. Finally, the literature review ends with a summary, gap analysis and the resulting research questions.

Figure 9: Structure and content of the literature review



Source: The author

2.2 Theoretical Background of Digitalisation

According to Mertens and Wiener (2018), the term "digitalisation" has evolved into a substantial body of literature covering topics such as digital technologies, digital innovations, digital business models, digital transformation and digital entrepreneurship, which are explored in more detail in this section. Sometimes the term concerns technologies, other times transformation, and still others business or new customer interfaces or even - in the context of Industry 4.0 and Smart Factories - increased automation. Therefore, it is first necessary to clarify the terminology and definitions associated with this study, as certain terms are not used consistently in the literature.

2.2.1 Definition of Basic Terms concerning Digitalisation

Firstly, it is valuable to make a clear distinction between digitisation and digitalisation and some other overlapping terms, such as Industry 4.0 and Smart Factory. “Digitisation” and “digitalisation” are two conceptual terms that are closely associated and often used interchangeably in the literature. In addition, the translation from English into German leads to further definitional problems. Both terms are translated into German as “Digitalisierung” (Mertens & Wiener, 2018). The English language distinguishes between digitisation and digitalisation with different meanings.

Brennen and Kreiss (2016) referred to the Oxford English Dictionary (OED) which traces the first use of the term digitisation in the context of computers to the mid-1950s. According to the OED (as cited in Brennen and Kreiss, 2016, p. 1), “digitisation refers to the action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form” and is also a more technical interpretation. Digitalisation, by contrast, is more broadly defined and is intended to express the fact that digitalisation now affects all economic and social areas, with an increase in use of digital technologies (Hess, 2016).

Riedl et al. (2017) defined digitalisation as “the process of introducing digital technologies, which essentially deal with changes caused by information technologies” (p. 475). In line with this, Koch et al. (2016) considered digitalisation as the innovative use of information technologies and systems and defined four conditions for this. Firstly, the technologies used do not have to be new - rather the newness is created in the context of business and value creation models. Secondly, digitalisation is data-driven, and is based on an increased generation, processing and analysis of often new types of data. Thirdly, digitalisation means that the character of the value added or the business model changes significantly as a result. Fourthly, there needs to be an association with a clear strategic dimension, as companies expect competitive advantages from it.

Thus, the focus of digitalisation is on digital technologies, for which Wynn (2022) outlined "the 13 digital technology wheel diagram" (Figure 10). Additionally, Appendix 10.2 refers to the investment phases along the Gartner Hype Cycle which provides graphical representation of the maturity of digital technologies.

Figure 10: The digital technology wheel diagram

Source: Wynn (2022)

El Sawy et al. (2020) pointed out that the North America term for digitalisation is digital transformation. Hess (2016) also observed that digitalisation is often and somewhat broadly regarded as a driver of digital transformation. In line with this, Bharadwaj et al. (2013) viewed digital transformation as a result of digitalisation and referred to how the deployment of digital technologies can lead to new, disruptive business and value creation models. Benlian (2017, as cited in Riedl et al., 2017) agreed that the term digitalisation is synonymous with digital transformation. Sikora (2017, as cited in Riedl et al., 2017) described digitalisation as "the process, which leads society from the post-industrial information society into all aspects of the 'digital society' ('digitality')" (p. 481). Brennen and Kreis (2016) argued that a broad range of scholarship views digitalisation as the defining characteristic of the contemporary era.

Gebayew et al. (2018) divided the term digital transformation into "digital" and "transformation." They viewed digital as identical with "information technology" and claimed that the term is generally used as a synonym for the speed of change and the adoption of powerful information technologies, which are the drivers of digitalisation. This is in line with the understanding of Winkelhake (2017) that the driver of digitalisation is information technology, with increasingly powerful, highly flexible and efficient hardware and software, which enables previously unknown solutions and penetrates into many related technology areas.

For practitioners in the German automotive industry, the focus of the term digitalisation is on digitalisation as an enabler of the digital transformation. "Digitalisation is not just an engine for tapping important future potential at the product level. It also permeates all the Group's activities for implementing our sustainability strategy and thus works as an important enabler for achieving our ambitions and objectives …. for the transformation of the Group" (Volkswagen, 2021b, p. 26).

However, Mertens and Wiener (2018) referred to the ongoing debate concerning the extent to which digitalisation leads to the destruction of existing business models and posed the critical question of whether digitalisation is just another fad, because technology-driven change has been at the centre of activity for decades. In line with this, Stelzer (2017, as cited in Riedl et al., 2017, p. 480) argued that digitalisation is not a new issue for Business and Information Systems Engineering (BISE) or Information Management (IM) and should not be treated as a completely new phenomenon, as many traditional IM tasks are closely linked to aspects of digitalisation, even if activities such as new artificial intelligence projects undoubtedly present new challenges. The current emphasis on digitalisation rather suggests that it is a fad. The plethora of newly coined "digital" terms could be seen as indicators in this context. Despite the popularity of the term, Mertens and Wiener (2018) hold the view that treating digitalisation as a completely new phenomenon involves the risk of "reinventing the wheel" (p. 2). They attribute the popularity of the term to aggressive marketing campaigns by hardware / software-vendors and IT consultancies, which have shaped the understanding of practitioners, politicians, journalists and lobbyists. Therefore, the central question would be what is really new about digitalisation and what is only "old wine in new bottles?" (p. 8).

Finally, digitalisation is often used in the literature and by practitioners as synonymous with Industry 4.0 or Smart Factory. “Industry 4.0” can be viewed as part of digitalisation, encompassing the entry of complex digital technologies and architectures into manufacturing processes. The term “Industry 4.0” was originally coined by the German Federal Government as part of a research programme on the High-Tech Strategy 2020 with the participation of universities and industry (Frank et al., 2019). It was a strategic agenda for the design of advanced production systems with the aim of increasing productivity and efficiency of the German industry (Kagermann et al., 2013). This approach represents a new industrial level of manufacturing systems by integrating a number of evolving and complementary technologies that provide added value throughout the product life cycle. The term became publicly known through its presentation at the Hannover Messe 2013 (Kagermann et al., 2013). A uniform definition for this term has not yet been established in the literature; therefore, among the definitions of Industry 4.0, that of Roth (2016, p. 6), which is one of the most quoted ones, has been selected for further use in this study: “Industry 4.0 comprises the networking of all human and machine actors along the entire value chain as well as the digitalisation and real-time evaluation of all relevant information with the aim of making processes and value creation more transparent and efficient in order to optimise customer benefits with intelligent processes and services.”

Industry 4.0 is also named as the “fourth industrial revolution” or “Industrial Internet of Things” (Kagermann et al., 2013). This is based on the previous industrial revolutions: The use of water and steam power (1st revolution), the introduction of mass production based on the division of labour using electrical energy (2nd revolution) and the use of IT and electronics to further automated production (3rd revolution). These are now continued by the fourth industrial (digital) revolution, where the focus is on the strong integration of internet-based information and communication technology (cyber-physical systems) into industrial processes (Roth, 2016). Mertens and Wiener (2018) claimed that the term Industry 4.0 was well founded, at least in terms of the historical development from pure mechanics to electricity to cyber-physical systems. Unfortunately, the meaning of Industry 4.0 has become so ambiguous that many different concepts can be subsumed under this umbrella term.

However, Industry 4.0 has its roots in the concept of the “Smart Factory” and this is viewed as the starting point and main purpose of Industry 4.0 (Kagermann et al., 2013). People, machines and products to be manufactured are connected in a network. The aim of this network is to achieve the overall optimisation of quality, lead-time and utilisation of resources. It is considered a decisive innovation that all data are available in real time, providing a permanently up-to-date virtual image of reality, which allows complex manufacturing processes to be better controlled (Kagermann et al., 2013). According to Frank et al. (2019), the Smart Factory represents an adaptable system in which flexible production lines automatically adjust their processes to different types of products and changing conditions.

2.2.2 Digital Technology Environments in the German Automotive Industry

Digitalisation with its related digital technologies spans three technology fields in the German automotive industry: traditional corporate IT, product IT (encompassing connected cars / car IT), and cloud-based platforms and ecosystems for mobility services.

Digital processes and automation (also referred to traditional IT, corporate IT, company business information systems, backend-IT, mainstream business systems) concern the traditional processes of the automotive industry for the development, production and distribution of vehicles. The value chains consist of complex and already highly automated core-processes, which should ideally be integrated into one seamless system using state-of-the-art technologies. In this area, it is assumed the automotive industry has extensive business and IT expertise. This refers, among other things, to Industry 4.0 and Smart Factory components such as cyber-physical systems (CPS), the Industrial Internet of Things (IIoT), big data and cloud computing, robotics, and artificial intelligence-based systems, which have become a reality in modern factories (Kagermann & Wahlster, 2021).

However, the processes are being reshaped by digital technologies as these technologies offer many more possibilities for accelerating innovation (Paunov & Planes-Satorra, 2019). Kagermann and Wahlster (2021) referred to six trends which will have a decisive impact over the next 10 years: industrial AI, edge computing, 5G in the factory, team robotics, autonomous intralogistics systems, and trustworthy data infrastructures. With industrial AI, a second wave of digitalisation in manufacturing is becoming possible. The first wave, making all production and supply chain data available digitally via cloud systems, is largely completed. This data can now be analysed and contextually interpreted in real time by AI systems, to be actively used for new value chains and business models. With digital training data for machine learning systems, AI systems can be used not only for predictive maintenance, which is already widespread, but increasingly for incremental quality control, mostly via video sensors. Thus, the next phase of Industry 4.0 aims at AI-based zero-defect production. Smart factories are characterised by high flexibility, wherein a capability-oriented production architecture ensures expandability and mutability at the next level of Industry 4.0, in order to be able to react quickly to volatility in the markets. In 5G campus networks, edge devices with the high bandwidth and guaranteed low latency can be interconnected to form a local edge cloud, which then meets the real-time requirements in the factory. Hybrid teams of workers and collaborative robots with different capabilities are leading to a new form of team robotics for solving complex manufacturing tasks.

Connected cars (also termed Car-IT) refers to digital information technologies able to network the car with its environment, which allow for a step-by-step development culminating in fully autonomous driving. These technologies relate to three domains: the vehicle itself, consisting of the on-board network and the control units, the portal at the car manufacturer, and the communication link between them (Bosler et al., 2018; Copolla & Morisio, 2016; Cacilo & Haag, 2018). According to these authors, however, no generally accepted definition for this topic has yet emerged. Bosler et al. (2018), for instance, explained that connected cars have telematic components for data exchange with the ecosystem, whereby digital services provide added value for drivers and owners in terms of safety, navigation and security, information, comfort and entertainment. During the drive, the connected car acts as a sender and receiver of various contents. Coppola and Morisio (2016) suggested the more detailed definition of the US Department of Transportation (2015): "Connected vehicle applications provide connectivity among vehicles to enable crash prevention, between vehicles and the infrastructure to enable safety, mobility and environmental benefits; among vehicles, infrastructure, and wireless devices to provide continuous real-time connectivity to all system users" (p. 3). In their study, Coppola and Morisio (2016) also provided more clarifications. A connected car can access the internet at any time, either through a built-in device or by bringing in user devices, such as a smartphone. It is equipped with a range of advanced applications and dynamic contextual functionalities, providing advanced infotainment functions for the driver and passengers. The connected car is able to interact with other intelligent devices on the road, using car-to-road infrastructure communication technologies and is able to interact with other cars using car-to-car communication technologies.

As a result of connected cars, innovative automotive companies will be able to use **platform technologies** to create **ecosystems** together with other actors, with the aim of holding and controlling a strategic position in the new value chain of mobility services. While networked cars generate data from the physical world, it is the function of digital platforms to receive this data, process it, make it available to other vehicles and devices or actors in the ecosystems, and supply the car with all necessary data and services in real time.

Bosler et al. (2018) asserted that platforms, ecosystems and IT backend systems have an essential role in the implementation and provision of connected car services and form the core of connected car business models. Automobile manufacturers operate platform-based solutions to offer digital services to the buyers of a networked vehicle. In the associated ecosystem, numerous actors are involved in various tasks to process the necessary content. Additionally, Bosler et al. (2017) raised the issue of IT backend systems, which comprise a complex, multi-layered IT infrastructure that operates the provision of services, the vehicle's communication and its data management. Powerful back-end servers form the hub that handles all data streams entering and leaving the car. In this respect, cybersecurity to secure all processes against the intervention of unauthorized persons is also an important factor. Furthermore, the IT architecture includes interfaces to the systems of the cooperating partners.

Bosler et al. (2017) explained the term platform as opposed to the term ecosystem. The digital platform represents the technical core of the digital ecosystem, representing the technical implementation in an IT system. In particular, a digital platform ensures the interaction of various actors in the ecosystem and manifests the rules defined by the ecosystem initiator. Modules offered on a platform are often not only provided by the platform operator (e.g. automotive industry), but also by so called complementors. According to Bosler et al. (2017), complementors are actors who develop products or services for an external platform.

Skog et al. (2018) emphasised that the term digital ecosystem has been defined and used in the literature in different ways with various meanings. Adner (2017) and Floerecke (2019) argued that digital business models lead to the partial replacement of traditional, linear value chains, which are being replaced by network-like relationships, or so-called business ecosystems. They concluded a business ecosystem provides the framework for systematic innovation in which different and interdependent but intertwined companies cooperate to create customer solutions. Skog et al. (2018) referred to digital ecosystems as “sociotechnical networks of interdependent digital technologies and associated actors that are related based on a specific context of use” (p. 433). In contrast to Adner (2017) and Floerecke (2019), this definition is not bounded by a particular technology (e.g. a platform).

From the perspective of Skog et al. (2018), digital ecosystems are characterised by four different characteristics. Firstly, they are created from complex and dynamic networks of independent elements, including digital technologies, companies, institutions, providers and customers, which operationalise a combination of digital innovations. Secondly, digital ecosystems often span industry boundaries to link heterogeneous actors and technologies from various industries. Thirdly, they often overlap with larger ecosystems for general purposes, which in turn involve smaller and more specialised ecosystems. Finally, digital ecosystems are hierarchical, where the power to influence others increases with the number of actors that depend on a central actor.

2.2.3 Digital Innovations

The majority of scientists agree that digital technologies impact innovation in all sectors of the economy and enable entirely new digital products and business models (Paunov & Planes-Satorra, 2019). Brown and Brown (2019), for example, consider digital technologies as a trigger and driver for digital innovation to achieve sustainable competitive advantages. Riasanow et al. (2017) pointed to the automotive industry, where digital innovation is most visible with connected vehicles, autonomous driving, big data or artificial intelligence, which would fundamentally revolutionise the industry. However, according to Popaduik and Choo (2006) and Wynn (2021), many definitions of innovation and also varying degrees of innovation can be found in the literature. In general, the definition of innovation in the literature includes the concepts of novelty, commercialisation and/or implementation.

Popaduik and Choo (2006, p. 303) stated "if an idea has not been developed and transformed into a product, process or service, or it has not been commercialised, then it would not be classified as an innovation." Innovation is the development of a new idea and its transformation into a new product, process or service, resulting in the creation of profit for the innovative business. According to Popaduik and Choo (2006), some models of innovation differentiate between incremental and radical innovation. Von Stamm (2008) detailed differences between incremental and radical innovations according to nine perspectives, summarised in Table 5.

Table 5: Difference between incremental and radical innovation

Focus	Incremental	Radical
Time frame	Short term – 6 to 24 months	Long term – usually 10 years plus
Development trajectory	Step after step from conceptions to commercialization, high levels of certainty	Discontinuous, iterative, set-backs, high levels of uncertainty
Idea generation and opportunity recognition	Continuous stream of incremental improvement; critical events large anticipated	Ideas often pop up unexpectedly, and from unexpected sources, slack tends to be required; focus and purpose might change over the course of the development
Process	Formal, established, generally with stages and gates	A formal, structured process might hinder
Business case	A complete business case can be produced at the outset, customer reaction can be anticipated	The business case evolves throughout the development, and might change, predicting customer reaction is difficult
Players	Can be assigned to a cross-functional team with clearly assigned and understood roles, skill emphasis is on making things happen	Skill areas required; key players may come and go; finding the right skills often relies on informal networks; flexibility, persistence and willingness to experiment are required
Development structure	Typically, a cross-functional team operates within an existing business unit	Tends to originate in R&D; tends to be driven by the determination of one individual who pursues it wherever he or she is
Resource and skill requirements	All skills and competences necessary tend to be within the project team; resource allocation follows a standardized process	It is difficult to predict skill and competence requirements; additional expertise from outside might be required, informal networks, flexibility is required
Operating unit involvement	Operating units are involved from the beginning	Involving operating units to early can again lead to great ideas becoming small

Source: Von Stamm (2008)

Radical innovations are viewed as clear departures from previous practice (Von Stamm, 2008). For Urabe (1988), radical product innovation usually occurs in the early stages of a new industry but has little or no economic impact at that time, because product design is still in flux and the market is uncertain. This perception can be applied to the current situation with C.A.S.E. in the German automotive industry. Indeed, Pedersen and Dalum (2004) emphasised that radical innovation implies radical change, which creates a high level of uncertainty in organisations and industry. In addition, significant parts of previous investments in technical skills and knowledge, designs, production techniques, plant and equipment are wiped out. These innovations are usually reactions to external environmental changes and lead to structural and organisational transformations in an entire industry. In contrast, incremental innovations are "gradual and cumulative" applications of new technologies, and bring about changes in organisations, processes, products or services (Pedersen & Dalum, 2004, p. 3).

However, Urbach et al. (2019) and Oswald et al. (2018) hold the view that many of the digital technologies are not in essence new or revolutionary. Their innovative strength is rather the result of the increased efficiency, significantly better network possibilities, as well as their widespread use. As an example, they refer to machine learning as a sub-area of artificial intelligence, which has been the subject of research for decades. Only the explosion of data volumes and the availability of large data sources in combination with more efficient algorithms and data structures has made it possible to train computer systems to make independent decisions. Moreover, the breakthrough was only made possible by specialised, high-performance computer chips with enormous computing speeds that were unthinkable in the past. What is remarkable about digital technologies is the intensity and also the speed of change. In line with this, Urbach and Ahlemann (2016) emphasised that almost all of these digital technologies are not ground-breaking innovations, but usually further developments of existing ones, partly established technologies and approaches, but which have now reached the necessary maturity and can be combined with each other in such a way that they can deliver significant business benefits.

In contrast, digitalisation is frequently referred to as digital disruption, the use of disruptive technologies, or disruptive innovation. The term "disruptive" has become very prominent in the literature and has also provoked an ongoing and controversial discussion in the field of management studies (Kawamoto & Spers, 2019). According to Skog et al. (2018), many publications emphasise that digital disturbances could "shake the core of every industry" or trigger "big bang" situations that could threaten entire sectors (p. 431). Kane (2019) stated that digital disruption refers to the way digital technologies upend entire industries and change the rules of business. Companies are forced to adapt to the new reality as part of this digital transformation. Berghaus and Bach (2016) and Vial (2021) characterised disruptive technologies and innovations by three features: Firstly, they clearly stand out from other alternatives, which is evidenced by the fact that digital technologies enable new cases of usage. Secondly, their application requires the acquisition of new patterns of intellectual thinking, which become necessary as the ubiquity of technology changes user behaviour and user expectations of products and services. Thirdly, they influence future innovations, associated structures and processes.

It is worth comparing digital technologies with Porter's (2001) remarks on the internet and the hype surrounding the dot-com industries and the new economy. Porter emphasised the need to take a clear view of the internet and to regard it as what it is: “an enabling technology” (p. 63). Regardless of all the power of the internet, it is not a break from the past, but rather one more step in the ongoing evolution of information technology. Consequently, the author argued, the internet is not disruptive to existing industries and this technology is also rarely a source of competitive advantage, as it is essential for all industries and is available to all. Businesses will not survive without the internet, but they do not gain any competitive advantage from it. The more robust competitive advantages come from traditional strengths such as unique products or strong service. This view was vehemently criticised by Tapscott (2001). The author argued that only the internet has made modern supply chains possible and reduced transaction costs. It is only through the internet that countless new business models have emerged that differ from the earlier industrial age, with a high range of globalisation, global supply chains and vertical integration. Only the internet has made it possible for businesses to concentrate on their core competencies, and have other functions and processes provided by partners through globe-spanning supplier-networks.

Moreover, digital disruption is often mixed-up with Schumpeter’s (1972) theory of “creative destruction", which today is often referred to as "disruptive innovation.” The definition of disruptive innovation was coined and analysed in depth by Christensen (1997) in his book *The innovator's dilemma*. According to Christensen, disruptive technologies are innovations that might perform worse than existing products, at least in the short term. These innovations usually have a different value proposition than existing products and services. Additionally, disruptive innovations often have multiple and usually new features that are not initially valuable to the existing customer base. These features are not what the majority of existing customers are initially looking for. Finally, disruptive innovations have often been the catalyst for societal change. However, according to Skog et al. (2018), the concepts of Christensen (1997) have also started intense debates because there is still only a limited understanding of how disruptive innovations are triggered. They pointed out that digital disruption is typically perceived from the perspective of companies that have invested heavily in old business models, whose specific or intended path of development is interrupted.

Christensen et al. (2018) complained that the core concept of "disruptive innovation" has been alarmingly misunderstood. In particular, any risk that is partly technological is incorrectly labelled as "disruptive technology.” This has led to the use of response strategies that are inappropriate and applied without practical or theoretical basis to determine likely outcomes. The term "disruptive technology" as commonly used is largely at odds with the actual meaning of the concept. Turner (2021) explained the original concept of disruptive technology through the behaviour of two actors: First, the incumbent and second, the new entrant, what is illustrated in this study by the example of an OEM like Daimler as incumbent and the market newcomer Tesla. The incumbent is either unaware of, or does not consider the innovator Tesla's battery electric vehicle offering as a threat to its incumbent technology with the internal combustion engine. This may be because the innovation is considered niche, or its market share is tiny, or especially irrelevant to the incumbent's high-value offerings. Over time, sales of the innovative product from Tesla increase (while sales of the incumbent may or may not decrease). The innovation eventually gains and overtakes the incumbent's sales, eating them up to the point where the incumbent's offering becomes potentially obsolete from a consumer perspective. That is, the customer demand has transferred to the innovative offering. Now it is no longer a niche. Turner (2021) further explained that whether the innovator's growth is due to continuous product improvements, diffusion of the concept to other businesses or consumer acceptance, or whether the incumbent improves its own product through incremental product improvements is completely irrelevant: the disruptive technology of battery-electric vehicles is inherently an innovation and therefore new. The OEM as the incumbent did not foresee the impact and was unable or unwilling to move away from its main offering. Once the innovation overtakes the incumbent's offering, disruption occurs. This overlap is the point of disruption, which is a potential disaster for the incumbent.

Christensen's original concept has been updated over time to include the general case where the technology itself is not the source of disruption, leading to the more general concept of disruptive innovation which may or may not be causally linked to new technical concepts or physical products. For this reason, Turner (2021) suggested that the concept of a technology as a "disruptive technology" is not accurate by the mere fact of its existence. Turner pointed to 3D printing, machine learning, blockchain or Industry 4.0 as examples that are not disruptive by nature. These digital technologies do not automatically disrupt anything. Turner (2021) emphasised the decisive impact on economic activity and all that goes with it, and these are absolutely context-dependent. Hence, it depends on individual industries, businesses or markets, for whom disruptive technologies are a threat or an opportunity. Above all, it depends on the way business models are implemented in companies in terms of resource allocation and the skills and knowledge of staff or third parties.

While many authors and practitioners view digital technologies, innovations or digital transformations as synonymous with disruption, other authors such as Kim and Mauborgne (2019) doubted that disruption is the only path to innovation and growth. They argue that innovation and growth are achievable and even more realistic without destroying existing concepts. Wynn (2021b) found the best way to approach digital transformation is to consider it as a combination of disruptive and non-disruptive activities. Kim and Mauborgne (2019) perceived the risk that a one-sided focus on disruption would lead to overlooking another “building block”, which they call “nondisruptive creation”, and which they consider much more important. According to this, the challenge is to use the creative power of the business and the latest technological developments to solve problems or seize opportunities that were previously considered unattainable by conventional means and methods, as organisational innovations also create market leaders.

Finally, the concept of “open innovation” has emerged, which relates to the use of external resources and knowledge in R&D processes and is viewed by Enkel et al. (2011) as an extension of the resource-based view (Wernerfeld, 1984). The term was first invented by Chesbrough (2003) and re-defined several times (Chesbrough & Bogers, 2014). Chesbrough (2017) interpreted the open innovation paradigm as the antithesis of the traditional vertical integration model, in which internal innovation activities lead to internally developed products and services. Chesbrough and Bogers (2014) defined open innovation as “a distributed innovation process that relies on purposively managed knowledge flows across organisational boundaries, using pecuniary and nonpecuniary mechanisms in line with the organisation’s business model to guide and motivate knowledge sharing” (p. 3).

Chesbrough (2017) differentiated between two kinds of knowledge flows that underpin open innovation: outside-in and inside-out, also referred to as inbound and outbound open innovation. In support, Winkelhake (2017) explained the two models for practical application in the automotive industry. The outside-in process involves the knowledge of external sources such as customers, suppliers and also research institutions. For this purpose, targeted scouting for possible creative ideas and approaches and corresponding partners must be organised. Special innovation and scouting units are recommended, or at least cooperation with start-ups in the innovation centres of digitalisation, such as Silicon Valley or India. In this way, trends and shifts, especially "disruptive forces", can be recognised early on in terms of their relevance to companies’ business models, and these can be taken up in the innovation process. The inside-out process is about publishing one's own ideas, testing and enriching them in interest groups or cooperations. It also includes getting involved in open developer communities, such as the Open Automotive Alliance, which promotes the use of Android in vehicles, or the Open Stack Community, which develops open software for cloud environments. Such cooperation provides impulses for the company's own ideas and secures them.

For the German automotive industry, it is very promising to apply the open innovation approach to the digital transformation process. The industry can certainly draw on existing experience from the traditional manufacturing environment, for example from joint development partnerships in its extensive worldwide supplier network for components (Bosch, 2020). The task now is to achieve a similar innovative strength in the area of digitalisation developing enterprises into software-enabled companies. However, in the context of open innovation, the literature shows a variety of corresponding activities in the German automotive industry, such as innovation hubs, strategic partnerships for joint developments, digital development platforms, newly established research facilities, cooperation with universities, venture capital firms, start-ups and much more. Businesses also opening up; for example, providing industrial cloud solutions to other companies from the mechanical engineering and technology sectors in the form of open-source software (e.g. Bosch, 2020; Daimler, 2021b; Volkswagen, 2021b).

However, Chesbrough (2017) pointed out that it is a common misunderstanding to treat open-source methods, and software communities in particular, as being the same as open innovation, as they ignore, among other things, the inside-out part of the open innovation model. The author argued that open-source methods also take care to ensure that intellectual property (IP) remains within the company, representing a closed innovation. Yet, this is precisely what open innovation aims to consider: a new class of assets that are actively sold and generate additional revenue.

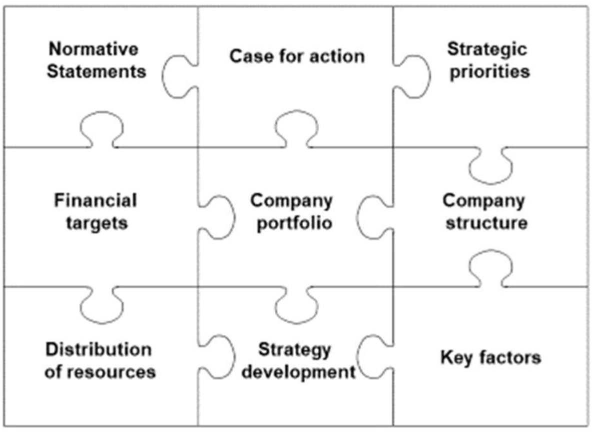
2.2.4 Digital Business Model

Whether it is a traditional business model or a digital business model, the business model concept has been controversially discussed not only in theory but also in practice, and there are different views on which components constitute a business model (Turner, 2021). Additionally, Casadesus-Masanell and Ricart (2010) emphasised the need to make a clear distinction between business model, strategy and tactics. They stated: “Business Model refers to the logic of the firm, the way it operates and how it creates value for its stakeholders; and Strategy refers to the choice of Business Model through which the firm will compete in the marketplace; while Tactics refers to the residual choices open to a firm by virtue of the Business Model it chooses to employ” (p. 196). They observed that strategy is often defined as a contingent plan of action to achieve a specific goal and concluded that a strategy involves choices for creating value. Thus, the object of strategy is the choice of which business model to use, and the business model used determines the tactics available to the company to compete or collaborate with other companies in the market. Therefore, “strategy is a higher-order choice that has a profound impact on competitive outcomes” (Casadesus-Masanell and Ricart, 2010, p. 203). Choosing a particular business model means choosing a particular type of competition, a particular logic of the business, a particular way of doing business and creating value. According to this view, a company's business model is a reflection of its realised strategy. The essential difference between strategy and business model arises when certain events occur and the business’s action plan changes the business model. When there are no contingencies on which to base the choice of business model, there is a one-to-one mapping from strategy to business models. In this rare occasion, the strategy is essentially the same as the business model, so that an outside observer can identify the business's strategy by looking at its business model.

Either way, the literature agrees that the core of business models consists of two key functions: value creation and value capture. This is in line with the definition of Osterwalder and Pigneur (2010, p. 14): “Business model describes the rationale of how an organization creates, delivers, and captures value.”

Figure 11 (below) provides nine elements of an integrated business model from practice. Faced with globalisation and other economic trends, Mercedes-Benz underwent a comprehensive transformation process in the second half of the 1990s to fundamentally realign the structure of the group (Fischer, 1997). Mercedes-Benz discovered that the term business model is subject to the usual conceptual ambiguities and describes a variety of concepts, from the simple idea of how the business works and how to earn money with it ("business idea"), to mature and comprehensive governance models of entrepreneurial action. Therefore, Mercedes-Benz described an integrated business model and understood it as to be the entirety of *documented* rules for managing a company and acting within the company.

Figure 11: Elements of an integrated business model for Mercedes Benz

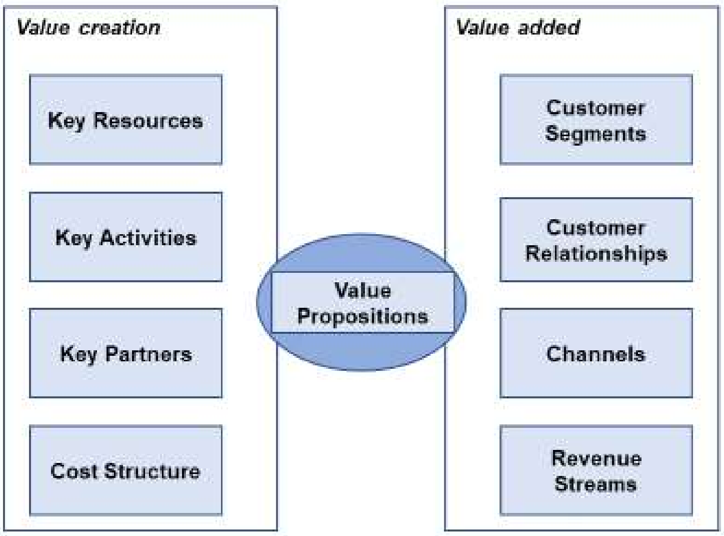


Source: Fischer (1997)

According to Fischer (1997), the elements are summarised as follows: Highest **normative statements** on mission, vision and values. The **"Case for Action"** as the sum of the basic statements about the necessity and appropriateness of the strategy, which serves to document and communicate the pressure to act (unadorned presentation of the opportunities and threats facing the company, essential challenges of the future as well as possible consequences of a failure of the strategy). Statements on **strategic priorities** (strategic directions, definition of a differentiation or cost leadership strategy, definition of key business areas, development and use of core competencies. Setting **financial targets** for the company as a whole and, derived from this, for the individual business functions (in particular return on capital and sales growth). Rules for managing the **company portfolio** (acquisitions and divestments). Description of the basic **structure of the company** (e.g. divisional versus functional organisation, distribution of competencies and responsibilities between headquarters and business functions, relationships between business functions). Rules for the **distribution of resources** between the business functions. Description of the processes involved in **strategy development** (how the strategy is developed, who is involved and how, in what form is the strategy documented, who has access to it). Statements on the **key factors** that influence the company's value at the normative, strategic and operational levels (value drivers).

Osterwalder and Pigneur (2010) developed the "Business Model Canvas" as a tool for describing, analysing and designing business models, consisting of nine buildings blocks (Figure 12).

Figure 12: Elements of a business model



Source: Osterwalder & Pigneur (2010; Scherer et al. (2019)

The business model integrates the way in which a business, together with its partners, produces a value proposition (value creation) and markets it to its customers (value delivery). The nine blocks cover the four main areas of a business: customers, offer, infrastructure, and financial viability. According to Osterwalder and Pigneur (2010), this concept has been applied to practice in many businesses and also serves the BMWi (2021b) as a recommendation and template for business founders to create a business model. Scherer et al. (2019) regrouped the nine elements into two pillars: value creation, and value added.

Key resources such as premises, staff, and start-up capital are required to offer and deliver the products and services which, in turn, require key activities, such as production or marketing and sales. Depending on the business model, it might be appropriate to enter into strategic partnerships in order to increase the effectiveness of the business (Scherer et al., 2019). The elements of the business model result in a cost structure for resources, activities and partners. Value propositions seek to solve customer problems and satisfy customer needs. An organisation serves one or several customer segments, such as mass market, a niche or different types of customers. Customer relationships are established and maintained with each customer segment. Value propositions are delivered to customers through communication, distribution, and sales channels. Revenue streams result from value propositions successfully offered to customers (Osterwalder & Pigneur, 2010; Scherer et al., 2019).

Either way, digital business is driven by the same forces as traditional business and have in common that the customer or user focus is decisive for success (Keen & Williams, 2013). Digital business models are also about considering the individual elements of the business model and addressing essential questions to create the greatest possible added value for the customer and thus generate the maximum revenue for the business. In terms of the impact of digitalisation on business models, Keen and Williams (2013) argued that future digital solutions will be based on value architectures, unlike traditional business models. Brown and Brown (2019) referred to value architectures as digital platforms with loosely coupled segments that facilitate third parties to add value to these architectures. Caputo et al. (2021) added that previous business models refer to the central role of physical elements, while digital business models are characterised by a lesser dependence on physical elements. Current and emerging forms of business models rely heavily on the use of digital infrastructures. They cite as typical examples the development of new business forms, i.e., platforms that serve as hubs between buyers and sellers in the exchange of products and services. In light of these findings, business logics that use fully IT-mediated processes and digital products or services for value creation and delivery can be defined as digital business models and associated new ventures (Osterwalder & Pigneur, 2010).

2.2.5 Digital Transformation and related operational models

As for other industries, the digital transformation constitutes a challenge for companies in the German automotive industry on two levels (Riedl et al., 2017). On the first level, companies are striving for digitally driven business innovations. These challenges involve concrete changes in processes, products and business models through digital technologies. On a second level, companies are also faced with the challenge of managing the process of digital transformation, i.e., identifying, realising and implementing new business models, processes and products. Authors such as Matt et al. (2015), Paunov and Planes-Satorra (2019) and Riasanow et al. (2017) emphasised that the main question for the German automotive industry is not so much what digital technologies they use, but rather how they shape the transformation process that defines how they want to achieve a company-specific future mode of operation in order to harness the opportunities of digitalisation. In this context, the literature shows two organisational priorities to master the change process: digital transformation strategies and digital entrepreneurship. Specifically, the authors Bonnet and Westerman (2021) have researched how the competitive advantages offered by digital technology have evolved. It requires that companies become what they call "digital masters." Digital masters combine two capabilities: firstly, digital capability, which enables them to use innovative technology to improve their business; secondly, leadership capability, which enables them to design and drive organisational change systematically and profitably. Together, these two capabilities enable a company to turn digital technology into a business advantage. Taking digital transformation first, this sub-section reviews a) the strategies and b) the model and frameworks for digital transformation. The required entrepreneurial competencies are the topic of the subsequent sub-section.

According to Singh and Hess (2020), a company-wide **digital transformation strategy** is required to guide a company through the transformation process. However, there is no uniform definition of this term to date. Vial (2021) reviewed 282 academic publications related to digital transformation and found 23 different definitions. Based on the existing definitions, the author developed a conceptual definition of digital transformation as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2021, p. 13). According to Matt et al. (2015), digital transformation strategies encompass four essential dimensions: "use of technology, changes in value creation, structural changes, and financial aspects" (p. 341). Wade et al. (2017) specified that the financial aspect, as the focus of a company, is not on digitalisation itself but on sustainable growth and long-term benefits. The financial aspect can be both an impulse and a limiting force for transformation. While less financial pressure may reduce the perceived urgency to act, companies that are already under financial pressure may lack the options to finance the necessary transformation.

Tucci (2021) asked what the role of technology was in digital transformation and concluded that technology is absolutely necessary for digital transformation. However, digital transformation is not *only* about technology. The author showed that having a vision, the right culture, a roadmap and leaders who understand cutting-edge technologies and recognise where digitalisation can benefit the business are the most important success factors. In line with this, Turchi (2018) also pointed out that digital technology is the enabler of digital transformation, but is actually not its core. Weill and Woerner (2018) echoed this view, stating that top performers in the digital economy focus on business transformation rather than digital transformation. Therefore, faced with the complexity of coordinating digital transformation activities across a company, a digital transformation strategy is considered to be an overarching and company-wide strategy which guides an organisation in its entire digital transformation process (Ismail et al., 2017). The scope of a digital transformation is similarly articulated by the European Commission (2019, as cited in Verina and Titko, 2019, p. 721): "Digital transformation is characterised by a fusion of advanced technologies and the integration of physical and digital systems, the predominance of innovative business models and new processes, and the creation of smart products." Moreover, Ismail et al. (2017, p. 6) summed up the complexity of digital transformation by stating "it as the process through which companies converge multiple new digital technologies, enhanced with ubiquitous connectivity, with the intention of reaching superior performance and sustained competitive advantage, by transforming multiple business dimensions, including the business model, the customer experience (comprising digitally enabled products and services) and operations (comprising processes and decision-making), and simultaneously impacting people (including skills talent and culture) and networks (including the entire value system)."

As digitalisation spans all organisations, operations and functions of a company, the digital transformation will be more and more challenging the larger the company is (Antonizzi & Smuts, 2020). As an example, for Volkswagen as a company with 12 brands, more than 670,000 employees and 124 factories, the transition to electromobility, digitalisation and new mobility services is the biggest transformation in the company's history. VW wants to survive these challenges and become a leading company for individual mobility in the electrical, digitised and connected age (Volkswagen, 2020). Therefore, a clear and consistent digital transformation strategy with a shared vision for the future, communicated and driven top-down by executives, is mandatory and crucial for future business success (Paunov & Planes-Satorra, 2019).

However, Hess (2016) pointed out that there is disagreement in the literature about the relationship between digital transformation strategy and IT strategy. As outlined above, Gebayew et al. (2018) viewed digital technology as identical to information technology. Winkelhake (2017) regards information technology as the driver of digitalisation. For Riedl et al. (2017) the introduction of digital technologies is caused by changes in information technologies, whereas Koch et al. (2016) considered digitalisation as the innovative use of information technologies. In line with these statements, Wynn (2021b, p. 410) suggested, based on evidence from case studies, that "digital transformation should be incorporated into IT strategy, rather than constituting a separate strategic strand or activity." In contrast, authors such as Hess et al. (2020) and Chanias and Hess (2016) argued that the digital transformation strategy is a signpost that guides management through the transformation processes that result from the integration and use of digital technologies. It is more comprehensive than an IT strategy because it reaches far beyond the boundaries of the company and goes beyond the rather technology-centric view of IT strategies. Ismail et al. (2017) concurred with this view, concluding that the degree of complexity of digital transformation exceeds that of previous IT-enabled transformation and also requires an independent digital transformation strategy. Conversely, Felser (2021) and Vial (2021) concluded that in the case of the German automotive industry, this industry has undergone continuous IT-enabled transformation processes for decades. The industry claims to have had extensive experience with digital technologies for years and has continuously invested in state-of-the-art technologies. The ultimate intention of these transformative investments has been to avoid becoming a victim of major business model disruption. Thus, the strategy of digital transformation is strongly interlinked with IT-enabled transformation, as has been practised for decades (Vial, 2021). A wider focus relates more to the central entrepreneurial issues: How to succeed in the transformation to e-mobility and how to develop into a software-enabled company.

In the context of IT-enabled transformation, well-established theories, frameworks and models have already been used to assess and analyse the adoption of information technology in businesses and can still be usefully applied in the digital age. These include the Technology, Organisation and Environment (TOE) model, the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), which was developed and applied to explore factors and reasons for technology adoption (Nobbay, 2021; Olayinka & Wynn, 2021; Skuridin, 2021). In addition, the academic literature reveals a number of new frameworks to address specific elements of digital transformation. The TOE model (DePietro et al., 1990) is perhaps one of the most popular frameworks for assessing technology adoption in a variety of contexts (Skuridin, 2021). It is still frequently used to examine the process of new technology adoption and assumes that there are three main groups of factors that influence technology adoption: technological factors, organisational factors and external environmental factors. However, Hanafizadeh and Zareravasan (2020) claim that the TOE framework only examines the factors that affect adoption, not the extent to which they affect different areas of an organisation.

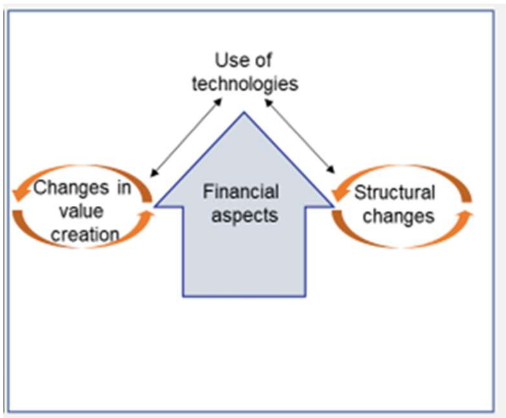
The Technology Acceptance Model (TAM) was introduced by Davis (1989) and is used in the study of information technology adoption behaviour. Davis hypothesised that the adoption of new IT systems depends on two attributes that have a significant influence on end-user use: "perceived usefulness and perceived ease of use" (p. 319). The theory is based on the assumption that users will not readily adopt a system unless they immediately see a tangible benefit in their workplace from using the system. This is completely independent of how innovative or efficient an IT system is. In principle, the Technology Acceptance Model has been criticised for being too simple to explain complex psychological processes such as behaviour and technology acceptance. Therefore, the original TAM has been developed into TAM2 and TAM3 (Venkatesh & Bala, 2008). These in turn were criticised for being too complex and inflexible to reliably explain user behaviour and technology acceptance. The

UTAUT framework developed by Venkatesh et al. (2003) was developed from a synthesis of the TAM framework and, while maintaining the flow and context of Davis' original pragmatic work, includes an analysis of the role of cultural aspects in the adoption of new technologies. The model is considered an effective response to criticisms of the TAM.

Moreover, researchers have developed numerous digital transformation frameworks which aim to understand digital transformation processes in an organisation and cover all areas that businesses must actively consider during a digital transformation (Table 6). While the frameworks differ in their consideration of individual elements, they have overlaps in the basic proposition that digital transformation should be viewed from a business-centric perspective, going beyond the previous technology and process paradigm to include changes and impacts on products, services and business models as a whole (Matt et al., 2015).

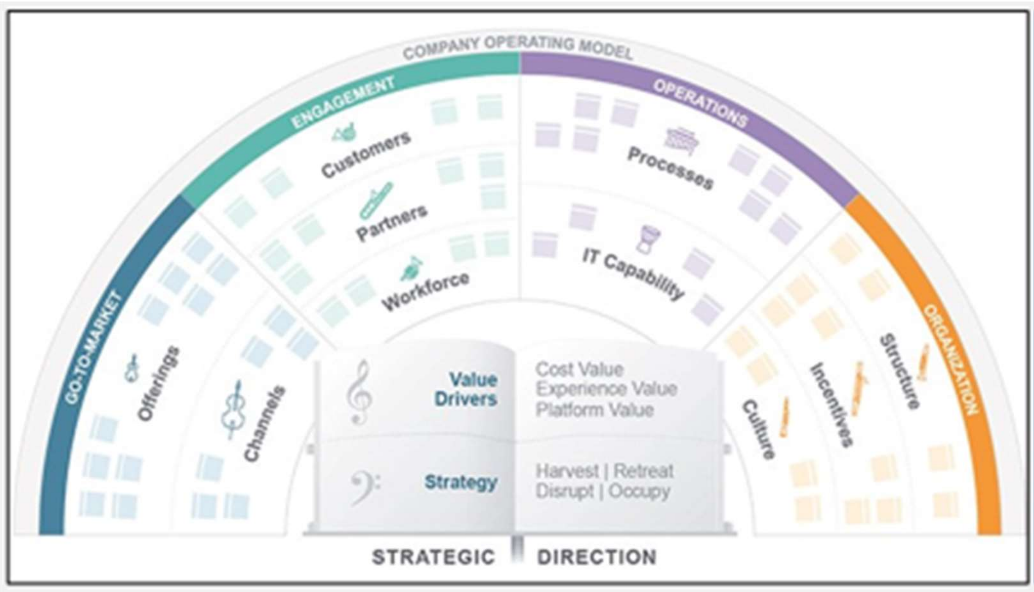
Table 6: Digital transformation frameworks

Matt et al. (2015) developed a digital framework with four essential dimensions of digital transformation strategies: use of technology, changes in value creation, structural changes, and financial aspects.



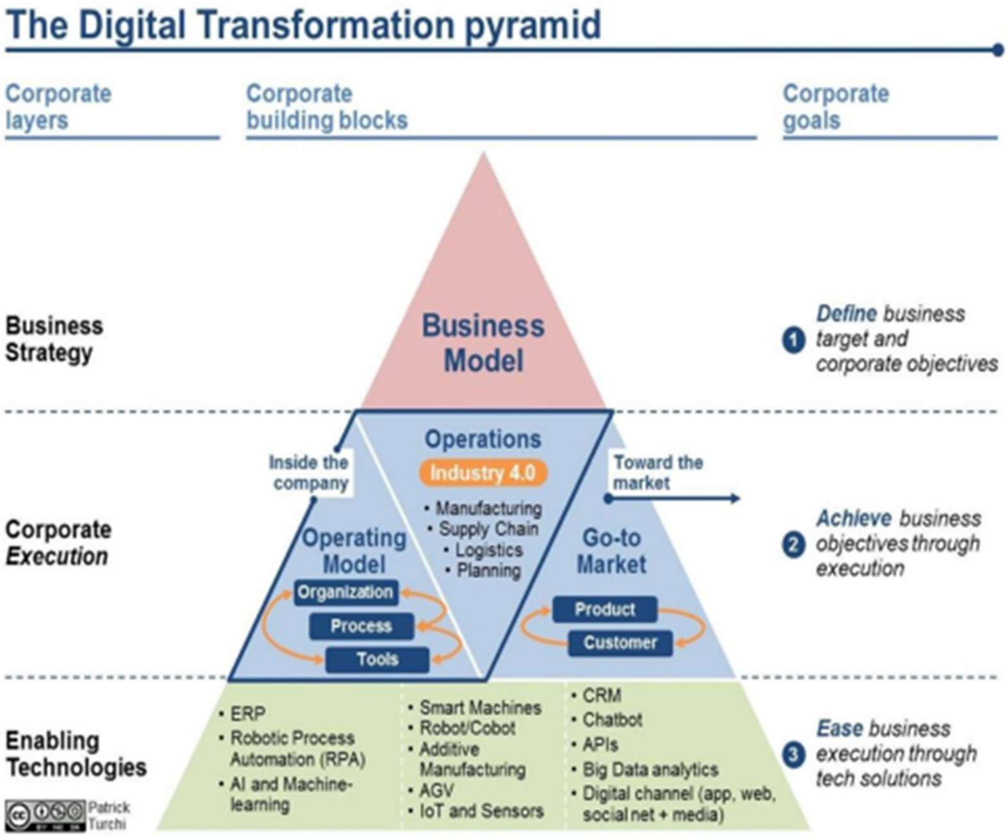
The use of technology is concerned with the attitude of a business towards new technologies, its future technological ambitions as well as its own capabilities to use these technologies. The decision has to be made whether the business wants to become a leader in technology or a follower. Being a technological market leader can lead to competitive advantages and the business can set technological standards which dominate the industry. However, it could be riskier and requires certain technological skills. From a business perspective, the adoption of new technologies often implies changes in value creation. The technologies offer opportunities to expand the current portfolio of products and services. Despite this fact, such opportunities may need greater technological and product-related skills and lead to higher risks due to limited experience in the new digital business area. When new digital technologies are applied and new forms of added value are created, this often results in structural changes to create a strong foundation for the new operations. Finally, the financial aspect is the centre of the framework as this can be both an impulse and a limiting force for transformation.

The Global Centre for Digital Business Transformation (as cited in Wade et al., 2017) suggested a digital orchestra framework which corresponds to four sections of an operating model that needs to be orchestrated to perform the digital transformation of the business.



Within each section are instruments which unite together seamlessly on the transformation path of any business. Go-To-Market covers what the business will offer (offerings) and how it will distribute the offerings (channels). Engagement deals with the question how the business will engage differently with key stakeholders (customers, partners, workforce). Operations covers how the business will modify its operations to align with the target-state business models (processes) and the strategy to support these (IT capability). Organisation addresses how the business will change its organisation in terms of its structure and ethos to support the new operating model. This section includes instruments, structure, incentives and culture. In summary, to perform the transformation, the "digital orchestra" must first set the strategic direction. In addition, the “players” need deep business and IT knowledge, as well as digital business agility. Finally, successful digital transformation demands that all four sections of the “digital orchestra" work like a “concert.”

Turchi (2018) developed the "the digital transformation pyramid" and proposed three levels on which digital transformation needs to be approached within a business: strategy, execution, and technology.



Turchi highlighted the importance "that each of the three level of the pyramid has a strong influence on (and actually defines) the other elements of the framework" (2018, p. 2). The framework is defined by five building blocks: business model / business strategy, operating model, operations, Go-to market, and technology. The three levels with the five building blocks and the linking of the individual elements reflect the complexity of a digital transformation with its multifaceted contents and contexts. Layer 1, strategy, defines the opportunities and impacts (as well as potential threats) of technology-enabled business models. Layer 2, execution, realises the defined strategies and differentiates between inside and outside the company. Layer 3, technology, is regarded as enabler of digital transformation and the driver of changes on each level of the pyramid.

Bonnet and Westerman (2021) developed elements of digital transformation and digital capability. Emphasis is placed on transforming

- business models (how, for example, digital processes can lead to innovative business models with information-based services);
- customer experience (seeing the business from the customers' perspective);
- operations (in the area of core process automation, connected and dynamic manufacturing, and real-time data-driven decision making);
- employee experience (the realisation that, for example, employees can be either the biggest barriers or the strongest enablers for the success of the transformation);

- and transforming the digital platform (viewing the digital technologies, the IT applications, and the data power of the business as a foundation for digital transformation).

BUSINESS MODEL		
Digital enhancements		
Information-based service extensions		
Multisided platform businesses		
CUSTOMER EXPERIENCE	**OPERATIONS**	**EMPLOYEE EXPERIENCE**
Experience design	Core process automation	Augmentation
Customer intelligence	Connected and dynamic operations	Future-readying
Emotional engagement	Data-driven decision-making	Flexforcing
DIGITAL PLATFORM		
Core		
Externally facing		
Data		

Bonnet and Westerman (2021) also emphasised a new importance of the IT function in driving digital transformation to success. They concluded that "now IT leaders are driving digital transformation in some companies. In other companies, IT and digital and business leaders are working more closely together to make the digital transformation faster, more innovative, more comprehensive, and more effective than before" (p. 88).

As with all other frameworks or operational models, focusing on a single element alone does not succeed in transforming a business; only an integrated approach of all elements enables business transformation.

Source: Matt et al. (2015); Wade et al. (2017); Turchi (2018); Bonnet & Westerman (2020)

Digital transformation requires a high degree of strategic thinking and creativity (Van Dyk & Van Belle, 2019). In line with this, Kraus et al. (2022) referred to the general misunderstanding that technology would drive digital transformation and highlighted additional requirements such as change in leadership, culture and mindsets. They also revealed that "strategy" and "change management" are the most frequently mentioned keywords in academic literature since 2018. Matt et al. (2015) suggested that companies should establish management practices to govern such complex transformation. BMW (2020) stated that the technological change towards electrification, digitalisation and new mobility services is leading to a fundamental change of the automotive sector. The integration of the car into a "multimodal, digitally networked mobility ecosystem" (p. 55) represents a major transformation process and entrepreneurial challenge. Therefore, navigating the transformation and re-thinking leadership are important factors reviewed below.

2.2.6 Digital Entrepreneurship

The term "entrepreneurship" has gained growing interest in the context of digitalisation in the academic literature. However, the terms, concepts, characteristics and values of digital entrepreneurship vary widely and concern a range of issues, as authors address this topic from different methodologies and perspectives (Shen et al., 2018).

Anim-Yeboah et al. (2020), Berger et al. (2019), and Kane (2019) discussed the differences between traditional and digital entrepreneurship, while Elia et al. (2020) illustrated definitions for digital entrepreneurship as a subcategory of entrepreneurship. They viewed entrepreneurship as identifying business opportunities through the recombination of existing resources or the creation of new ones to deploy new products and services. Digital entrepreneurship is the "creation of new ventures and transforming of existing business by developing novel digital technologies" (p. 3). Other authors, such as Anim-Yeboah et al. (2020), Antonizzi and Smuts (2020), Berger et al. (2019), and Recker and Von Briel (2019) associated terms such as digital entrepreneurship and digital innovation with the transformative changes that digital technologies entail. They argued, with reference to the academic literature, that digital technologies dissolve traditional boundaries and change the way entrepreneurship, innovation processes and outcomes function. The underlying assumption is that digital technologies are fundamentally different from traditional technologies and represent more than just another technological change. Therefore, Recker and Von Briel (2019) supported the scholars´ focus on the "digital" in entrepreneurship and argued that digital technologies upend traditional entrepreneurship; for example, by unlocking previously inaccessible networks, ecosystems and communities, and accelerating the evolution of new ventures. However, Anim-Yeboah et al. (2020) and Antonizzi and Smuts (2020) admitted that critical issues concerning digital entrepreneurship remain unsolved in the literature; for example, how it predicts performance outcomes currently. Additionally, Anim-Yeboah et al. (2020) explained that many authors focus mainly on technology issues. The strategies and entrepreneurial skills for the implementation of the transformation and use of digital technologies, on the other hand, are key issues that have been given too little attention so far.

In line with this, Kane (2019) expanded the perspectives that determine successful digital entrepreneurship and pointed out which mistakes should be avoided. First, the author pointed to the technological fallacy and misconception that the solutions to business challenges caused by digital technologies are to be found in digital technologies. In doing so, companies forget that the culture of the company, its organisation and its employees are what drives new technologies to success. Secondly, it is relatively easy to hurriedly invest in a new technology, but it is extremely difficult to change the way a company works and the way the organisation interacts. Therefore, his argument for digital entrepreneurs is to first invest in changing the mindset of management, organisation and employees. This shift brings about a cultural change that enables the company to be more agile, more experimental, risk-taking to an acceptable degree, more continually learning and adaptive and tolerant of new forms of collaboration. Then, there is a basis to generate value from technology. Finally, the author pointed out the challenge of keeping the lights on and running the core business on the one hand, while at the same time pursuing digital transformation and being innovative. In line with this, Antonizzi and Smuts (2020), Kane (2019) and Modiba and Kekwaletswe (2020) underlined the importance of understanding all implications of the digital transformation, and, therefore, the complex characteristics and interactions of the multi-faced digital entrepreneurship.

Another discussion arises from a two-folded perspective. Fang et al. (2018), Nambisan and Baron (2019), Recker and Von Briel (2019) and Shen at al. (2018) differentiate between digital technologies as enablers of entrepreneurship and digital entrepreneurship as creator of digital business opportunities. The first is more concerned with entrepreneurs as founders of digital start-ups, their role and mentality as well as concepts such as crowd-funding to finance the start-up. The latter is more concerned with corporate entrepreneurship, which takes place in already established organisations, including incumbent corporations. Both forms are relevant to the German automotive industry, which needs to create a variety of new digital companies and start-ups as well as transform complex corporate operations into new business models. Antonizzi and Smuts (2020) underlined that digitalisation and digital transformation, which encompasses all functions and operations of a company, can be considered more difficult the larger the company. Additionally, the practice of large companies to upgrade outdated and obsolete business systems to modernised, digital systems can be problematic due to the irregularities within these systems. Other challenges related to digital transformation in the automotive industry are that existing business models, such as the traditional business model with internal combustion engines, yield so much profit that the need to develop new, digitised products and services for customers is not addressed well in advance.

Taking a more holistic perspective, authors such as Jones and Maas (2019), Maas et al. (2019), Miller and Collier (2010), and Roth and DiBella (2015) focused on the term "transformational entrepreneurship" as an alternate type of entrepreneurial activity. It has been argued by Jones and Maas (2019) that transformational entrepreneurship considers or balances both the significant economic and long-term societal impacts, in addition to the technical and financial aspects of the business. This is particularly relevant for the German automotive industry, which in addition to its economic goals must also fulfil its long-term social responsibility for employment and prosperity as well as for climate protection.

Maas et al. (2019) and Roth and DiBella (2015) argued that growth opportunities may be missed because of the current focus on cost efficiency. Therefore, transformational entrepreneurship is needed in larger organisations, among others, to create a vision for exploiting new growth opportunities in a competitive environment. Roth and DiBella (2015) suggested five competencies required to enable transformative change: business awareness (e.g. industry knowledge), innovation, balanced relationships between management and workers in the context of organisational change, and striving for growth and leadership. These competencies are becoming critical for the success of the German automotive industry in particular, to overcome the highly resistant forces and cultural barriers in its widely spread organisations. The transformative challenges relate primarily to addressing the high sunk costs of combustion technology, the employment impacts of electromobility and further automation, the development of entirely new core competencies, the re-qualification of hundreds of thousands of employees, the decades-old self-image of this industry and its hardware-centric engineers, and the like.

Moreover, it is assumed that a company exists because it has advantages in the market through the generation of knowledge and innovations (Grant, 1996). This view has received a great deal of interest in the literature because it recognises the fundamental economic changes that have resulted from the accumulation and availability of knowledge over the last decades. The economy has undergone a structural change in the productive paradigm. The transition from production to service in most developed economies is based on the manipulation of information and not on the use of physical products (Felser & Wynn, 2020b). Jones and Ratten (2021) underlined that knowledge has become one of the most important assets for creating a sustainable competitive advantage. This trend is becoming even more pronounced with digitalisation. The digital future means everything is expressed in terms of data. A central element of digitalisation and of Industry 4.0 is the generation of huge amounts of data with cyber-physical systems and the storage and linking with technologies such as Big Data. However, data themselves are of little value. The data from many different sources are only transformed into valuable information through comprehensive analyses and correlations to become a strategic value. Therefore, what matters is the management of information and the intelligent usage of this information for new business models and processes, interlinking the business with its ecosystems, for cognitive solutions, virtual reality, predictions and robotics. New core competencies and unique knowledge becomes the critical success factor (Felser & Wynn, 2020b).

Hence, according to Jones and Ratten (2021), businesses need to create knowledge communities in the form of ecosystems, which enable a wide variety of actors from different organisations to acquire, exchange and use knowledge through mutual interaction, such as joint work on projects. As a result, the focus of the business's activities will be on the acquisition of relevant and reliable sources of knowledge. Therefore, entrepreneurship depends on the successful transfer of knowledge.

This corresponds with a study conducted by Wynn and Jones (2019), who identified knowledge transfer intensity, among other things, as a critical entrepreneurial success factor that determines the outcome of technology-based projects. Hence, it can be clearly assumed that this is valid regardless of whether it is a small company (such as the many start-ups in the automotive and technology sector), a medium-sized company (such as many suppliers) or the large OEM groups. However, Wynn (2018) revealed that external sourcing of knowledge requires specific internal capabilities for the effective integration and use of new knowledge for innovations. Consequently, among other insights, Vial (2021) showed that the literature highlights new leadership roles for corporate digital entrepreneurship to ensure that organisations develop a digital mindset while responding to the disruptions associated with the use of digital technologies. Entrepreneurship is about developing initial ideas and then turning them into market reality (Jones & Ratten, 2021). In particular, the introduction of a "chief digital officer (CDO)" or "an innovation officer" to manage knowledge and promote digital transformation has been recognised (Singh & Hess, 2020; Stockhinger & Teubner, 2019). Additionally, Steiniger (2019) and Szalavetz (2020) emphasised that digital entrepreneurs have a transformative impact and are at the forefront as change-agents and knowledge managers.

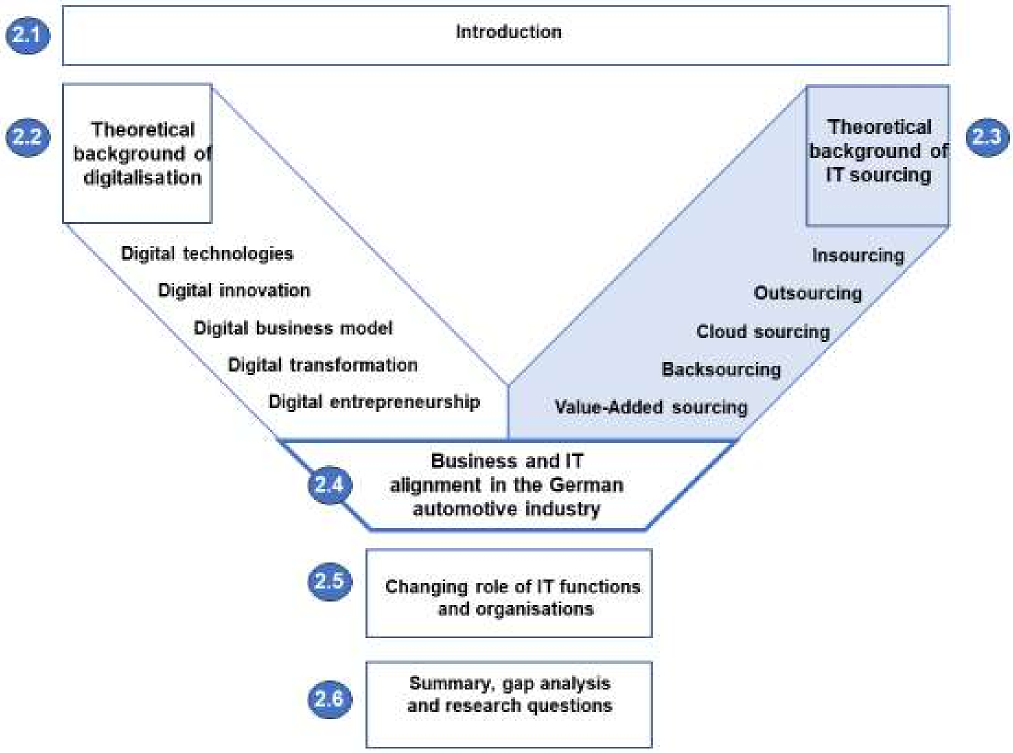
In summary, the German automotive industry has four choices for digital transformation. Firstly, partial digitalisation in certain business areas only. Secondly, efficiency-driven digitalisation through digitised processes or automation. Thirdly, business driven digitalisation with new delivery processes, from physical products to services and mobility solutions and from single actors to value networks and ecosystems. Fourthly, disruptive digitalisation from cars with internal combustion engines and powertrains to e-mobility. Realistically, the German automotive industry has to deal with all four levels and in particular, the last two levels require substantial structural changes and new capabilities within organisations. Developing the required capabilities is about new knowledge and skills for the overall digital transformation that need to be sourced and provided, internally or externally. Hence, major impacts on IT sourcing are to be expected, as this function provides the industry with the necessary capabilities and resources for the deployment of digital technologies and digital transformation into new business models and innovation.

2.3 Theoretical Background of IT Sourcing

The literature review on IT sourcing revealed basic concepts of IT sourcing, such as insourcing, outsourcing, cloud sourcing, and value-added sourcing, which will be reviewed in this subsection (Figure 13). The option of IT backsourcing will not be discussed further here, as the relevant details have already been published in the publications by Felser and Wynn (2020a; 2020b).

The term sourcing is a generic term that combines several different sub-concepts, models, or strategies besides the two fundamental directions of insourcing and outsourcing. Theoretical and empirical studies to explain insourcing and outsourcing decisions also refer to the terminology of vertical integration. Vertical integration is generally defined as the degree to which a firm intends to source services externally or carry out the activity in-house. This leads to make-or-buy decisions which reflect the strategic intent and purposeful design of in-house service competencies and depth (Krcmar, 2015; Von Jouanne-Diedrich et al., 2005). Based on these considerations, a business has to decide how IT benefits the business and which core IT competencies it holds, especially in the digital transformation process of the business.

Figure 13: Literature review of IT sourcing



Source: The author

2.3.1 IT Sourcing in the Context of Core Competencies

Before proceeding to investigate the literature in terms of the various IT sourcing concepts, it is useful to consider IT sourcing in the context of core competencies coupled with the controversial question of the value of IT and how it has been viewed in recent decades. According to Krcmar (2015) and Von Jouanne-Diedrich et al. (2005), this debate is dominated by the ongoing issues surrounding the automation and standardisation of the IT service creation process - the so-called industrialisation of IT – as well as the associated tendencies towards the commoditisation of IT.

Some authors mark the start of IT outsourcing to the foundation of Ross Perot's Electronic Data Systems – called EDS (Leimbach, 2010), probably the first company that can be called a professional IT outsourcing provider, and which, until its takeover by Hewlett-Packard, was one of the world's largest providers of software and services. It started by handling various data processing services for Frito-Lay and Blue Cross & Blue Shield in the 1960s (Lacity & Hirschheim, 1993, p. 74). The size of the deals between EDS and its customers were, however, relatively low. As Krcmar (1992) explained, until the late 1980s there was a striking and one-sided argument on the IT side that IT was a corporate resource, and outsourcing was rejected. Subsequently, however, with the so-called "Kodak effect", the topic has experienced a significant boost in the IT sector (Loh & Venkatraman, 1992). In support of this, Hirschheim and Lacity (2000) and Krcmar (2015) added that Eastman Kodak's decision in 1989 to transfer its entire information technology to DEC, IBM and Businessland is generally regarded as a milestone in the process of considering IT outsourcing in a scientific and practical context. Since the Eastman Kodak decision, many other organisations have identified outsourcing of IT as a serious strategic choice to allow businesses to focus on core competencies. Subsequent outsourcing mega-deals could be seen as "imitative behaviour" of Kodak's decision (Loh & Venkatraman, 1992, p. 27). After Kodak's decision the way was paved for the rapid growth of IT outsourcing. Outsourcing of significant portions of their IT functions by companies such as British Aerospace, Chase Manhattan Bank, BMW Bank, JP Morgan, Xerox, and Lufthansa have been attributed to this. With these perspectives of IT as a commodity, IT was no longer regarded as a core competency or a process that should be handled internally (Johansson et al., 2017).

A second important trigger, which made IT outsourcing and thus concentration on the core business only possible on a large scale, was the so-called industrialisation of IT. While information technology initially contributed significantly to the industrialisation of the business processes of the automotive industry and other sectors of the economy, IT itself became increasingly the subject of an industrialisation process (Becker et al., 2011). Walter et al. (2007) argued that the discussion of the structural principles of industrialisation shows that, as the process of industrialisation progresses, changes in the price of factors, product, production, personnel and partners occur.

Becker et al. (2011) addressed several approaches to the industrialisation of IT. The individual IT solutions that had dominated were increasingly replaced by standardised solutions in order to realise economies of scale. This trend was evident early in the IT infrastructure sector and hardware was increasingly viewed as a "commodity." Walter et al. (2007) noted that individually developed infrastructure - so called "custom built" - is only used in very special cases. They also noted that standardisation was increasing rapidly for software products, and more and more standard software was available for special fields of deployment. Becker et al. (2011) emphasised that this was encouraged by the fact that software development to a large extent followed industrial methods by standardising design processes, increasingly establishing quality management processes, and using tools for computer-aided software engineering. Gabriel et al. (2009) highlighted the growing divergence of requirements while at the same time ensuring flexibility, which increasingly called for the use of the modularisation (multiple reuses of once-developed components) both at the product and at the infrastructure and process level. According to Böhmann and Krcmar (2014), modularisation offers the possibility of meeting the demands for individualised IT services at the price of a standard product. Modular product structures are used for this purpose. Böhmann and Krcmar (2014) addressed this as "mass-customized solutions" (p. 2). With the use of defined modules and interfaces, a service product is compiled and can then, according to customer requirements, be further configured.

Von Jouanne-Diedrich et al. (2005) highlighted the industrialisation of the IT sourcing process and argued that the proven methods and processes of classic industrial procurement or industrial logistics can be useful for IT sourcing. They mentioned methods to support outsourcing decisions and supplier selection, such as ABC analysis, to differentiate between commodities and strategically important services. Zarnekow (2007) also emphasised that industrialised IT sourcing processes represent a concentration on core competencies. Increasing standardisation and modularity improve the integration possibilities of in-house and third-party IT services, making it easier to purchase external services.

As a result of the concentration on core competencies outlined above and the outsourcing of areas that were not part of the core business, IT was predominantly regarded as a commodity (Walter et al., 2007). In 2003, Carr made the provocative statement "IT doesn't matter", which is still controversially discussed in academic literature and among practitioners. Carr raised the question of why IT had lost its strategic importance despite its growing power and omnipresence. The author referred to findings concerning negative relationships between IT spending and the performance of a firm and quoted practitioners, such as the CEO of Oracle, "that most companies spend too much on IT and get very little in return" (Carr, 2003, p. 12). Carr concluded that IT has become a commodity and does not provide competitive advantage to companies. IT would initially undoubtedly have brought great advantages and technological innovations for companies, but over time it had become more cost-effective and standardised and was, therefore, available to everyone. McFarlan and Nolan (2003) responded to the much-discussed statements from Carr and argued "that IT matters." IT could, for example, change the rules of competition and new IT technologies could give companies the possibility to differentiate. They also called Carr's argument "the most dangerous advice to CEOs" (p. 1).

In 2004, Carr responded to criticisms that his statement related only to IT as technology - i.e., software and hardware and the processing of data in digital form and not to the information processed by the technologies. Nevertheless, Qu et al. (2010) stated that Carr's statements had led CEOs in the wrong direction. Kurbel and Nowakowski (2012) contradicted this and pointed out that Carr's argument has proven to be correct, at least in part. They explained that the commoditisation of IT has contributed to the availability of many types of software as a commodity, such as software-as-a-service (SaaS). Based on cloud sourcing, infrastructures and platforms no longer need to be physically operated in-house. Infrastructure-as-a-service (IaaS) and Platform-as-a-Service (PaaS) provide virtualised computing resources delivered through cloud technology.

However, as Veltri et al. (2008) explained, business strategies are subject to many changes over time, caused by internal and external factors, and this leads to constant re-positioning and restructuring of core competencies. In this context, the role of IT and the sourcing strategy of IT should be repeatedly re-assessed. According to Butler et al. (2011), the proper alignment of business and IT strategy is the link to re-position IT from commodity to IT being a strategic investment and leads to appropriate sourcing decisions. The authors also pointed out that not all IT functions are core business or non-core business, but the challenge is to categorise IT functions as either commodity or strategic in order to adjust the IT sourcing strategy. Qu et al. (2010) also emphasised that the business should make more efforts to assess the strategic value of IT, rather than considering IT as a non-core activity. Consequently, a key responsibility for the strategic information management of a company is the constant assessment of which IT services should be performed by the company itself or should be outsourced in order to support business processes more effectively and efficiently (Krcmar, 2015).

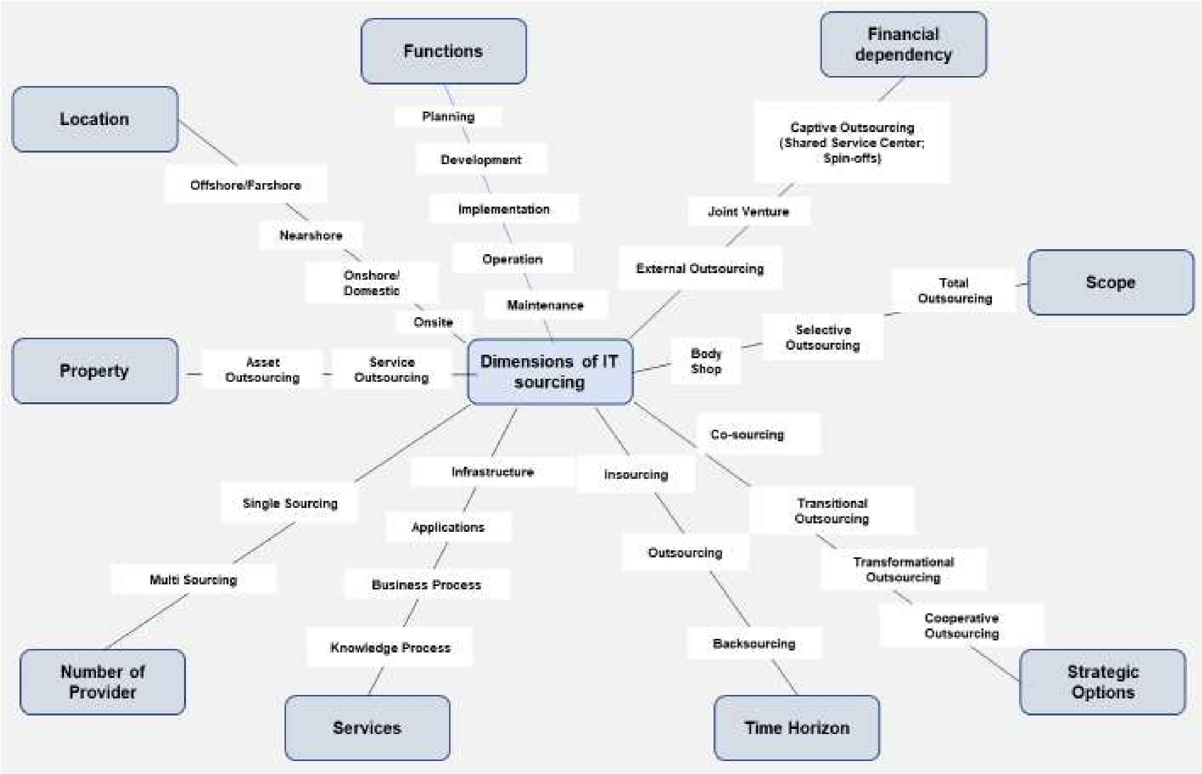
As the aim of this study is to understand evolving IT sourcing strategies in the German automotive industry it is worth taking a retrospective glance at some landmarks of IT sourcing in the German automotive industry from the start of IT sourcing until the present. Therefore, Appendix 10.3 shows the developments in IT sourcing over the last three decades, resulting from the changing views on IT core competencies.

2.3.2 IT Insourcing and Outsourcing

These two basic sourcing strategies can be classified in general terms and distinguished from each other. In terms of IT, insourcing is seen as a business's dependence on an internal department to obtain IT services (Dibbern et al., 2004). In this case it is irrelevant whether the service was previously outsourced or was provided internally from the outset. Outsourcing is defined as "handing over the management of a function, assets, people, or activity to a third party for a specified cost, time and level of service" (Willcocks et al., 2015, p. 3). Conversely, in this case it is of no importance whether the outsourced function was previously located within the business or was outsourced from the outset. Additionally, Hirschheim and Lacity (1997) offered a taxonomy of general sourcing decision options: total outsourcing, total insourcing and selective outsourcing. Total outsourcing arises when more than 80 per cent of the IT budget is outsourced to external provider (low range of vertical integration / depth of services). Similarly, total insourcing occurs when more than 80 per cent of the IT budget remains in the business (high range of vertical integration / depth of services). Finally, selective outsourcing describes a degree of outsourcing between 20 per cent and 80 per cent. According to Könning et al. (2018), selective outsourcing has become the most popular and the most successful outsourcing alternative.

Many different forms of IT outsourcing have emerged, all associated with expectations that the business can better concentrate on its core business, focus on innovation, reduce costs and increase the effectiveness of IT (Krcmar, 2015). This range of concepts can be combined in many ways and lead to a high degree of complexity, there being many possible dimensions to the outsourcing process (Figure 14).

Figure 14: Sourcing map



Source: Krcmar (2015); Von Jouanne-Diedrich et al. (2005)

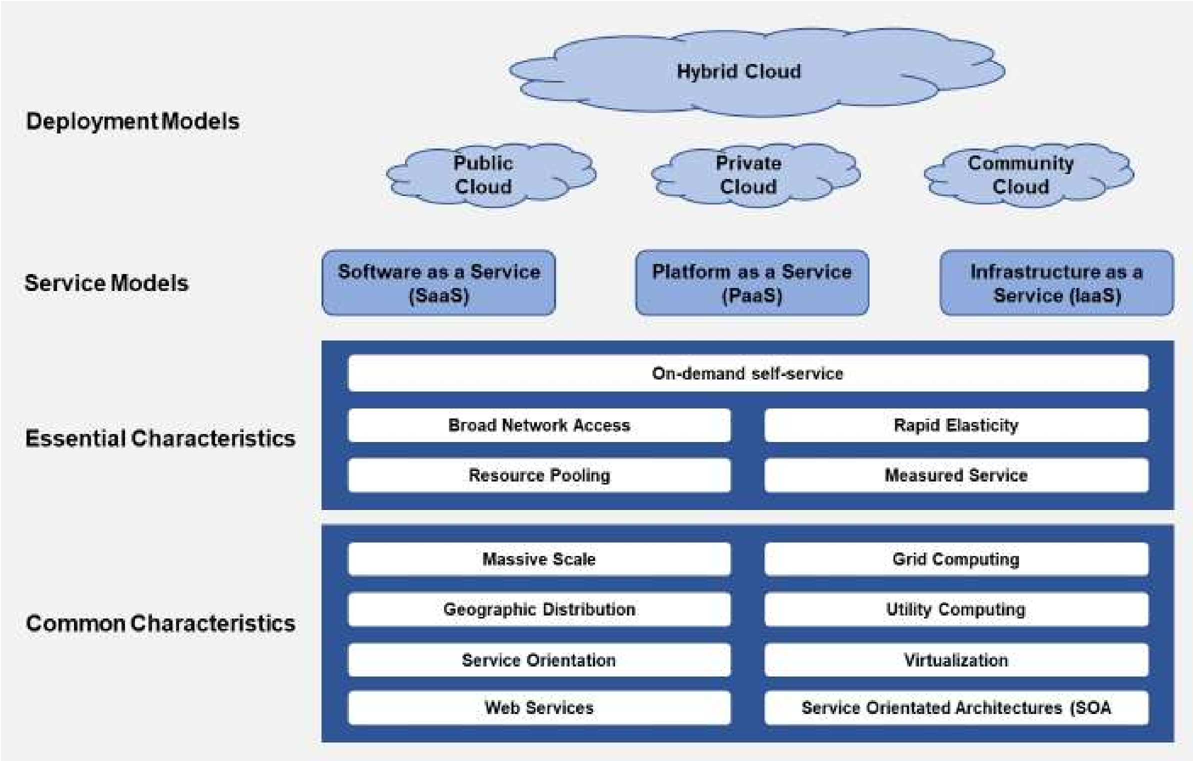
2.3.3 Cloud Computing / Cloud Sourcing

Cloud computing / cloud sourcing has been defined in different ways in the literature, is controversially discussed with regard to its origin and significance, and is differentiated in various ways from classic outsourcing. Lipsky (2011) and Muhic (2019) stated that the terms cloud computing, cloud sourcing and IT outsourcing in the literature are used synonymously and often not sufficiently differentiated. Moreover, Muhic (2019) stressed that cloud computing and cloud sourcing are two different phenomena. Cloud computing refers more to the technological aspect of hardware, software, virtualisation, data centre, networks, etc., whereas cloud sourcing refers to the decision-making process to use these technologies in the form of customer-supplier-agreements, contracts, service delivery models, relationships etc. Hence, it involves an economic or business strategic perspective which allows third parties to be directly integrated. Furthermore, the literature shows a high diversity in the definitions of cloud computing. Lipsky (2011) has collected 48 different definitions and views of actors from practice and science to highlight the lack of a common terminology. However, research on cloud computing has broadly adopted the recommendations of the National Institute of Standards and Technology (NIST), defined by Mell and Grance (2011).

Mell and Grance (2011) defined *cloud computing* as a model for providing omnipresent, convenient, on-demand network access to a common pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly deployed and shared with minimal management or service provider interaction. The International Organisation for Standardisation (ISO, 2014) regards *cloud* as a communications network, such as wide area network like the public Internet, local area network or private network of any size. The word "cloud" refers to a data centre comprising servers that are connected to the Internet. Mell and Grance (2011) distinguished between five key characteristics, three service models and four deployment models of cloud computing.

The *five key characteristics* are the provision of on-demand self-service, access to virtualised, shared, and managed IT resources that are scalable on-demand, available over a network, and priced on a pay-per-use basis. According to Mell and Grance (2011), the *three service models* are Iaas, Paas and SaaS. *Infrastructure as a Service (IaaS)* provides virtualised computing resources (e.g. servers, storage, networks) on which users can deploy, control, and run software such as operating systems and applications, but users do not own, manage, or operate these resources. *Platform as a Service (PaaS)* provides a highly integrated environment in which custom applications can be designed, developed, tested and deployed without the cost and complexity of purchasing and managing the underlying hardware and software layers. *Software as a Services (SaaS)* provides software applications that run on cloud infrastructures, are remotely accessible over the Internet, and are typically accessed by end users through a thin-client interface (such as a web browser). With SaaS, users do not own, manage or operate the underlying infrastructure, platform or even individual applications. Figure 15 summarises a cloud definition framework.

Figure 15: Cloud Definition Framework



Source: Youseff et al. (2008); Mell & Grance (2011); Lipsky (2011); ISO (2014); Muhic, (2019)

Mell and Grance (2011) categorised the *four deployment models* in public clouds, private clouds, community clouds and hybrid clouds. *Public clouds* are owned, managed and operated by external providers and made available to the general public via the Internet. *Private clouds*, by contrast, are intended for exclusive use by a single organisation and are not available to the general public (Mell & Grance, 2011). However, availability, security and privacy have become important concerns in public cloud computing. Private clouds are easier to align with security, compliance and regulatory requirements, but offer fewer benefits, such as cost reduction and scalability. In addition, combinations of private and public clouds aim to combine the separate advantages of public and private clouds. *Community clouds* are controlled and shared by a group of organisations with mutual interests, with their strengths and weaknesses lying between public and private clouds. *Hybrid clouds* are a mixture of public and private cloud services

(Mell & Grance, 2011). Usually, non-critical information is outsourced to the public cloud, while mission-critical services and data are kept under the control of the business.

Leimeister et al. (2010) regarded cloud computing as an innovation in various ways, since it has the potential to revolutionise business models through its use of computer resources. In line with this, Willcocks et al. (2013) considered cloud computing as potentially disruptive and addressed it as a new delivery model, a technological disruption and the restructuring of the IT industry. However, no explanations were provided as to what they understood by disruptive. In spite of the above declarations, Boes et al. (2019) asserted that, whenever disruptive innovations of business models, production models and the organisation of work are considered, cloud concepts seem to play an important role. They also claimed that trends like artificial intelligence, Internet of Things, big data and new platform strategies would be, in one way or another, based on cloud concepts.

Cloud sourcing, as it will be referred to from now on, is generally regarded in the literature as IT outsourcing, but with a different emphasis. Muhic and Johansson (2014) considered it the next generation of outsourcing. Leimeister et al. (2010) and Schneider and Sunyaev (2016) addressed cloud sourcing as an evolution and specific form of IT outsourcing. On the one hand, cloud sourcing and IT outsourcing have common characteristics and provide similar benefits to the user. On the other hand, there are specific differences. Dhar (2012) compared the similarities and differences between cloud sourcing and traditional IT outsourcing and concluded "that cloud sourcing represents a fundamental shift" (p. 664) in the evolution of IT service delivery and labelled cloud sourcing as a "new computing paradigm" (p. 664). What distinguishes cloud sourcing from previous outsourcing models is the elastic scaling of resources or services and charging based on actual usage (pay-per-use). With traditional outsourcing models, the physical resources are held either by the customer or by the provider. Cloud sourcing, on the other hand, offers a resource-free (asset free) provision of technological capacities. However, the literature does not show a clear classification for the case that a private cloud is operated by a business itself and by its own IT staff, while the business remains the owner of its infrastructure. Baun et al. (2019) refer to private cloud services that are operated within a business as in-house service. Other authors (e.g. Armbrust et al., 2009) also excluded private clouds from IT outsourcing.

2.3.4 Value-Added Sourcing

As reviewed above, insourcing and outsourcing are the two opposing sourcing concepts. Lacity and Willcocks (2000) identified further contractual models such as co-sourcing, value-added sourcing, joint equity sourcing, and contracts with flexible pricing, but at the same time mention that "some of these newer options will not reach maturity for years to come" (p. 32). They treated these terms independently but acknowledged considerable overlap. They referred to *value-added deals* as the sharing of revenue from the sale of a jointly developed product, or to contracts with a supplier that offer industry-specific expertise. *Joint equity deals* can be considered as "value-added" deals with an additional incentive of joint ownership. Performance-based contracts may relate to the fact that the supplier's fees are linked to the business performance of a customer (e.g. sales revenue) or may be based on the performance of the supplier (e.g. productivity and quality improvements). Flexible price agreements can refer to the fact that the fixed fees are reduced on the basis of a vendor's internal costs or on the basis of best-of-breed benchmarks.

Weinert and Meyer (2005) also raised these topics and stated that businesses doing outsourcing for strategic reasons are seeking more advanced forms such as *joint ventures* or *network partnerships* with multiple suppliers. Gabriel et al. (2009) supported this view and reported a tendency towards cooperation and hybrid forms. Crowley et al. (2017) referred to make-or-buy-or-cooperate decisions. In particular, these authors describe so-called *gap closing alliances* as cooperation to close existing resource and competency gaps to achieve competitive advantages that cannot be achieved individually. In line with this, Lipsky (2011) concluded that the classic make-or-buy decision is partly developing into a *make-buy-or-share* decision. *Joint ventures* between businesses are viewed as an alternative to pure external and internal outsourcing that organises complementary competencies more sensibly. Wiegard (2020) referred to make, buy or ally, which refers to the phenomenon of co-opetition where firms simultaneously cooperate and compete (Xu et al., 2017); this is partly due to competition of such intensity that competitors cooperate to achieve strategic results. To sum up, in this study the above mentioned and overlapping terms are summarised under the heading value-added sourcing. This reflects alternatives to external and internal sourcing of the IT provision to provide mutual benefit from complementary competencies.

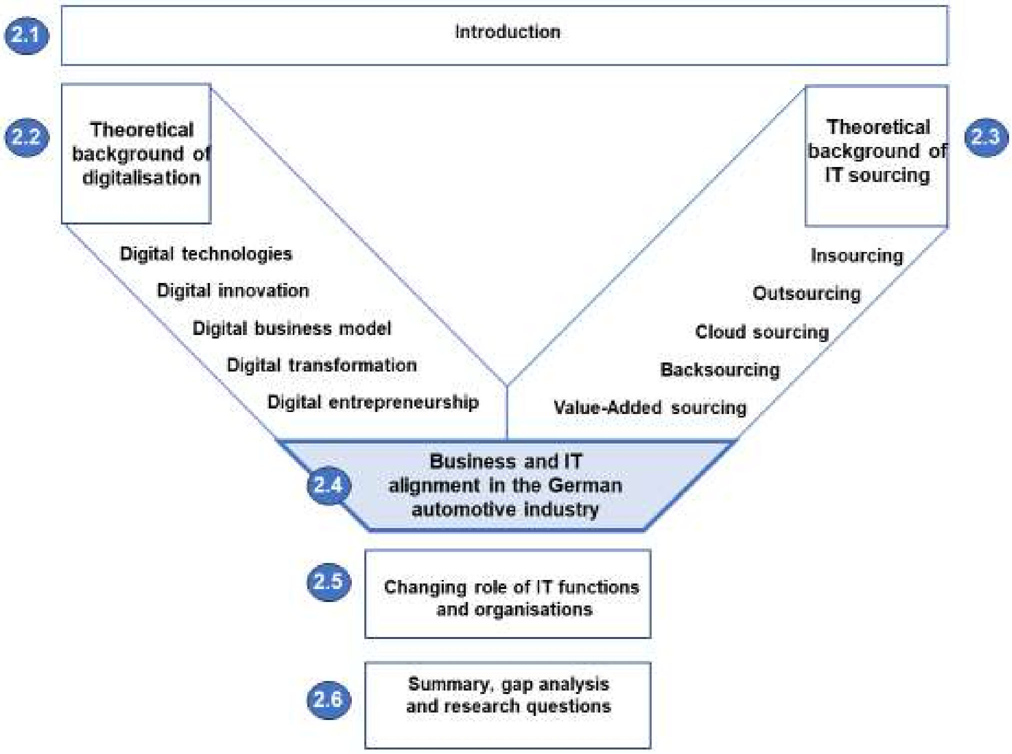
2.4 Business-IT Alignment for Digital Transformation

Rueckel et al. (2020) referred to research studies that have explained decision-making factors for IT sourcing and applied various theories to align business and IT strategies. IT strategies and related IT sourcing strategies are ususally cascadingly derived from the corporate business strategy. The definition of IT competencies and the derivation of IT sourcing strategies is based on existing corporate value creation processes. Contrary to Carr's (2003) claims that "IT doesn't matter", it has indeed become accepted that IT has a strategic importance and has become a competitive factor and the basis for business adaptability. Nevertheless, the high proportion of IT outsourcing demonstrates that the alignment between business and IT strategy in the last decade was still predominantly driven by the notion of efficiency (e.g. Nissen & Termer, 2014; Rueckel et al., 2020). Rueckel et al. (2020) concluded that IT sourcing decisions were mostly driven by financial and cost aspects and revealed three approaches to outsourcing. The most established one is operational efficiency to reduce costs. The second reason is to free up internal resources for new projects or to transfer knowledge from external partners to internal resources. The third one is to support strategic initiatives of the business while cutting costs and adding capacity.

Therefore, this sub-section reviews how current assumptions regarding the strategic alignment process have been questioned and forms a link with the overall digital transformation in the German automotive industry and its alignment with IT sourcing strategies (Figure 16).

The literature shows that there is already a large body of literature on alignment; however, this sub-section starts with a general understanding of business-IT alignment and how the view of science has evolved over the last decades to the extent that the strategic alignment process has been questioned. For reasons of focus, this study avoids going into detail about the various models of business-IT alignment. The aim is rather to build a bridge between traditional alignment and new approaches through digitalisation in the German automotive industry. After this general understanding, the review focusses on the three technological environments in the German automotive industry which are affected in many ways by digitalisation, as well as on consequences for IT sourcing strategies highlighted in the literature, which need to be newly aligned in one way or the other. This part of the study also refrains from assessing whether business drives or should drive IT or vice versa. What is important from an entrepreneurial point of view is the result, namely that business and IT are coordinated in such a way that they harmonise perfectly for the benefit of the business. For as long as information technology has existed, there has been a need for this alignment to use IT to gain an advantage in the business environment or to make up for a disadvantage (Reinheimer & Robra-Bissantz, 2014).

Figure 16: Literature review on business and IT alignment



Source: The author

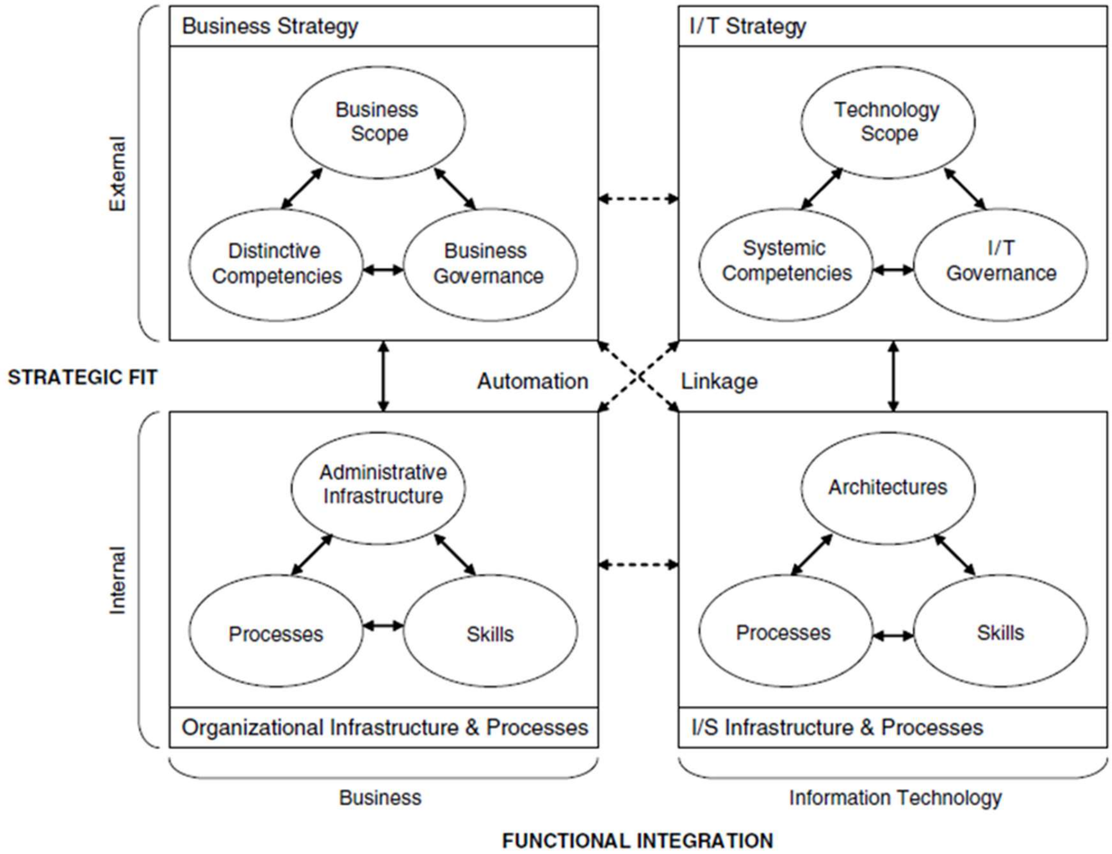
2.4.1 From Traditional to Digital Business-IT Alignment

Conceptually, alignment has been defined variously as the degree of fit and integration between an organization's business strategy, business structure or business processes, and its IT infrastructure (Chan & Reich, 2007; Galliers, 2011; Henderson & Venkatraman, 1993; Karpovsky & Galliers, 2015). The central argument underlying these studies is that organisations perform well when key IT resources are aligned with business strategy and when appropriate structures are used to supervise the deployment and effective management of these resources. A common theme is the argument that alignment leads to a more focused and strategic use of IT and that those organisations that are able to successfully align their business and IT strategies tend to perform better than their competitors (e.g. Coltman et al., 2015; Ilmudeen et al., 2019). Luftman (2004) defined the important role of business-IT alignment as the “application of information technology in an appropriate and timely way, in harmony with business strategies, goals and needs” (p. 3). According to Jonathan et al. (2020), surveys consistantly placed business-IT alignment among the top concerns for IT leaders, it also continues to be ranked as one of the most researched topics in the IT domains.

According to Reinheimer and Robra-Bissantz (2014), the focus of business-IT alignment has shifted over the decades: In the 1970s and 1980s, alignment between business and IT was still a “one-way street” - it was understood as the derivation of an IT strategy from the business strategy, e.g. in the form of IBM's Business Systems Planning (1984). In the 1990s, a search for explanatory models and methods for business-IT alignment followed. Henderson and Venkatraman (1993, 1999) developed the Strategic Alignment Model (Figure 17), which is perhaps the most widely cited of all alignment models and accepted in the alignment community.

Henderson and Venkatraman (1993) described the strategic alignment model (SAM) as the degree of consistency and integration between the organisation’s strategies and its information technology strategies. The SAM model shows four quadrants with three components for each key element in an organisation, and identifies the importance of specifying two types of integration between business and IT domains. The external perspective is dealt with differently from the internal perspective and covers the environment of the business. The strategic integration as the link between the business strategy and the IT strategy reflects the ability of the IT functions to shape and support the corporate strategy. This capability is particularly important as IT was assumed by Henderson and Venkatraman (1993) as an important source of strategic advantage for businesses. The internal domain covers the administrative structure of the organisation, e.g. the link between the organisational infrastructure and processes of the business and the related IT infrastructure and processes, and its delivery capabilities. Additionally, the model differentiates between business and IT, leading to the logic that a change in business strategy creates a change in IT strategy. Moreover, the model defines key issues and management challenges in each domain, namely: scope of the technologies, unique competencies, governance, infrastructure, processes and skills.

Figure 17: Strategic Alignment Model



Source: Henderson & Venkatraman (1993)

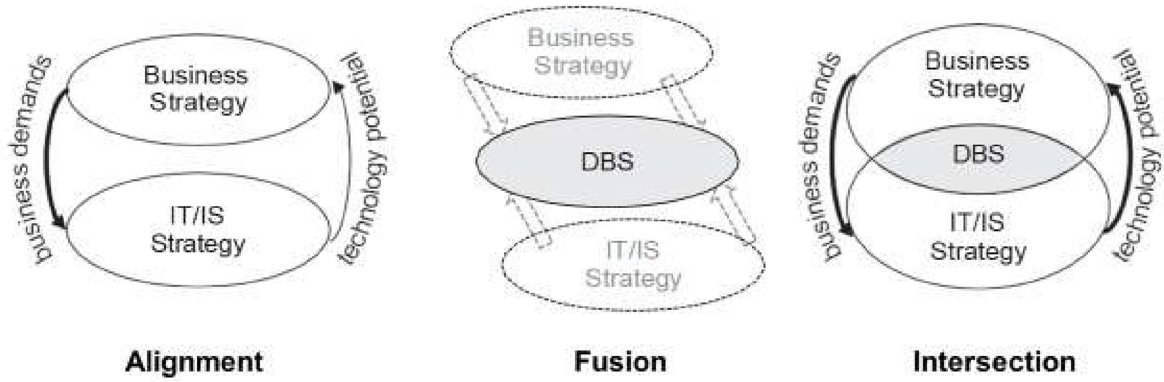
However, other authors (e.g. Coltman et al., 2015) claimed that the alignment construct of Henderson and Venkatraman (1993), with the assumption that alignment emerges from some fit between business and IT strategy, has proven difficult to operationalise and measure. This was reaffirmed by Kotusev (2020, p. 47), who refered to the "hard side of business and IT alignment" and that the way business and IT alignment practically works in organisations has never been studied. This was most clearly articulated by Karpovsky and Galliers (2015, p. 2) who stated that "we know little about what managers and other organizational actors *do* in their day-to-day activities to achieve alignment." They also concluded that a majority of the literature views alignment as a prescribed methodical process following rational decision making. In contrast to the mechanistic process underlying the SAM model, Karpovsky and Galliers (2015) and Magalhaes (2016) considered alignment as any action or activity among actors in an organisation and believed that organisational values, roles, culture, leadership and the relationship among the actors of business and IT is the basis for strategic IT alignment. Thus, IT alignment is not an essential planning issue, but rather a managerial action problem.

Additionally, according to Krcmar (2015), the SAM model of Henderson and Venkatraman (1993) is based on the implicit assumption that a business's IT strategy must be aligned with a single business strategy. However, automotive companies have a large number of different business units (sometimes called "strategic business units"), each of which operates in its own market. In order to adapt optimally to the competitive conditions of these markets, each business unit needs its own business strategy, which is specified within the framework conditions set by the corporate strategy. While the corporate strategy specifies, for example, in which markets the company should operate, the strategies of the business units determine the positioning in these markets.

Turning to digitalisation, authors (e.g. Coltman et al., 2015; Peppard, 2018) have also suggested that the traditional alignment models are the product of a time when IT was less complicated and business was more stable. The major concern has been that most of the models treat IT strategies as subordinate to business strategies (Kahre et al., 2017). It has been argued that the separate view is losing ground for a more integrated approach, where IT is embedded in a digital business strategy. Bharadwaj et al. (2013) have fundamentally questioned traditional IT strategy conceptions. Starting from the premise of a world reconfigured by digital technologies, they say: "Across many firms spanning different industries and sectors, digital technologies […] are fundamentally transforming business strategies, business processes, firm capabilities, products and services, and key interfirm relationships in extended business networks. Accordingly, we argue that the time is right to re-think the role of IT strategy, from that of a functional-level strategy – aligned but essentially always subordinate to business strategy – to one that reflects a fusion between IT strategy and business strategy" (p. 471). They also posted that the IT strategy should not be positioned under a business strategy. Moreover, digitalisation should be treated as the business strategy in itself and IT as an embedded part of this. Additionally, Bharadwaj et al. (2013) identified four key themes to guide the digital business strategy and build a corresponding framework, defined by: "the *scope* of digital business strategy, the *scale* of digital business strategy, the *speed* of digital business strategy, and the *sources* of business value creation and capture in digital business strategy" (p. 471). The scope defining the product and service portfolio illustrates that digital business strategies not only unite corporate and IT strategies but include the entire business ecosystem. In this sense, scaling, i.e., the use of network effects, is becoming more and more important due to the increasing connectivity between partners and competitors. In addition to connectivity, digitalisation also leads to a higher speed of business activities. Finally, the sources of value creation are expanded as digital technologies enable new business models that extend traditional supply chains.

Teubner and Stockhinger (2020) were concerned because the fusion perspective (middle of Figure 18) rejects the idea of a conceptual distinction between corporate business strategy and IT strategies.

Figure 18: DBS between the poles of business and IT strategy



Source: Teubner & Stockhinger (2020)

This perspective could come at the price of making obsolete traditional alignment research and the well-established knowledge base developed so far. Therefore, they suggested considering digital business strategy as an intersection of both strategies (Figure 18, right). The intersection is where digital technologies are directly and deeply integrated into value creation and do not just play a supporting role. This is the case when the digital technology is the central production technology or part of the product; for example, with purely digital products and services (Hess et al., 2020) as well as with smart, networked products where the digital technology is embedded in physical products.

2.4.2 Reassessment of IT Sourcing in the German Automotive Industry

Urbach and Ahlemann (2016) stated that digitalisation will lead to greater dependence on external partners than ever before. Their assumption is that, despite the challenges posed by digital transformation, businesses tend to solve this by outsourcing. They argued that the trend towards cloud sourcing, which is experiencing strong growth, is leading to a further gradual reduction in the depth of IT value creation concurrent with the outsourcing of activities. This applies to almost all parts of the software and hardware - from the infrastructure to platforms to applications. Additionally, Boes et al. (2019) argued that digital information technologies such as Artificial Intelligence and Internet of Things up to Big Data and new platform strategies are based in one way or another on cloud concepts. When disruptive innovations of business models, production models and the organisation of work are being considered, cloud concepts seem to be an important base.

Könning et al. (2018) raised the issue of an increasing popularity of multi-sourcing. In their analysis they confirmed that outsourcing of information technology has led to numerous potential benefits such as cost reduction, access to external expertise and improvements in efficiency, flexibility and quality. However, it also exposes companies to various risks, such as vendor lock-in, lack of agility or insufficient vendor expertise in individual areas, especially in an increasingly dynamic business environment. As a result, businesses align their IT sourcing strategies by adopting a multi-sourcing approach with a larger number of smaller but highly specialised suppliers, i.e., by forming a "best of breed" set of suppliers for their various IT services.

Moreover, the main reason for this strategy has been addressed by Urbach and Ahlemann (2017). Digitalisation requires skills and competencies that are not yet available in many businesses. These could be developed in-house, but that takes time, which is not available in the automotive industry. Digital technologies such as the use of massively scalable cloud infrastructures, big data, predictive data analytics, IIoT, Smart Factories or machine learning require know-how that is often only available from specialised technology providers that have to function as digital accelerators. In spite of the above declarations, Kahl et al. (2017) addressed three different IT sourcing strategies as most promising, concluding the objective of cost reduction can best be achieved with the strategy "single-vendor," while the "best-of-breed" solutions are most suitable to improve the quality of services. An increase in customer satisfaction is most satisfactorily achieved with the strategy "competition."

Gerster and Dremel (2019) addressed the conflict between flexibility and long-lasting contracts with providers. Digital innovations need to be launched in an ever-shorter time frame in response to the high market dynamics of the automotive industry (Gerster & Dremel, 2019). Strict and long-term contracts contradict the need to increase speed and flexibility. As a result, businesses are reviewing their IT sourcing strategies to reflect agile supply, shorten the tender duration and increase contract flexibility for large-scale IT projects. Crowley and Veling (2018) also emphasised that the organisation should negotiate contracts to ensure agile sourcing and the transition to/from switching between suppliers. To avoid high transaction costs, precautions must be taken to allow flexible adjustments to the constantly changing outsourcing landscape (Olzmann & Wynn, 2012).

In contrast to the discussion above and with regard to another trend towards outsourcing as part of the digital transformation, the Harvey Nash and KPMG survey (2018 and 2019) of nearly 4,000 IT leaders comes to a different conclusion. By contrast, the survey confirmed that businesses have long pursued an outsourcing approach to reduce costs, but that the intention behind IT outsourcing has now shifted from cost savings to access to skills that are not available in-house. They also stated "this is the first time we have seen a divergence between technology spend growth and outsourcing spend growth in the last decade, suggesting that many organisations are choosing to keep, or bring back, technology in-house. As organisations drive their digital strategies, many are seeing value in keeping business-critical or innovation-led activities close to home" (Harvey Nash & KPMG, 2018, p. 46). This indicates companies are increasingly disinclined to raise spending on outsourcing.

However, the academic literature discusses a range of reasons why the German automotive industry has to acquire external knowledge in different ways to open up market access, gain speed, reduce development risks and to capture the potentials of digital innovations, which are an integral part of the digital transformation of the physical automotive industry (Gambal et al., 2022). Urbach and Ahlemann (2017) highlighted two factors that support the case for joint innovation activities with selected partners. Businesses that want to develop new products and services on the basis of these technologies are faced with the problem that the internal build-up of corresponding knowledge and skills is risky and time-consuming. The risk lies in the shortage of necessary expertise, whose availability cannot be ensured. Often the necessary technical experts are not available and cannot be easily recruited by a company (Gambal et al., 2022). Additionally, it is time-consuming because research and development activities often require several years. For this reason, businesses are looking for other ways to access the necessary skills.

Since acquiring specialised tech-firms is not a suitable option in many cases, cooperation models are particularly worth considering (Fernandes et al., 2022). In a partnership, both businesses can contribute their individual know-how and jointly realise innovations. Non-IT companies usually provide market access and a deeper understanding of customers and product ideas, whereas technology companies contribute the skills to implement appropriate digital solutions. Urbach and Ahlemann (2016) added that such partnerships can also have a network character, so that more than two companies can be involved in the realisation of an innovative idea. Companies with limited investment opportunities often choose such an approach, which can also be supported with public funds under certain conditions. In line with this, Cacilo and Haag (2018) and Paunov and Planes-Satorra (2019) highlighted that a main driving force is closing skills or competency gaps and conclude that the transfer of IT competencies, in the context of digitalisation in particular, will become a core task of future partnerships between companies from a wide range of sectors. Winkelhake (2017) explained that beyond traditional IT sourcing, strategic partnerships are an important instrument to increase the availability of digital information technologies, to secure access to certain technologies and to influence the direction of technological innovations in accordance with a manufacturer’s strategies. However, Vial (2021) argued that firms have no choice but to source external capabilities and rely on multiple partners because the value networks on which firms operate are becoming larger and more complex. The integration of digital technologies provided by multiple parties is a crucial piece of the puzzle that enables a company to successfully participate in a digital platform or ecosystem.

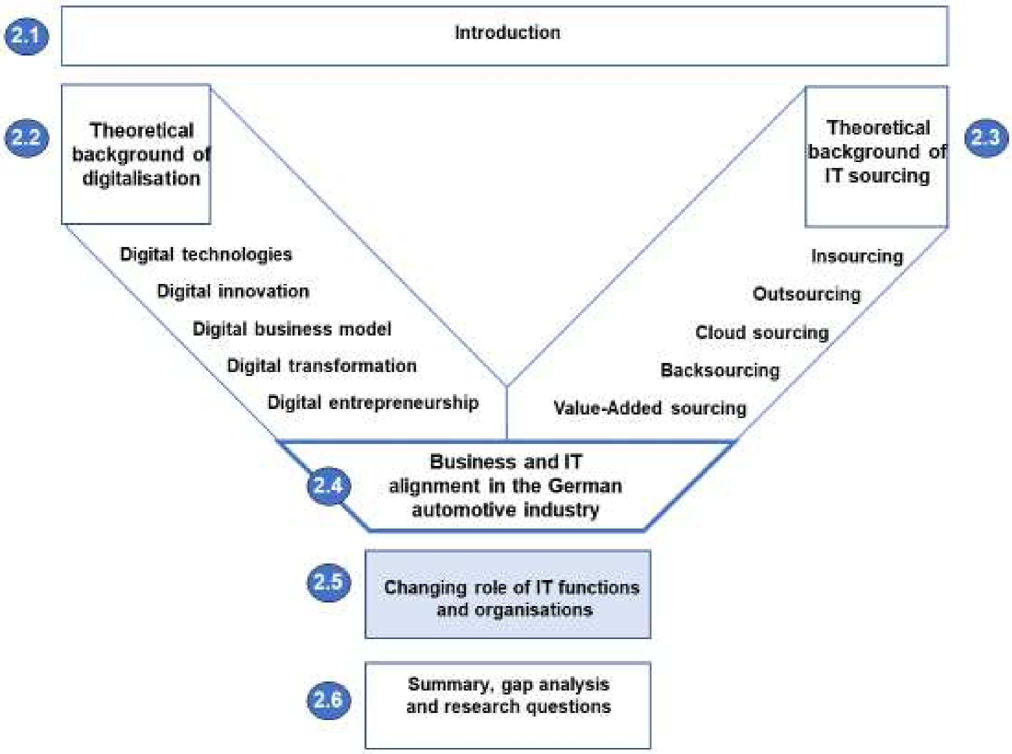
Hence, a priority for the automotive industry will be meeting the challenge of successfully partnering with digital technology companies for digital innovations, such as developing the car operating systems or creating platforms and ecosystems for mobility services. Partnerships with direct competitors within the industry or across industries are also gaining momentum (Bosler et al., 2018). Moreover, partnerships also address the vital question for car manufacturers of which players may use certain data. Holland (2018) stated the crucial aspect of the new value network and partnerships is to find out who will own the customer interface and the data, and hence be able to own the business model. In consequence, OEMs need to become software-controlled to capture the potential of digital innovations. OEMs attach great importance to always remaining the uppermost controlling authority and not losing sight of the decisive route between the automobile and the platform (Bosler et al., 2018).

However, Winkelhake (2017) believes that car manufacturers have yet to learn this kind of partnership in the new environment of digitalisation. In the past, IT sourcing was decided too much on the basis of cost considerations. This approach has led to very heterogeneous IT landscapes with different technologies and a high number of vendor relationships. Because IT is becoming a core element of vehicles, a re-thinking process has to start: partnerships need to be entered into for strategic reasons and not exclusively based on purchase prices.

2.5 Changing Role of IT Organisations through Digital Transformation

Many researchers, such as Chalons and Dufft (2016), Gerster and Dremel (2019), Schwarz (2018), and Stockhinger and Teubner (2019) have addressed important requirements, opportunities and challenges for IT sourcing in the digital age. Crowley et al. (2017) stated that new sourcing models require shifts in behavioural and managerial types. The management of relationships, for example, within value-added sourcing becomes a new dimension and requires new management capabilities. However, the management of IT sourcing is usually seen as a function and responsibility of a central IT organisation, also known as Corporate IT and led by a Chief Information Officer (CIO). Consequently, any consideration of the future organisation of IT sourcing management depends significantly on the overarching tendencies for the positioning of future Corporate IT and the CIO within the companies. Therefore, this section also reviews some of the discussion in the literature on the future of corporate IT organisations and the CIO in the context of digital transformation (Figure 19).

Figure 19: Literature review on changing roles of IT organisations

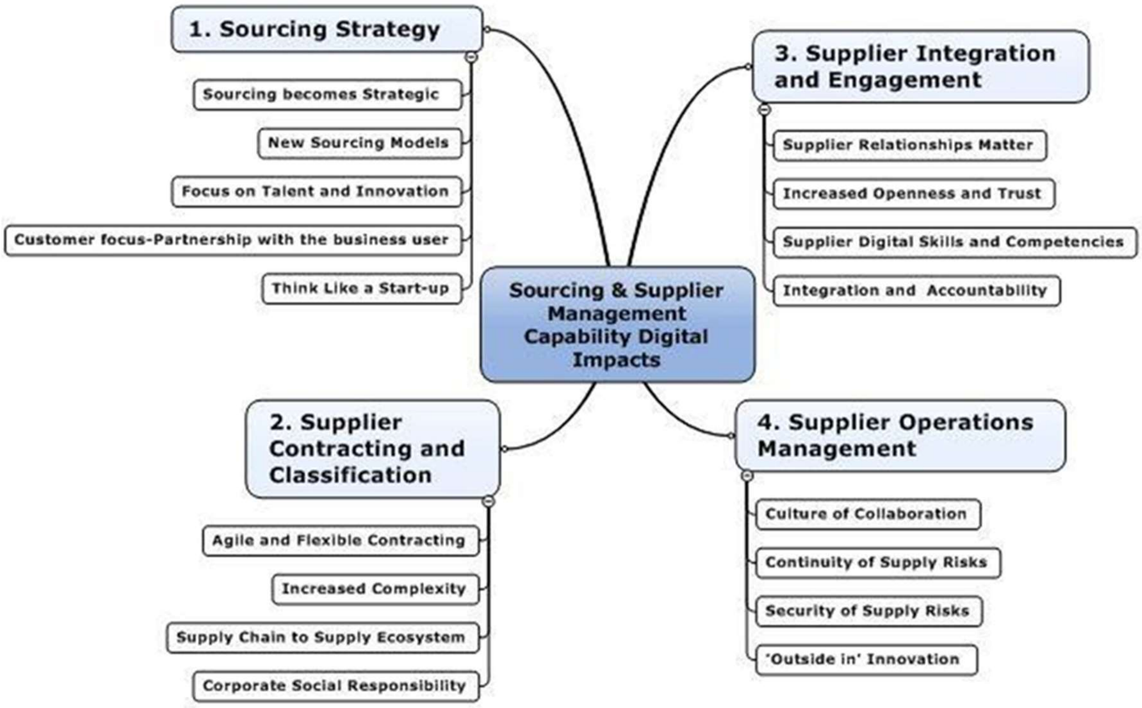


Source: The author

2.5.1 Future IT Sourcing and Supplier Management

According to Crowley et al. (2017, p. 8), basic capabilities for IT sourcing and supplier management are required as a "backbone before the challenges of the digital business context can be addressed and opportunities arising exploited." This "backbone" is represented by the four elements of "Sourcing Strategy", "Supplier Contracting and Classification", "Supplier Integration and Engagement" and "Supplier Operations Management" (Figure 20) and is summarised (in a simplified way) as follows: Establishing a sourcing strategy that is aligned with the more strategic role of sourcing in the digital context, taking into account important issues such as the development and applicability of different sourcing models and the viability of sourcing as an option to address internal skills gaps and to jointly innovate through collaborative relationships with a network of sourcing partners. This requires organisations to set effective criteria for classifying suppliers and an approach to managing the increasing complexity of sourcing contracts, and to take into account aspects such as corporate social responsibility and building agility and flexibility into the contracting process. They also need to integrate and engage suppliers to foster mutually beneficial and lasting relationships built on the foundations of openness, trust and accountability, and manage day-to-day supplier operations, taking into account risks to security and continuity of supply and institutionalising a process of 'outside-in' innovation through a culture of collaboration with partners.

Figure 20: Sourcing & supplier management capabilities



Source: Crowley et al. (2017)

However, Stockhinger and Teubner (2019) concluded that new expectations place the traditional IT organisation in a dilemma. From their perspective, the indicated key requirements are agility and adaptability, faster access to pools of digital expertise and know-how, practices for increasing speed in the provision of the required technologies and implementation of digital projects before competitors and tech players move ahead, higher flexibility in the provision of IT services and high scalability of IT infrastructure, while continuing to be under pressure to reduce costs. Particular emphasis is placed on agility as an essential success factor. At the same time, a reliable IT operation and system stability has to be guaranteed for the current mode of operation, and existing relationships with IT service providers have to be managed for existing systems. For the balancing of these two opposing demands, Chalons and Dufft (2016) and Kahl et al. (2017) recommended a two-speed-IT: An IT organisation tuned to stability and efficiency for the existing systems and an IT organisation tailored to innovation and speed for the new digital technologies.

Meanwhile, researchers such as Haffke et al. (2017) and Jöhnk et al. (2017) have already proposed organisational steps to bridge the gap between "keeping the lights on" (Haffke et al., 2017, p. 103) and striving for innovation and agility. With reference to the term "biomodal IT", a duality of IT was proposed: the traditional, classic and stable mode as well as a faster and more experimental mode. Depending on the mission of IT, the functions have different characteristics and need corresponding IT and sourcing strategies. For the latter, the objective is not to develop the optimal system for the next ten years, but to implement an idea as quickly as possible and to optimise it in a continuous learning process. Therefore, speed, reactivity and flexibility are the key words. In addition, many companies have founded so-called innovation labs, digital factories or technology accelerators in recent years, in order to keep pace with the increased requirements of digitalisation (Kahl et al., 2017). However, Chalons and Dufft (2016) also pointed out that system integration - at least in part - must take place at an early stage in order to avoid the emergence of new, isolated applications.

2.5.2 The Future of Corporate IT

The roles, tasks and competencies of Corporate IT, and specifically of the CIO, have been discussed in the academic literature for decades, particularly with regard to how they have changed over time (Liebe, 2020). The literature discusses the role of a CIO in various ways, such as technical expert, technology provider, facilitator, strategic partner of the business, innovator, enabler, integrator or architect. Ulrich and Lehmann (2018) generally understand roles in this context as the expectations of a role holder held by other people; for example, an IT manager. A role thus consists of rights and duties and reflects a certain hierarchical position. In the corporate context, the fulfilment of a role is associated with certain tasks, goals and responsibilities. In order to create optimal conditions for the fulfilment of role expectations and to avoid conflicts, tasks and objectives should be unambiguous and explicitly formulated and should not contradict each other.

Based on a systematic literature review, Liebe (2020) concluded that the CIO has finally become a member of the top management team and is the top IT manager in a company. In this role, the CIO is responsible for developing the IT strategy, building and maintaining the IT architecture and ensuring the smooth operation of all IT systems. However, there are still many ambiguities about the role. According to Gerth and Peppard (2020), the variety of CIO roles is one of the main reasons why companies struggle with digital transformation and additional organisations and positions emerged as a result. Liebe (2020) also admitted that the CIO position is still not clearly defined and clarified that management expectations regarding the CIO vary. In the context of digital transformation, the tasks of employees and managers are changing and with them the requirements regarding their competencies and skills. In order to cope with digital transformation, companies employ different approaches. Some companies have expanded their top management to include the position of Chief Digital Officer (CDO) or Chief Technology Officer (CTO). Other companies bundle these tasks with the CIO. However, these new management positions are not without controversy, and critical views in the literature point out that there is too much overlap.

The literature consistently points out that the role of the IT organisation and the CIO in the company should be re-defined. Authors such as Ahlemann and Urbach (2016), Alt et al. (2020), Châlons and Dufft (2016), Koch et al. (2016), Schröder and Müller (2017), Urbach and Ahlemann (2016), and Urbach and Ahlemann (2017) have addressed digitalisation-driven aspects of the design of a future IT organisation.

Ahlemann and Urbach (2016) and Urbach and Ahlemann (2016) concluded that digital transformation would lead to fundamental changes in respect of organisation, processes, personnel and culture. The authors formulated a number of hypotheses regarding the possible future of Corporate IT but were not able to specify exactly how this would develop in practice.

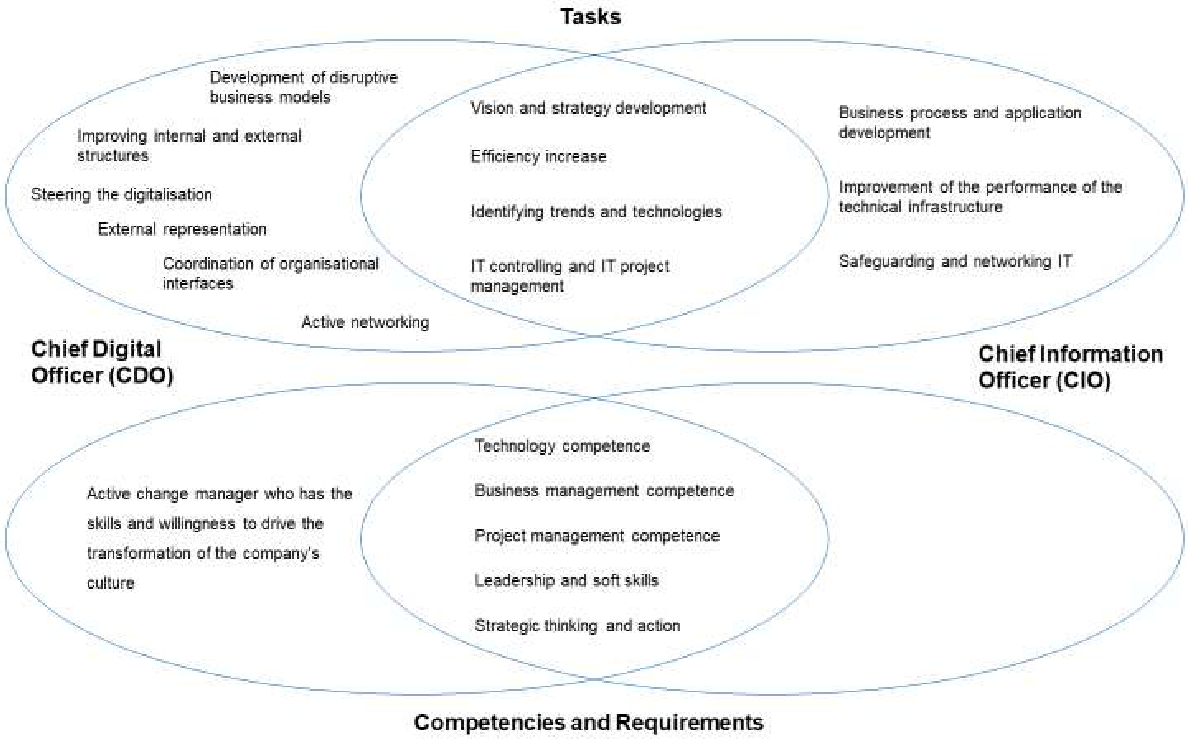
Kopper et al. (2018) explained the term “shadow IT” which is any software (incl. software-/platform/-infrastructure-as-a-service), hardware or IT service process used autonomously by the business functions of users and/or developed by them without involving the company's Corporate IT organisation. The assumption is that businesses often do not know the exact extent of shadow IT in their company. Due to the negative connotation of the term, the authors emphasised the term "business-driven IT." Shadow IT is justified by the fact that companies are often forced to reduce costs or quickly establish innovative solutions, to which information technology has to contribute. Despite the loss of transparency and control of Corporate IT over shadow IT and the associated negative connotation of the term, shadow IT is also a driver for user-driven innovations and process improvements (Brenner et al., 2011). However, if the Corporate IT organisation does not react quickly enough or repeatedly rejects requests from departments for capacity reasons or security concerns, the business takes the initiative themselves. The increase in shadow IT is also due to the fact that more and more technically skilled employees are able to procure or develop IT solutions themselves (Ahlemann & Urbach, 2016). The barriers to this are becoming lower and lower due to easily accessible cloud services and user-friendly development environments (Kopper et al., 2018).

Schröder and Müller (2017) understood the term "IT organisation" holistically. The subject matter is the tasks associated with the use of IT, which are assigned to specific task holders - regardless of whether the task holders are located in the business area, the IT department or with external partners, and regardless of whether the IT is in the product, in customer interaction or in internal processes. However, in practice, the term IT organisation refers to a corporate IT function led by a CIO as the most senior IT manager of a company. The management of IT sourcing is traditionally considered part of corporate IT. They develop scenarios for designing a future-proof IT organisation that aims at a company-specific allocation of tasks between the IT organisation, the business areas and external partners, that is adapted to the needs of cloud computing.

Studies by Singh and Hess (2020), Teubner and Ehnes (2018) and Stockhinger and Teubner (2019) revealed emerging roles for digital innovation such as Chief Technology officer (CTO), Chief Digital officer (CDO), Chief Data Officer etc., which will be part of the business organisation and will challenge the traditional role of corporate IT functions. Companies have created the role of Chief Digital Officer to bundle the responsibilities for digital transformation. According to a study by the Berlin University of Applied Sciences (HTW), many industrial companies had already created a CDO or an equivalent position in 2017 (Computerwoche, 2017; CIO, 2019). The CDO primarily focuses on the business, the markets, the products and the digital innovation of a company, driving the digital mobilisation of the company, developing its digital transformation strategies and initiating innovation projects (Sing et al., 2017).

Walchshofer and Riedl (2017) stated that the CDO is responsible for strategic aspects, while the CIO is often responsible for organisational and technical aspects, and conclude that many CIOs do not (primarily) operate at the strategic level. Besides, their research demonstrates that there are significant intersections or overlaps in both their tasks and competencies / requirements (Figure 21). Therefore, they considered that the CDO's tasks might only be temporary. When companies have completed digital transformation and digitalisation has permeated all areas of the company, the tasks that distinguish the CDO from the CIO would essentially be obsolete. However, opinions on the new position of the CDO differ widely in the academic literature. From one perspective, a strong increase in the importance of the CDO and the replacement of the CIO is predicted. By contrast, the function of the CDO is questioned, especially among practitioners.

Figure 21: Differences and similarities between CDO / CIO



Source: Walchshofer & Riedl (2017)

According to Zeichardt (2018), the CIO acts as the “master of systems", while the CDO as the "master of business" and is in charge of the digitalisation of the business model. Additionally, IT is traditionally structurally anchored in the core processes. However, digital innovations are increasingly being developed in new digital units. In these, the working and other conditions are completely different; for example, the digital way of thinking can be lived and implemented more effectively than in the traditional core processes. Singh et al. (2017) defined the role of the CIO as a strategic IT specialist and the role of the CDO as a digital transformation specialist. They argue that the role of the CDO is always particularly appropriate when both the pressure to innovate and the complexity of an organisation (for example, due to strong decentralisation, resulting in many brands and divisions) are particularly high. Where IT-based innovations go beyond changing internal processes, a CDO is increasingly employed to support the leading CEO.

Bergmann (2019) claimed “the IT department in the classical form is an obsolete model” (p. 370). Among other findings, the author referred to a study by Forrester (Behenna et al., 2014) which revealed that the majority of business managers were of the opinion that their own IT department was hindering the success of their company. This resulted in a communication gap between corporate IT and the business departments. In principle, IT is generally given a lot of credit, but only with external support. There is a great willingness by business managers to search outside the company for strategic technology solutions and support, leading to pronounced shadow ITs. It was concluded that business areas could make better and faster decisions without the involvement of their own IT organisation. Consequently, according to Bergmann (2019), it was empirically proven for the first time in 2014 that the majority of IT budgets are the responsibility of departments. In the meantime, this has become the norm. The IT department is being pushed back by its own companies, becoming increasingly irrelevant in its role as a technical service provider, until it is likely to disappear due to the increasing availability of clouds. The critical attitude towards the value contribution of the IT organisation can be be reinforced by the increased self-confidence of the departments. They will talk to external providers about their business and not about technology, and they increasingly make business-driven IT-related decisions without their own IT and purchase services from external providers as a natural course of action. The ever-expanding world of cloud providers is eroding the exclusivity of in-house IT.

Alt et al. (2020, p. 10) raised the question “who actually leads IT in a digitalised company?” They concluded by validated statistical procedures that the corporate business strategy, which incorporates IT-related resources, is exclusively influenced by business leaders, meaning the CIO exerts little influence on the design of the digital business strategy. Alt et al. (2020) also underlined that the increasing relevance of IT for the entire company would shift the strategic responsibility for IT from the CIO to the business executives. The most senior business executive is thus tasked with recognising the importance of IT for the company and integrating this paradigm into a digital business strategy in order to enact and establish a top-down policy for the digitalisation of the company. The "digitalisation" of business strategies will lead to a disempowerment of the CIO in strategic matters, triggered by the rise of IT to the core of business processes, business models and entire companies, which influences the organisational structures around IT.

2.6 Summary, Gap Analysis and Research Questions

This chapter has reviewed the literature related to a variety of aspects concerning megatrends, digitalisation, IT sourcing and digital entrepreneurship. However, the review raises fundamental questions about evolving IT sourcing strategies in the German automotive industry, which are not answered in the existing academic literature, or lack sufficient supporting evidence to formulate convincing responses. The main weaknesses of the existing literature relate to the following key aspects.

For decades, the German automotive industry has pursued a product-centric business model consisting of highly complex and automated processes and comprising the design and development of vehicles, logistics and production, sales and distribution as well as after-sales activities. The intensity of the use of IT in daily business is so significant that the industry depends on reliable and comprehensive IT applications and operations and cannot exist without IT. IT applications now represent the entire knowledge of high-tech processes and state-of-the-art technologies in the automotive industry, which has been developed since the automobile was invented. Consequently, IT contributes to the competitiveness of the technology-affine automotive industry (Schwarz, 2018). However, at the same time, the vertical range of integration / depth of IT services for the traditional processes of the automotive industry is low. In-house provision of IT services is generally between 20 and 30 per cent of the overall IT budget. IT sourcing is based on case-by-case decisions, which has led to a multi-provider approach with a combination of big and small, but highly specialised providers, forming a best-of-breed set for the various IT services. In particular, the software components for car IT are purchased from suppliers (Winkelhake, 2017). Although digitalisation is not entirely new for this industry, the literature lacks sufficient evidence as to which digital technologies are most important for the digital transformation of the automotive industry and which technologies are considered as disruptive (leading to radical change) or only evolutionary (a continuation in the development of existing IT technologies).

Digitalisation in the German automotive industry has resulted in new technological environments that will determine the future business of the automotive industry: digital processes and automation, Car-IT and platforms / ecosystems (Felser & Wynn, 2020b). The development of digital innovations and IT solutions required for these areas goes far beyond the traditionally existing strengths and competencies of the automotive industry. Businesses have to decide how to re-position their core competencies within the transition from product-centric business models to a software-enabled car company and mobility service provider. The literature review revealed that a considerable amount of research has been done concerning digitalisation in the automotive industry, around connected cars, platforms and ecosystems as well as digital transformation. However, the existing literature provides little insight into the implications for future IT sourcing strategies and to what extent the vertical range of integration will change within the different technological environments. Additionally, the literature provides very little information on which digital technologies the IT core competencies will be re-defined, and whether a higher in-house provision of innovative digital technologies should be an aim. Moreover, the literature does not provide a consistent perspective on whether intelligent IT sourcing is considered a source of sustainable competitive advantage, i.e., a company's unique market position that enables it to generate returns above the industry average.

The literature review has also highlighted that there is growing interest from researchers in digital innovation and digital entrepreneurship. The underlying assumption is that traditional technologies differ fundamentally from digital technologies and the latter is more than just another enhancement of existing technologies (Nambisan & Baron, 2019). Existing literature addresses the characteristics of digital entrepreneurs, how digital technologies enable entrepreneurship and innovation and, in turn, digital technology as an outcome of entrepreneurial activities (e.g. Recker & Von Briel, 2019). The focus is mainly on new ventures such as digital start-ups as well as questions of financing start-ups and their market entry. Consequently, there is a dearth of literature on a different area is corporate entrepreneurship within already established companies with a long history of corporate culture. In this context, the literature points, for example, to the introduction of emerging management roles for digital innovation in general and lacks knowledge on how digital entrepreneurship is becoming a significant new competency in making IT sourcing decisions in the German automotive industry.

In this context, the review revealed that the industry will be challenged to partner with world-leading internet and digital technology players. However, value-added sourcing with tech players as an alternative to insourcing and outsourcing requires new entrepreneurial skills to manage relationships rather than power play and dictating prices, as in traditional outsourcing processes. Hence, the automotive industry has yet to learn this kind of partnership in the new environment of digitalisation (Winkelhake, 2017). The literature lacks evidence concerning the biggest challenges for digital entrepreneurship to successfully support these evolving IT sourcing strategies and how IT has to organise and to manage these advanced forms of IT sourcing in order to achieve competitive advantages that cannot be achieved individually.

The literature consistently points out that the role of the corporate IT organisation in the company should be re-defined. Hypotheses, scenarios, models and frameworks have been developed to support this assumption. In this context, the literature also discusses the role of a corporate CIO in various guises, such as technical expert, technology provider, facilitator, strategic partner of the business, innovator, enabler, integrator or architect. In this context, the traditional business-IT alignment has been also questioned as not suitable for digitalisation. One of the main assumptions behind a new consolidated digital business strategy is a shift of corporate IT competencies to business lines. However, the literature lacks sufficient evidence from practice concerning the extent to which this takes place and the important factors and risks involved.

Finally, researchers have developed various frameworks for operational guidance for practitioners, such as process models for IT outsourcing (e.g. Brautsch & Wynn, 2013), switching vendors (Olzmann & Wynn, 2012), re-integration of knowledge (e.g. Nujen et al., 2015), risk management in IT outsourcing as well as criteria for make-or-buy decisions (e.g.

Krcmar, 2015). However, the review has revealed that neither a blueprint nor a holistic guidance for practitioners exists to support automotive industry practitioners in the re-organisation of the overall IT functions, creating a suitable business-IT alignment, developing new IT sourcing strategies and managing the transition necessitated by digitalisation.

Therefore, and in line with the research objectives of this study as well as in light of the review of existing literature and knowledge above, the following research questions have been formulated to be answered by this study.

- RQ1: To what extent has digitalisation influenced the German automotive industry's strategy regarding IT sourcing?
- RQ2: What are the new entrepreneurial competencies for the successful transitioning to new IT sourcing strategies in the German automotive industry?
- RQ3: What blueprint can be developed to aid practitioners in the German automotive industry in the re-assessment of IT sourcing?

To the best of the author's knowledge and belief, this study is the first to research and analyse the influence of digitalisation on IT sourcing within an entire industry that has a leading role in the German economy.

3 Conceptual Framework (for German Automotive Industry Research)

3.1 Introduction

After exploring the relevant literature, this chapter establishes a conceptual framework and explains relationships between contextual factors which, consequently, lead to evolving IT sourcing strategies in the German automotive industry. The conceptual framework also provides the primary guidance and logic to support the qualitative data collection with the respective areas of discussion within a case study. Miles et al. (2018) described a conceptual framework as an important aspect for showing a researcher's fundamental ideas about their research project. The term refers to a system of concepts and assumptions and also includes the actual ideas and beliefs a researcher holds about the phenomena studied.

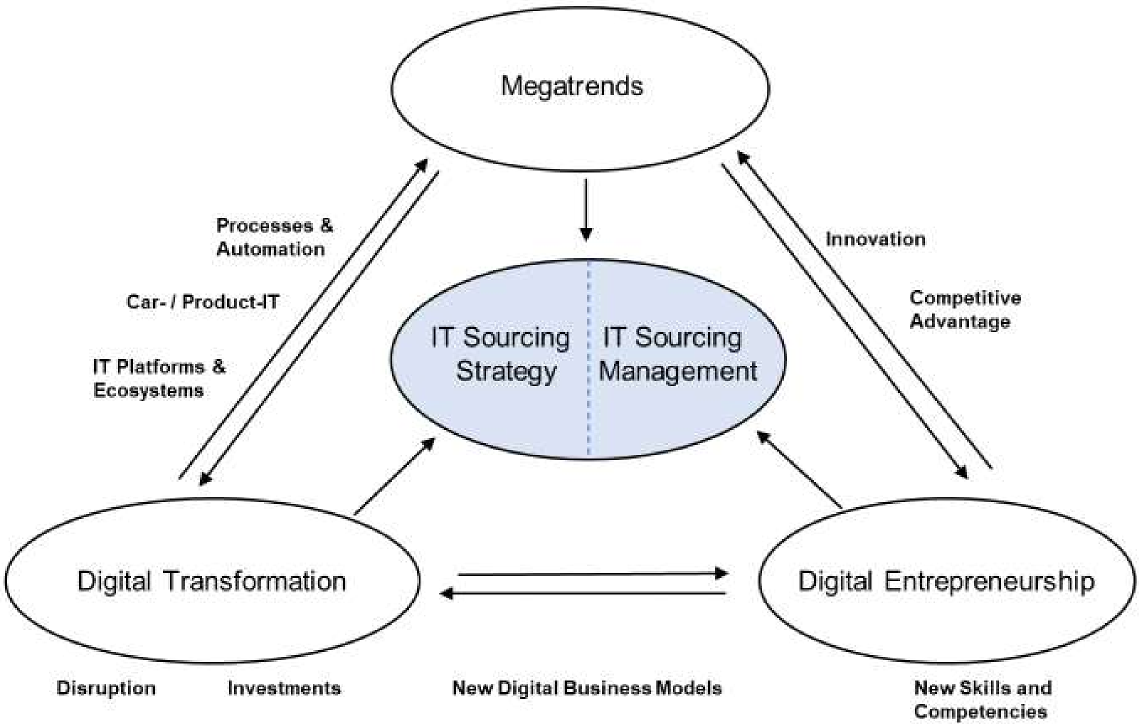
Maxwell (2005) considered a conceptual framework to be an essential part of the research project's design, addressing what is out there to be studied, what is going on and why. The author viewed the conceptual framework as the researcher's map for conducting the research, something that is *constructed* or *built* by the researcher and not exclusively the outcome of the literature review. Maxwell thus refuted the traditional view that the researcher's own experience should be eliminated from the design and argued in favour of the explicit incorporation of the researcher's own identity and experience. This view has gained wide support in the literature. Qualitative researchers have recognised that "the researcher *is* the instrument of the research" (Maxwell, 2005, p. 38). Blaikie and Priest (2017) supported this view and argued that the elimination of the researcher's experiences "is just not possible" (p. 17) and would cut off major sources of insights or validity checks.

There are various frameworks, models and tools developed by researchers to assess IT sourcing. However, the literature review revealed that there is no suitable framework that demonstrates the link between relevant contextual factors, nor which explains the main lines of interaction between the four elements - megatrends, digital transformation strategy, digital entrepreneurship and IT sourcing strategy - in the concrete case of the German automotive industry. In light of this, the developed conceptual framework is underpinned by an understanding that IT sourcing is not an end in itself, but the consequence of other strategic business decisions that need to be considered in context to understand why, where and how IT sourcing strategies evolve and how they need to be managed.

3.2 Conceptual Framework Development

The conceptual framework for research of the German automotive industry reflects presumed interactions between contextual factors and groups all relevant themes around the four elements mentioned above to capture the research objectives and questions (Figure 22). Additional sub-elements resulting from the literature review have been grouped under the corresponding main elements.

Figure 22: Conceptual framework for research of the German automotive industry



Source: The author

Megatrends and C.A.S.E. in the German automotive industry are coupled with digitalisation, decarbonisation and electrification. However, there is an increasing overlap between these phenomena as decarbonisation and electrification will also accelerate further digitalisation.

Therefore, in an abstract form, megatrends and C.A.S.E. can be considered directly under the term digitalisation.

The German automotive industry has been at the forefront of technological innovation for decades, but the established companies are facing competition from powerful digital players with proven business models and superior digital capabilities. Therefore, digitalisation requires technological innovations with important strategic implications for the individual German automotive companies, but also affecting the entire industry. According to Porter (1985), technological innovations in high-technology industries are one of the principal drivers of competition. In this context, the megatrends and C.A.S.E represent the forces driving industry competition.

Digitalisation is expected to offer transformational solutions to design, develop, produce and sell cars and mobility services, enabled by digital technologies, and will change the nature of the industry through the combination of vehicles, computers and the internet. The following three technology environments are equally affected:

- With regard to digital processes and automation (encompassing traditional corporate IT), automotive companies have already launched, for example, initiatives for the digital factory as part of Industry 4.0. The new challenges, however, are to digitally map the entire value creation chain, which is a prerequisite, for example, for recording emissions during production and ideally throughout the entire life cycle of a vehicle. Industrial AI, team robotics, advanced analytics and autonomous intralogistics systems to further optimise manufacturing performance and high asset utilisation will be required.

- Car IT, combined with cloud solutions and big data analytics, is enabling vehicles to become more connected, electrified and capable of driving autonomously. The biggest challenge is the development of an AI-based car operating system for automated driving and the corresponding middleware for the operating system software to communicate with the individual hardware functions.

- The connected car, equipped with digital communication technologies, is able to collect huge amounts of data that are still largely untapped today, such as road conditions or traffic situations, which can be monetised by the German automotive industry for profitable cloud-based platforms and ecosystems for mobility services.

As a next step, automotive companies must respond to the new opportunities and also risks arising from digitalisation by introducing company-wide digital transformation strategies and focussing on key digital capabilities that drive digitalisation. This systematically addresses the development steps towards new value creation models, including the redefinition of brands as well as the initiation of organisational and cultural change. Digitalisation can also lead to disruption or evolution of existing business models, which may require new digital business models with the expectation of ensuring the firm's unique market position in the future, along with sustainable growth and long-term benefits.

In this way, the strategies must deliver all business-specific transformation efforts and serve as a central portfolio to coordinate, prioritise, and implement the cases for action in the different technology environments. The digital transformation of the industry is expected to lead to a major reorganisation of business structures. Instead of combustion engines, automotive companies now increasingly need battery and semiconductor factories. Instead of engine power, brands will be distinguished by software for connectivity functions and driving range. This is likely to require significant new investment in the German automotive industry, provided through innovative funding sources.

Digital transformation strategies, together with the resulting new digital business models also require a transformation of the business capabilities. Finding the best digital resources and talent requires a new ecosystem with IT providers and the creation of new partnerships. At the same time, cloud sourcing allows certain IT services to be obtained more economically from the market. These considerations are the catalyst for a review of existing IT sourcing strategies. IT sourcing strategies have to respond to the cases for action resulting from digital transformation strategies, as each individual case with its specific digital information technologies requires different core competencies and resources, which must be made available via the respective IT sourcing concepts. Moreover, it is assumed that a digital business strategy with a merged IT strategy will be pursued and that IT strategy is no longer subordinate to business strategy. IT has become an essential part of automotive products and IT is more than ever directly and deeply involved in the value creation process of the automotive industry. Consequently, in the alignment of business and IT, the previous classic "waterfall principle" with the maxim that IT follows the business, is abandoned. The future of the German automotive industry can be summed up in the phrase: business is IT.

In this context, strategic decisions regarding new competencies and skilled resources are necessary, which must be acquired via appropriate sourcing channels. These considerations will influence the future ratio of insourcing (in-house provision of IT services) to outsourcing and also reflect where and how IT needs to be positioned or re-positioned as a core or non-core competency. Thus, it is assumed that IT sourcing is responsible for acquiring the relevant capabilities to successfully shape the necessary digital transformation of the company.

Digital entrepreneurship emerges as an additional significant new competency in managing the increasing complexity of IT sourcing decisions in the three technology environments of the German automotive industry. Innovative automotive companies have to consider how technological developments go beyond traditional existing strengths of the company and, in response, they will need to develop and implement gap-closing strategies. In particular new partners, combined with knowledge sharing in the emerging IT sourcing ecosystem, require a different understanding of how to manage relationships. Especially in the area of car IT, there is a great need for mutual coordination between the partners to ensure that their respective software packages can communicate with each other. IT sourcing management must be equipped with entrepreneurial capabilities to efficiently orchestrate new ecosystems of IT sourcing. Therefore, it is also assumed that IT sourcing management must take on new roles and acquire new competencies to enable and support innovation and digital transformation. Thus, by aligning the IT sourcing strategy with the new (digital-driven) business strategies, IT sourcing contributes to the competitiveness of the business and becomes, in turn, an enabler of new digitalisation initiatives.

3.3 Summary

This chapter proposed a conceptual framework for studying evolving IT sourcing strategies in the German automotive industry and developing a blueprint for transition. The conceptual framework emphasises the importance of analysing the contextual factors that lead to strategic decisions in German automotive businesses and the corresponding digital transformation strategies. This, in turn, influences evolving IT sourcing strategies and requires transformational entrepreneurship in IT sourcing management. The conceptual model presented will provide the researcher with a better understanding of evolving IT sourcing strategies and of the success of a blueprint for managing transition. The next chapter presents the research methodology and the design for the data collection and analysis.

To ensure that the conceptual framework also addresses and meets all research objectives and answers the research questions, the following Table 7 displays the main lines of interaction from the conceptual framework and how this corresponds with the ROs and RQs.

Table 7: Alignment between conceptual framework and ROs / RQs

Conceptual Framework: Main Lines of Interaction	Adressing Research Objectives	Adressing Research Questions
▸ **Megatrends / Digitalisation / Digital Transformation**	▸ **RO1**: To analyse the impact of digitalisation on the German automotive industry	▸ **RQ1**: To what extent has digitalisation influenced the German automotive industry's strategy regarding IT sourcing?
▸ **IT Sourcing Strategy**	▸ **RO2**: To research and analyse changes in IT sourcing strategy in the German automotive industry in the current and future business environments	
▸ **Digital Entrepreneurship**	▸ **RO3**: To identify and evaluate the significance of new competencies in the successful transitioning to new IT sourcing strategies in the German automotive industry	▸ **RQ2**: What are the new entrepreneurial competencies for the successful transitioning to new IT sourcing strategies in the German automotive industry?
▸ **IT Sourcing Management**	▸ **RO4**: To critically assess the future management of IT sourcing in the German automotive industry and the implications for Corporate IT	▸ **RQ3**: What blueprint can be developed to aid practitioners in the German automotive industry in the reassessment of IT sourcing?

Source: The author

4 Methodology

According to Goles and Hirchheim (2000, p. 250), anyone doing research is confronted with two central questions: “How do we know what we know”, and “how do we acquire knowledge”, which are addressed by different research perspectives (or paradigms). This has led to debates among scientists on how social science should be conducted, and the value and validity of the results that can be derived from the various philosophical perspectives (Blaikie & Priest, 2019). Social science is essentially shaped by different world views, traditions and the cultural background of each single researcher. A main influence is the particular view of a researcher of the relationship between knowledge and the process by which it is developed (Crotty, 1998).

The researcher needs ethical principles, basic positions in scientific theory, solid methodological competency, conscious choice of topic, structuring ability, research and presentation techniques, citation guidelines and a matter-of-fact writing style (Bell, 2014). According to Yin (2018, p. 26) the way a researcher conducts and plans the research can be referred to as “a logical plan for getting from here to there.” “Here” is defined as the initial research questions to be answered and “there” as some set of conclusions that are reached as a result of answering the research questions. Therefore, this chapter outlines the methodological conduct of the research project, to explore and understand the complex phenomena under investigation.

4.1 Introduction

The main objective of research is the systematic production and increase of knowledge based on evidence (Bell et al., 2018). However, there are different definitions of what knowledge and reality are and also different theories and concepts of how knowledge can be generated and what the process of knowledge generation should be (Lee & Lings, 2008). Starting from the philosophical standpoint of the researcher and the questions, “what to research” and “how to research”, a number of fundamental methodological questions have to be considered in the overall research process (Holden & Lynch, 2004). Independently of this, there are essential characteristics and principles that apply to all research efforts. Any research process must have a comprehensible theoretical basis, be focused on a clear objective, be carefully and uncompromisingly designed, be based on sound and robust methods of data collection and analysis, be backed by solid evidence, and the subject must have research relevance and be of value (Hussain et al., 2013).

A research process consists of various elements, and almost all of them contain alternatives, which together provide a wide range of methodological options. This leads to multiple variations of research procedures from which a researcher has to choose what is appropriate for developing knowledge in a particular study (Blaikie & Priest, 2019). The chosen overall research process can be seen as a master plan that throws light on how the study will be conducted. This plan takes directions from the underlying philosophical assumptions as well as providing the methods for data analysis and presentation in order to maximise the overall quality and trustworthiness of the study (Lee & Lings, 2008).

One objective is firstly to understand the different research philosophies of business management as part of social science (Blaikie & Priest, 2019). Based on the understanding thus developed, a second objective should be to argue the chosen research approach of the investigation (Blaikie & Priest, 2017). A third objective is to create a dual effect on the researcher, as they open their mind to alternatives and thus enrich their own research capabilities, which in turn increases confidence in their research results (Holden & Lynch, 2004). Furthermore, taking into account the variety of conflicting philosophical and methodological positions that exist, it is a final objective to ensure the quality, relevance and rigour of the research process (Seale, 1999).

Consequently, the purposes and the choices of methodology have to be clarified and justified in each single research case so that the ground rules or assumptions underlying the research can be understood by other researchers (Aliyu et al., 2014). Blaikie and Priest (2017) emphasised that this should be precisely articulated at the beginning of a study, otherwise the results cannot easily be compared with other research on the same topic. Additionally, the declaration of value would also be beneficial to the researcher as "being honest with yourself", which should also sharpen awareness when making conclusions from selected data and findings (Saunders et al., 2009, p. 118).

The chapter consists of six sections. After this introductory section, the following section discusses the fundamental philosophical choices in social research. The next section provides justification for adopting the constructivist perspective and demonstrates that the methodology and practices chosen for this research are the most appropriate to meet the research objectives and answer the research questions. This is followed by a section that puts forward the argument for a single case study design and the principles for obtaining qualitative data, the process of data collection and the analysis and presentation of data. Finally, this chapter ends with a section concerning the trustworthiness of this study and ethical issues and, finally, a summary of the methodological fundamentals of this study.

4.2 Theoretical Foundations of Research

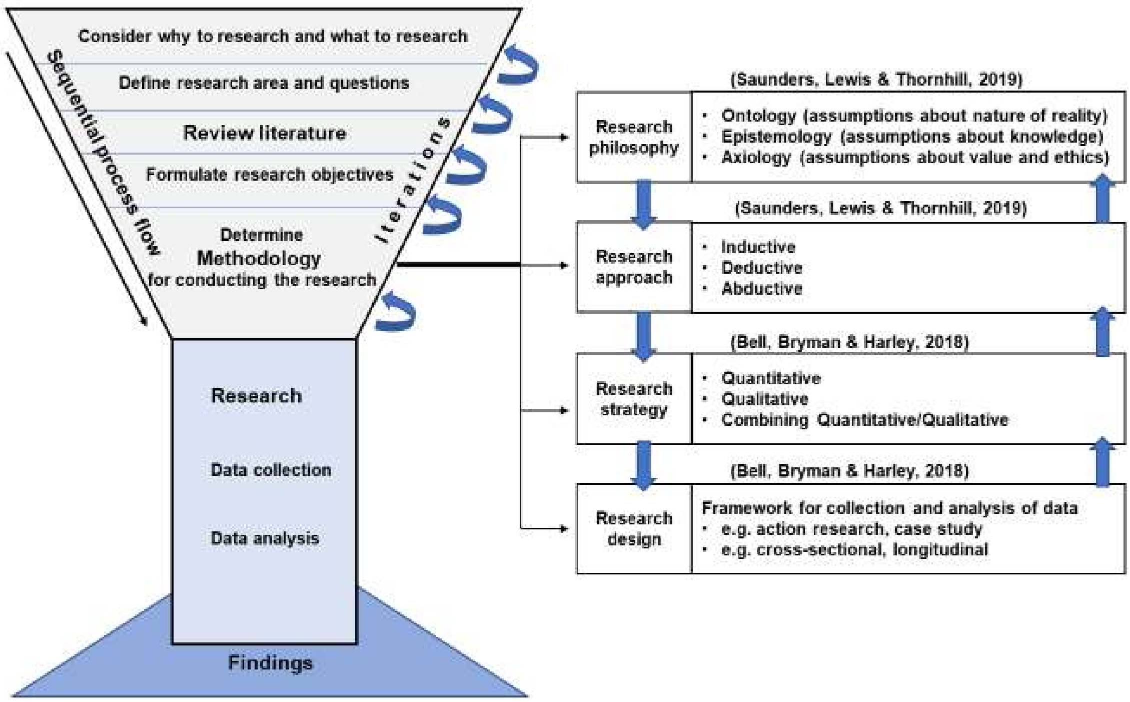
Saunders et al. (2019) emphasised that the way in which the research objectives and questions are presented gives an indication of the purpose of the research and determines research perspectives. They defined three main purposes of research activity: explanatory, descriptive, and exploratory purposes. The general focus of an explanatory purpose is to study a situation and search for causality and relationships between variables. Hart (2018) considers the purpose of descriptive research as being to gain knowledge and explain exactly why something happens. Exploratory studies attempt to gain new knowledge and to seek new insights by discovering what is happening. The intention is to assess a phenomenon in a new light, and also clarify and understand the nature of a problem.

The purpose of this study is to explore, reveal, examine, and understand evolving IT sourcing strategies as a consequence of digitalisation in the German automotive industry. This aims to address the general research questions "what is happening" and "what might be happening" (Blaikie & Priest, 2019, p. 85). It will need to take account of many influential entrepreneurial factors and the creation of meanings through interaction between individuals in a complex and dynamic situation. The explorative research purpose is looking at a "situation as a whole." Exploratory study is flexible and adaptable to change, which is an advantage for the researcher if the researcher is willing to change direction as a result of finding new data and insights (Saunders et al., 2012).

4.2.1 Methodological Fundamentals of the Research Process

The literature describes research as a multi-stage process that must be followed step-by-step in a rational way to conduct and complete a research project (Saunders et al., 2019). Nevertheless, Saunders et al. (2019) and Wilson (2014) emphasised that although the individual steps are linked to each other, the research process is not linear and does not follow a logical sequence of steps, the researcher must be prepared to repeat each step more than once. However, at the beginning of the research process, the philosophical position / paradigms of the researcher with regard to ontology, epistemology and axiology should be expressed, on the basis of which social science phenomenon is to be studied (Blaikie & Priest, 2017; Holden & Lynch, 2004). This determines the choice of other methodological elements that guides the entire research process, including the behaviour of the researcher (Antwi & Hamza, 2015). Summarising the various inputs from the respective literature (e.g. Bell et al., 2018), a research process model which integrates all methodological elements into the general flow of the research process can be derived (Figure 23). Moreover, it is combined with the logic of narrowing down the topic of a study in order to increase its level of focus (Saunders et al., 2019).

Figure 23: Research process model



Source: adapted from Bell et al. (2018); Saunders et al. (2019)

Nevertheless, the literature offers different interpretations of the term research methodology (Wilson, 2014). This study follows the example of Somekh and Lewin (2005) and understands methodology as an umbrella for the collection of theories, principles, values, methods and rules by which research is conducted. It was also observed that in the literature, related elements such as research philosophy, approach, strategy, and design are not used in a consistent way. Many authors use different terms for the same subjects or vice versa. Moreover, different descriptions, categorisations and classifications of research philosophy, approach, strategy, and design have been used in studies with overlapping emphasis and meanings (Wahyuni, 2012). Therefore, the intention of the developed research process model (Figure 23) is also to first determine how methodological elements are termed and used in this study.

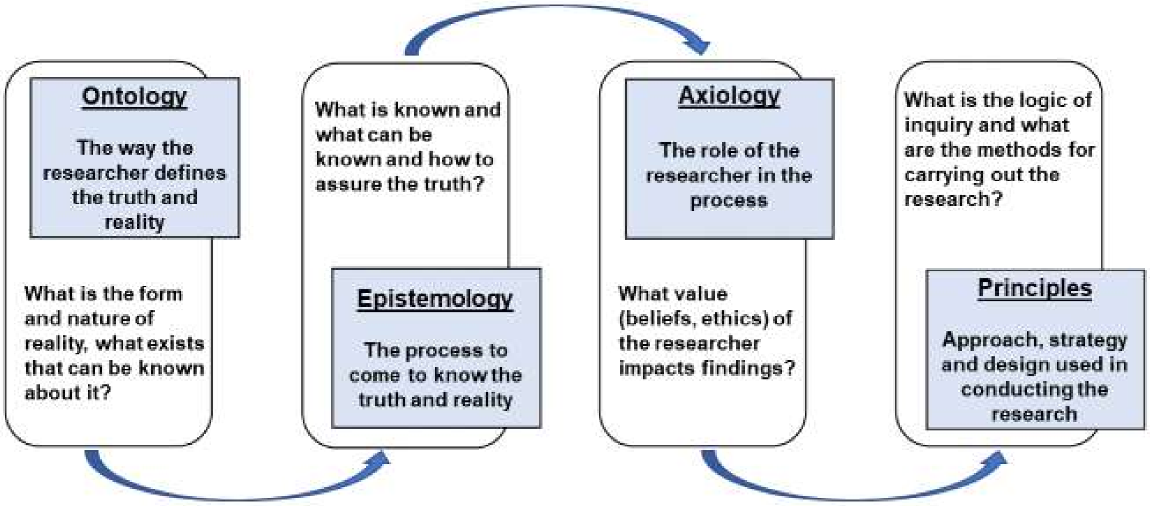
The majority of authors (e.g. Saunders et al., 2019) link research philosophy to the discussion of paradigms (ontology, epistemology and axiology) and research approach to the logic of inquiry (inductive, deductive and abductive). Research strategy and research design is used by the majority of authors (e.g. Bell et al., 2018) to determine whether a qualitative or quantitative strategy is used and which data collection methods and tools are used to answer the research questions. Therefore, this study follows the definitions shown in Figure 23.

4.2.2 Roadmap to consider Fundamental Assumptions

Burke (2007) explained that the philosophical position and research paradigms function as a roadmap with a set of lenses that guide the researcher through basic questions concerning knowledge and how to gain knowledge, which are so interconnected that the answer to one question limits the answer to the other (Figure 24). Consequently, a first step is to consider fundamental assumptions, discussed in the literature and applied by researchers with different emphasis: ontology, epistemology, and axiology (Easterby-Smith et al., 2015). The result in turn has a significant influence on decisions about research approach, research strategy and research design.

Bell et al. (2018) considered ontology as the core of a researcher's set of beliefs about how the nature of reality is interpreted and what constitutes facts. The ontological debate is therefore linked to two central questions in order to explore the nature of existence and what there is to know about the world (McLaughlin, 2012). One view is that social reality is independent of human imaginations and interpretations and social behaviour is governed by laws which can be considered unchangeable. Another view is that there are only multiple contextual realities constructed by those who experience them (Lee & Lings, 2008). Thus, ontology is linked to a central consideration of whether social entities must be perceived as objective or subjective.

Figure 24: Roadmap to consider fundamental assumptions



Source: Bell et al. (2018)

Epistemology, in contrast, should derive from an ontological position and addresses the essence of knowledge, its nature and forms, how knowledge can be gained from an assumed social reality, what constitutes acceptable, valid and legitimate knowledge and how knowledge can be communicated to others (Burrell & Morgan, 1979). The two most important epistemological positions dominating the debates on the choice of a philosophical perspective in social sciences are positivism and constructionism / interpretivism (Remenyi et al., 1998). Thus, epistemology attempts to answer whether the social world can be studied according to the same principles, procedures and ethos as the natural sciences, or not (Bell et al., 2018).

Saunders et al. (2019) stated that axiology must also be aligned with ontology and epistemology, since the research process may be influenced at all stages by the researcher's own values and the choice of philosophical approaches is a reflection of these values. How and whether one's own values play a role depends on the researcher's objectives. Aiming for explanation and prediction, to describe only what exists is assumed value-free, or alternatively for exploring and understanding, to describe why something is as it is or why something is happening is assumed to be value-bound.

The principles concerning research approach and research strategy finally complete the roadmap concerning methodological fundamentals and address the “logics of inquiry”, as Blaikie and Priest (2017, p. 12) state it. Deductive and inductive are most commonly used approaches (Saunders et al., 2019). A deductive approach involves developing a hypothesis and then designing a research process to test the hypothesis. This type of research is often associated with the quantitative type of research (Holden & Lynch, 2004) and preferred by positivists who believe that research needs to be carried out in a scientific way using experimental methods. In contrast, the inductive approach tries to understand human experience and a phenomenon rather than search for fundamental laws (Holden & Lynch, 2004). This approach produces generalisable results from observations and findings and is often associated with the qualitative type of research (Bell et al., 2018).

However, when comparing literature on research philosophy / paradigms, various researchers have defined and discussed different paradigms with varying characteristics for ontology, epistemology and axiology (Blaikie & Priest, 2017; Easterby-Smith et al., 2015). For example, Creswell (2007) discussed post-positivism, social constructivism, advocacy/participatory, and pragmatism as different philosophies. Creswell and Poth (2016) described positivism, post-positivism, interpretivism, and pragmatism as four philosophical assumptions that can be adopted in research. Other authors defined four research paradigms, which are: positivism, realism, critical theory, and constructivism. Therefore, in the next sub-sections a brief historical background concerning the origins of these paradigms is given to narrow down the potential paradigms for this study.

4.2.3 Origins of Research Paradigm

In the natural sciences the positivist view is predominant and claims that reality and truth exist independently of the observer, and it can be observed, measured and studied objectively (Aliyu et al., 2014). According to Guba and Lincoln (1994), reality is out there in the world and driven by permanent natural laws. The world exists independently of our knowledge (Grix, 2018). For social science, criticism of the positivist view was voiced by historians of science such as

Toulmin, Weber, Hanson, Kuhn, and Feyerabend who questioned the belief in, and the approach to, absolute truth (Holden & Lynch, 2004).

Scientists have argued that the researcher cannot distance him or herself from what is being observed or the study's subject matter, and researchers are value-laden, determined by their background, interests, beliefs, values, and skills (Holden & Lynch, 2004). Non-positivists, especially in social science, doubt whether it is possible to actually know that something is true or whether it makes sense to search for truth as though it exists as some independent reality (Goles & Hirchheim, 2000). They view knowledge as conditional, relative and therefore subjective (Aliyu et al., 2014). "Knowledge is not infallible but conditional; it is a matter of community acceptance and it is relative to both time and place" (Goles and Hirchheim, 2000, p. 250). As a result, post-positivists developed alternative views on research perspectives (or world views), trying to create more suitable approaches for social research (Aliyu et al., 2014).

In response to the positivist view of the natural sciences, Kuhn popularised in his book *The Structure of Scientific Revolutions* (1962) the idea of a paradigm. The author defines it as "an integrated cluster of substantive concepts, variables and problems attached with corresponding methodological approach and tools" (Kuhn, 1962, quoted in Flick, 2009, p. 69). Guba and Lincoln (1994) made this definition more applicable from a research point of view. They view a paradigm as "a basic system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways" (p. 105). The landmark works by Kuhn (1962) or Burrell and Morgan's model of "four sociological paradigms for organisational analysis" (1979, p. 4) have prompted a controversial debate on competing research paradigms as alternatives to the positivist view. Many researchers have analysed and revised the concept of a paradigm and various researchers have defined different paradigms, cumulating in what was phrased the "paradigm war" (e.g. Goles & Hirchheim, 2000; Sheperd & Challenger, 2013).

A particular trigger for the intense debate on research paradigms was the claim of Burrell and Morgan on the "incommensurability of paradigms" (as cited in Shepherd & Challenger, 2013, p. 225). As a result, two further views have emerged to extend this debate: multi-paradigm perspectives (Gioia & Pitre, 1990) and paradigm interplay (Schultz & Hatch, 1996). Both views claim that there are strengths and weaknesses in both the positivist and anti-positivist positions and that a single research perspective might be too narrow to cover the complexity of social reality (Goles & Hirchheim, 2000). Thus, the perspective of pragmatism became popular. For pragmatists “truth is what works” (Robson & McCartan, 2016). Tashakkori et al. (1998) finally viewed pragmatism as an attempt to make use of “whatever philosophical ... approach … works best for the particular research programme under study” (p. 5).

In consequence, the extensive paradigm debate has led to a variety of research perspectives. Blaikie and Priest (2017, p. 11) reviewed eleven paradigms discussed in social research and note that while they include philosophical and theoretical components, they should not all be regarded as "research" paradigms. Therefore, they have reduced these paradigms to only three, which relate to dominant traditions in the social sciences (Neo-Positive, Interpretive and Critical Realist paradigms). Blaikie and Priest (2017) also claim that these three paradigms correspond to the basic ideas of the sociologists Durkheim, Weber and Marx. From this, they derive the legitimacy to work with these paradigms in social science and regard them “as typifications, as abstractions that bring together similarities and recognise differences” (p. 12).

With regard to pragmatism, which is preferred by many researchers, Blaikie and Priest (2017) have a critical view of this trend after examining the literature. Pragmatism promotes mixed methods and this encourages researchers to downplay or sidestep fundamental philosophical and methodological issues of social science. Blaikie and Priest totally reject this trend (2017, p. 21). To answer the research problem and the research questions convincingly, it is essential to explain and explicitly justify the choice of the research paradigm and philosophical assumptions.

Although there has been an extensive paradigm debate, there is still no common definition of the term paradigm. The term is still used in the literature with varying characteristics and different interpretations (Mkansi & Acheampong, 2012). Synonyms such as “perspective”, “worldview”, “tradition”, “school”, “philosophy”, “approach” or “discipline” have randomly been applied to design or explain a paradigm. In this study perspective and paradigm are used as synonyms for the fundamental philosophical choices in social science. Sandberg (2016) summarised paradigm as a doctrine that is dominant at a particular time. Scientific paradigms represent basic patterns to explain phenomena. They emerge when scientists agree on long-term beliefs, methods and theoretical principles, and these ways of thinking have a decisive influence on the development of a scientific discipline for longer periods of time.

4.3 Evaluation of two Research Perspectives for this Study

In this section, the realist perspective / traditional realism is compared with constructivist perspective / social constructivism and the latter is justified as best fit to explore evolving IT sourcing strategies in the German automotive industry.

4.3.1 Demonstration of Realist Perspective

Regardless of different developments within realism, this perspective is shaped by the **ontological** position of objectivism (Guba & Lincoln, 1994). Proponents of the objectivist view claim that social phenomena and their meanings have an existence independent of social actors. The social world exists as a distinct and separate, i.e., objective reality, beyond the reach and control of human beings (McLaughlin, 2012). Objectivists also claim that the relationship between humans and nature or society is deterministic, i.e., governed by causal laws (Easterby-Smith et al., 2015).

Objectivism shows a strong tendency to the **epistemological** stance of positivism where traditional (classical, naïve) realists adopt the methods of natural sciences to create knowledge, in which the researcher is independent of the object of research and neither influences nor is influenced by it (Remenyi et al., 1998). Guba and Lincoln (1994) stated positivism is geared to deal with facts and relies on empirical findings obtained through valid and reliable measurements as a source of knowledge. Any subjective consideration is excluded as meaningless (Holden & Lynch, 2004). This has generated criticism in the social sciences as well, which has led to post-positivism. Proponents of this view argue that a reality cannot be perfectly understood by humans. Researchers can only try to get as close as possible to a reality with rigorous data collection (Eriksson & Kovalainen, 2015).

In terms of **axiology** positivists (classic, naïve) consider the research process as value-free, by taking the perspective of the ethical outsider (Wilson, 2014). This traditional view of the scientific method is that everything should be done to eliminate the subjective influences of researchers. Despite all the arguments that researchers should be objective and that research is used to produce truths about the social world, Blaikie and Priest (2017) believe that it is not possible to take a neutral position to achieve this because all knowledge generated by social research is always carried out in a specific context.

Finally, the **methodology** of the traditional realists contains quantitative, nomothetical approaches to prove law-like generalisations or hypotheses as being true or false (Scotland, 2012). In contrast, critical realists also use qualitative techniques when they focus on explanations within a particular context (Wahyuni, 2012). Methods such as experiments and large-scale surveys are core elements in realists' research (Lee & Lings, 2008).

4.3.2 Demonstration of Constructivist Perspective

The two main notions opposed to realism and positivism are **constructivism and interpretivism**. The fundamental difference derives from the subjectivist **ontological position** as opposed to the objectivist view of the realist perspective (Aliyu et al., 2014). The subjectivist view assumes that reality is an output of human cognitive processes (Johnson et al., 2006). Reality is constructed and interpreted by individuals according to their ideological and cultural positions. Therefore, a single phenomenon can have multiple interpretations or meanings which can change over time and context (Cohen et al., 2017). Relativism is the view that the perception of what constitutes reality differs from one person to another (Guba & Lincoln, 1994). Lee and Lings (2008) stated that language is of particular importance here as it actively shapes reality. Thus, reality is constructed through the interaction between language and aspects of an independent world.

As opposed to the realist perspective, the **epistemological perspective** of constructivism does not accept that an independent observer is capable of measuring reality (Burrell & Morgan, 2005). The assumption is that the social world and knowledge is never abstract, objective and absolute, but always situated and can only be understood by individuals directly involved in the activities (Alvesson, 2009). Therefore, this perspective wants to understand why people think and act the way they do in relation to their social environment (Blaikie & Priest, 2017).

Additionally, the constructivist perspective with the ontological stance of subjectivism and the epistemological stance of interpretivism relies on multiple realities. Interpretivism assumes there is no absolute truth, but the underlying principle of interpretivism is the understanding and reconstruction of knowledge. Findings are thus created by the researcher's interpretation and by the process of investigation between both parties: researchers and participants (Crotty, 1998; Guba & Lincoln, 1994). Reality is to be considered subjective, consisting of a synthesis of multiple perspectives and therefore socially constructed. Different researchers embrace different realities, as do the participants in a qualitative research project, which are interpreted by the researcher. Multiple realities are evidenced in the many different participant perspectives. Qualitative research has the intent of reporting these multiple realities. Consequently, evidence of multiple realities includes the use of multiple quotations based on the actual words of different individuals and presenting a range of different individual perspectives (Creswell, 2007).

However, Johnson and Onwuegbuzie (2004) accepted “that multiple, contradictory, but equally valid accounts of the same phenomenon are multiple realities also poses some potential problems” (p. 16). In general, subjective states that vary from person to person should not be referred to as multiple realities. For the purposes of clarity and greater precision, they should rather be referred to as multiple perspectives, opinions, beliefs, or be differentiated by putting the word subjective before the word reality (i.e., subjective reality).

Consequently, the **axiological position** of the constructivist / interpretivist is value-bounded, taking an emic position (insider’s viewpoint) towards research (Wahyuni, 2012). The emphasis on understanding rather than explaining is seen as the main difference to the realist perspective (Lee & Lings, 2008). The interpretive researcher is mainly interested in examining the perspectives of subjects and their view of things. In doing so, they are not only focused on individuals, but also on the environment and interaction with other participants. Hence the term social constructivism (Creswell & Creswell, 2017). The researcher interacts with the subjects being observed, and the collection and analysis of data is significantly influenced by the experiences and values of both the research participants and the researchers themselves (Wilson, 2014).

Finally, the **methodology** of the social constructivist perspective contains mainly qualitative, ideographic approaches to generate data, typically drawn from in-depth interviews with subjects involved as well as extensive background data collection (Tuli, 2010). In the literature, this perspective is also predominantly linked to the inductive and more or less linear research process. In contrast, Blaikie and Priest (2017, p. 30) argued that the research process in the constructivist perspective is rarely linear, but can rather involve many iterations. Therefore, they conclude, abductive logic would be more appropriate.

For the social constructivist, reality is not something naturally occurring. On the contrary, realities are socially and symbolically constructed and maintained by individuals. The focus is on the complexity of human reasoning in a given situation. Therefore, the ontological assumptions in constructionism are that a social reality is seen by many individuals but interpreted differently, leaving different perspectives on the same event.

In addition, there are many interactions between individuals in companies and organisations in the German automotive industry and the whole situation is dynamic, characterised by constant change. Nor can it be assumed that members of an organisation act as rational decision makers. Consequently, for the epistemological position of interpretivism, the knowledge necessary to understand something can only be gained through experience in relation to many contextual factors and their interrelations in a complex organisational environment of the German automotive industry. Thus, depending on many company-specific factors, each firm is likely to come to different conclusions for evolving sourcing strategies in the current and future business environment.

For this study, the necessary approach requires relying as much as possible on the perspectives and meanings of a variety of participants, who are questioned with methods such as in-depth interviews. Jönsson (2010) assumed that interviewees adapt their answers to what they think is the level of knowledge of the interviewer. Therefore, as an initial step, it is necessary for the constructivist to dive deep into the complexity of the subject matter and relationships that are relevant to the research problem and research objectives / questions, in order to build up a wide range of their own background knowledge and create a basis for understanding how participants involved construct their view on reality.

With this background knowledge, an inductive research approach can begin, to generate relevant data with semi-structured interviews. The questions are asked in a broad and general way so that the participants can construct their meaning of what the influence of digitalisation is on evolving IT sourcing strategies. The more open the questions, the better, and the more carefully one must listen in order to recognise what the participants really think. This allows the participants to introduce their own observations and discoveries. If necessary, the researcher may have a viewpoint at the beginning, but the result is open. It only matters what the participants involved think.

Regarding data, the constructivist's focus is on the generation of qualitative data based on the examples from the German automotive industry. Data analysis typically uses creative processes with coding methods to discern patterns in the qualitative data in order to identify categories or interpretation schemes. As a result, throughout the research process a theory of meaning is inductively developed concerning evolving IT sourcing strategies.

From the perspective of the social constructivist, the researcher's own values are of importance when collecting and interpreting the data as well as presenting the findings. The researcher cannot simply reproduce the participants' point of view; the reporting process is also a process of interpretation, from a certain point of view (Blaikie & Priest, 2017). Therefore, the research process is value-bounded, as exploration and understanding are based on the researcher's individual creativity and imagination, background knowledge and abilities to see possible connections between digitalisation and IT sourcing strategies in the German automotive industry. Moreover, this research process is associated with the tendency to prefer a certain research area or a specific approach because this corresponds to the personal affinities and interests of the researcher. Therefore, questions of trustworthiness and authenticity as opposed to the positivist criteria of validity, reliability and objectivity are key considerations in the interpretative paradigm. In order for research to be considered credible and authentic, investigations have to be based on a solid justification.

With its highly qualitative research character, the focus of constructivism / interpretivism is on the relationship between the researcher and the decision makers in the businesses, involved with their controversial view on 'reality' and acting in a complex environment. Above all, the constructivist needs listening, observation and communication skills. Empathy is also required, to control the interviews and to recognise what the interviewee really means but is not able to communicate. In line with Cassell et al. (2009), this demands a high level of professional background knowledge, as well as creative theoretical imagination, to establish the connections. Another specific skill of the researcher is the selection and mastery of appropriate methods and tools for coding and interpreting qualitative data to ensure that reasonable and understandable conclusions are drawn. Reflective thinking, common sense, discipline and responsibility in dealing with the interview results are also mandatory.

4.3.3 Justification of chosen Research Perspective

Figure 25 summarises the characteristics of the opposing perspectives. Other variations on these two perspectives, such as post-positivism, were not considered because they do not change the basic orientation. By contrast, the post-positivist perspective rejects positivist epistemology and ontology and their stance on both the objective nature of reality and the ability of science to know that reality. Moreover, it represents only the efforts of recent decades to respond in a limited way to some criticisms of positivism (such as realism being too mechanistic), but essentially maintaining the same basic beliefs (Blaikie & Priest, 2017).

Figure 25: Characteristics of realist and constructivist perspectives

	Realist perspectives	Constructionist perspectives
Research process	• Deductive / Linear • Hypothesis testing	• Inductive • Iterative
Researcher's stance	• Detached observer • Top-Down • Outsider	• Insider • Bottom-up • Empathetic observer
Methodology	• Mainly quantitative • Experiments / surveys	• Mainly qualitative • Interviews
Data	• Collected • Predominantly numerical • Large size of samples • Reduced data	• Generated • Predominantly textual / cognitive data • Small size of samples • Rich data
Researcher's value	• Value free • Etic position	• Value bound • Emic position
Use of results	• Validity and reliability established by accepted methods • Objectivity	• Trustworthiness • Credibility • Authenticity
Researcher's skills	• Conceptual • Analytical • Mastery of statistical methods and tools	• Sensitivity • Imagination • Creativity
Contribution to knowledge	• Measurable variables • Causalities • Law-like generalization • Prediction • Verification / Falsification of hypotheses	• Interpretation of meanings • Understanding • Description of characteristics • Generation of new theory

Source: adapted from Bell et al. (2018); Burrell & Morgan (1979); Easterby-Smith et al. (2015); Holden & Lynch (2004); Saunders et al. (2019)

As a result, the research methodology of realist perspectives does not offer adequate models to address the research aims and questions of this study. This perspective and corresponding methodology would reduce the complex situation to some variables that can be observed, measured and studied objectively as an independent reality. However, this would disregard many context-relevant factors that are important for a comprehensive consideration of the research aims and questions. Furthermore, the researcher does not believe that they can distance themselves from the study's subject matter and could take a value free, outsider's view.

In contrast, the constructivist perspective, with its associated interpretative research methodology, fits best for this study to explore, examine, and understand significant shifts in IT sourcing in the German automotive industry. Constructionism, with its ideas of the creation of meaning through interaction between individuals in a complex and dynamic situation offers an appropriate base for the research. The objective of this study to understand the implicit knowledge of all parties involved, utilising a network of professionals from the German automotive industry. The chosen paradigms are closely linked to a mainly qualitative research strategy, following an inductive / iterative research process. This creates understanding of evolving IT sourcing strategies in the German automotive industry from the ground up and is based on what was discovered from a survey, interviews and analysis of available secondary data, such as business documentations. Data obtained must always be understood in relation to the context of their production.

In line with Blaikie and Priest (2017), these decisions deliver a framework to anticipate the resulting research design, with its methods of data generation and analysis. Bell et al. (2018) defined research design as a guideline for the execution of methods for generation and analysis of data that aims to find provable answers to the research questions, which are a result of the literature review and conceptualised in the conceptual framework. In line with Saunders et al. (2019), an important consideration is to first establish coherence between methodological fundamentals as discussed in the previous sections, and then follow a research design process.

Appropriately, decisions about the priority being given to research methods for qualitative data collection and analysis have to be made. As a result, the methodological fundamentals are linked to a single *case* study design, taking the German automotive industry as a whole. It aims to understand the unique and individual *phenomenon* of evolving IT sourcing strategies in the *context* of digitalisation in the industry and employs in-depth investigation, using various sources of data. As Tayler et al. (2011) and Yin (2018) state, case study can be used for a wide variety of issues and has been used extensively in business management. Therefore, case study research is considered explicitly practicable for this study, as IT sourcing decisions are always driven by the management of an organisation. The overall case study design for this study will be discussed and justified in the next section.

4.4 Case Study

The case study applied in this research project follows the recommendations of Yin (2018) and has four major stages: design the case study, conduct the case study, analyse the case study evidence, and develop the conclusions, recommendations and implications. The following design of the case study also covers the widely discussed question of when and how to use case studies.

4.4.1 Case Study Design

The literature regards case studies in different ways and with multiple meanings. The term is used to describe an element of analysis (e.g. a case study of a particular organisation) or a research method. For example, Tellis (1997) viewed case study as an umbrella term for research methods and as an ideal methodology when a holistic, in-depth investigation is needed. However, other authors regard case study as a mode of organising data for some chosen units of analysis and avoid linking the case study to a particular methodology. Blaikie and Priest (2019) emphasised the view of Denzin and Lincoln (2018): "case study is not a methodological choice but a choice of what is to be studied" (p. 443). Yin (2018), one of the authorities on case study research, considers case study as "an empirical method that investigates a contemporary phenomenon (the "case") in depth within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident" (p. 15). Yin explained that the interaction between a phenomenon and its context is best understood through in-depth case studies. Hence, understanding context is fundamental to case study design. Yin (2018) stated that this definition distinguishes case studies from other modes of research design, such as surveys. While surveys are often used to collect large amounts of data from a distributed population (Gray, 2019), case studies focus on gaining a deep understanding within single settings. Additionally, the survey's ability to investigate and consider the context of a phenomenon is extremely limited, whereas a case study is a detailed examination of a phenomenon in the context in which it exists (Yin, 2018). Therefore, Yin (2018) concludes that a case study is not limited of being a data collection method, but has its own logic of design, data collection methods as well as data analysis.

This study centres on a single-case study, as opposed to multiple-case studies, and on a holistic design within the German automotive industry as a whole, which is the unit of analysis. A purposive sampling representing IT executives and practitioners from five selected German OEM's and 24 selected German tier-1 suppliers was conducted. This holistic design is opposed to an embedded design, where individual companies of the industry would be separate units of analysis (second level units) within the single case and the industry as whole would be the main unit (first level). The rationale for the holistic design lies in the consideration that expert-interviews with individual firms were conducted, which cannot be considered as a separate analysis of sub-units.

Moreover, Yin (2018) warns of possible criticism and scepticism when a single case is selected and recommends a very strong argument as a rationale. The author refers to the quality criteria for case studies with regard to validity or reliability and concludes that two or more cases would increase the possibility that the findings can generally be applied to other cases which will produce an even stronger effect and conclusion. From Yin's (2018) point of view, a single case study is applicable to a common case of an everyday situation, amongst others.

A revelatory approach was taken, for example, in the studies of Brautsch and Wynn (2013) and Gerster and Dremel (2019), where the company is an individual German car manufacturer and the researchers had deep access to gain empirical insights to specific sourcing topics. In contrast, this research has chosen the single-case study as a common case, where the objective is to capture the circumstances and conditions of evolving IT sourcing strategies within the IT management of the German automotive industry and the lessons it might provide to develop a blueprint for managing transition. This approach is about the breadth of an entire industry sector.

The topic of validity and reliability has been discussed widely and controversially in the literature, even though case studies have been used over a long period, including in business management (e.g. Bell et al., 2018; Gray, 2019). Yin (2018) distinguishes between internal and external validity, with the former being considered only for explanatory cases, when causal relationships are investigated. The critical discussion centres around external validity or generalisability and the question of how a single case possibly can be representative (Gray, 2019). Flyvbjerg (2006) referred to the misunderstandings about the ability of case studies to produce reliable contributions to knowledge. The author largely attributed this to positivist criticisms centred on the use of small samples, and general criticisms about interpretive approaches and qualitative research. Flyvbjerg (2006) emphasised that the concentration on the uniqueness of the case and developing a deep understanding of its complexity is the main strength of case studies, rather than generalisation. The author declared that an in-depth case study provides the basis for "concrete, context-dependent knowledge" (2006, p. 223) and concludes this is the only result social science can reliably produce. Additionally, other authors such as Bansal and Corley (2011) and Denzin and Lincoln (2018) recognised the value of qualitative research in case studies and refer to the long and widespread use of case studies with different designs and purposes. Case studies have been in use for positivist perspectives as well as for interpretative researchers, for deductive as well as for inductive approaches, and finally for descriptive, explanatory and exploratory purposes (Saunders et al., 2019).

Therefore, this research regards the single-case study as particularly valuable for revealing important sources of information in a new study context and entails a detailed investigation of evolving IT sourcing strategies. The exploratory character of the study underlines that the focus is not on generalisation or development of a theory (Lee & Lings, 2008). The intention is to reveal whether practitioners in the German automotive industry consider significant shifts in IT sourcing to be triggered by digitalisation in their organisation. In general, case studies do not claim to be representative, but the emphasis is on what can be learned from a single case (Tellis, 1997).

Furthermore, the single case study offers the possibility of focusing on a bounded situation as the research topic of evolving IT sourcing strategies within the scope of German automotive industry are continually kept in focus. According to Creswell (2007), this is another characteristic of a case study. The researcher focuses on a phenomenon and then selects one bounded case to illustrate it. If the phenomenon is not intrinsically bounded, it is not a case. In this study the case is also bounded by time and activity, as the research phase was conducted over a 38 months period. However, the results can be considered as having been obtained at a single point in time and do not focus on showing changes over time. This business research provides a “snapshot” of the current situation for IT sourcing strategies in a certain context, and conditions can change over time.

4.4.2 Collecting Case Study Evidence

Yin (2018) suggested principles of data collection for case studies in order to ensure trustworthiness. The first principle is using multiple sources of data, which Yin views as a major strength of case study data collection. The rationale for this is data triangulation, which serves to affirm the data collected from other sources. Hence, this study is designed to deliver details from the viewpoint of the participants by using two surveys, in-depth expert-interviews, project records, and documentary data.

The second principle suggested by Yin (2018) is the creation of two types of databases to organise and document collected data. Thus, one database had been created and represents all sources of evidence; a second database contains any procedure and the researcher’s reports to maintain a chain of evidence. This is viewed by Yin (2018) as an avenue which allows the reader to trace each single step and follow the derivations of any evidence from the initial research questions to the case study findings. Hence, the process of data collection is auditable. The process of data collection was conducted in four stages, which are described below.

4.4.2.1 Initial Interviews for Testing of Research Objectives

With the intention of an on-going reflection on the research journey, five initial interviews were conducted with three IT sourcing experts and two IT managers from OEMs in March and April 2020, to further test the relevance of the research objectives. According to Finlay (2008), reflective research is an essential part of the researcher’s ability to critically rethink the level of understanding achieved about the phenomena studied. Schön (1983) concluded reflective research is, in its simplest form, thinking about of what one is doing, considering what happens or happened, understanding it, learning from it and reaching a higher level of understanding.

The baseline for these interviews were the results of the initial systematic literature review, which examined the potential role of digitalisation in driving IT backsourcing in the German automotive industry. The interviews identified additional important issues concerning IT sourcing strategies and related trends in the German automotive industry from the practitioners' perspective. A report of the interviews was written and, as a result, the research objectives and questions were extended from IT backsourcing to a broader view of evolving IT sourcing strategies, as a sound basis for further research in this study. Grounded on this, the project was approved by the university with the proposed method of a case study of the German automotive industry. These first interviews also had the effect of offering training on how to ask questions and to interpret the answers. According to Yin (2018), data collection procedures in case studies are not routinised and require necessary skills and values of the researcher.

4.4.2.2 Conducting First Survey

As an intermediate stage and in preparation of the main stage of primary data collection – the in-depth expert-interviews – an online survey was conducted, drawing on the findings from the extant literature discussed above, and incorporating the results from the previous stage of initial interviews with practitioners from the German automotive industry, to identify the major areas of discussion to guide the main in-depth interviews.

According to Saunders et al. (2019), surveys are most frequently used for collection of standardised data. Blaikie and Priest (2019) state a terminological overlap with survey and questionnaire, and they recommend not to differentiate here. For example, the term survey could also be used to describe questionnaires and questionnaires are considered as structured or standardised interviews (Robson & McCartan, 2016; Saunders et al., 2019). A survey uses a set of clearly formulated questions that can be answered by participants without further help from the researcher (Blaikie & Priest, 2019). These questions are closed and therefore require precise answers, sometimes in form of options (usually with pre-coded answers). Flick (2009) explained that this type of interview can be standardised as all participants are asked the same questions.

The survey comprised twenty-four statements and a five-point Likert scale (ranging from Strongly Agree to Strongly Disagree), covering three main areas of IT sourcing related business activities (Appendix 10.4) and ensured an appropriate level of detail and completeness. Firstly, there were statements concerning the digital transformation strategy, which provides the business and management framework for decision-making and action in the different technology environments. Secondly, statements regarding digital entrepreneurship, which provide the culture and mindset for organisational changes. Thirdly, statements focusing on evolving IT sourcing strategies. The statements prepared for the survey were also assigned to the research questions, which guaranteed all research questions were addressed.

The target group for the survey consisted of IT executives from the German automotive industry (OEMs, Suppliers, and IT sourcing experts). A total of 33 letters of invitation were sent out, covering the following three sectors of business around the German automotive industry: Firstly, the five German OEMs comprising Audi, BMW, Daimler, Porsche, and Volkswagen. Secondly, 24 of Germany's largest tier-1 suppliers, of which 18 are among the world's top 100 automotive suppliers (VDA, 2021b; Berlin, 2021). Finally, four invitations to international IT sourcing experts. The link to the online survey was distributed with a letter of invitation that included a request for follow-up semi-structured interviews, and if the participants agreed they were asked to provide their contact information. The invitation letter also included a short project information sheet with further explanations and definitions. The survey was launched at the beginning of November 2020 and left online until the end of February 2021. A reminder mail was sent to all selected companies in mid-November 2020, after the original contact, to encourage participation. A total of 18 anonymous responses were received, representing a response rate of around 54 per cent.

Moreover, the survey was the first attempt to gain access to potential participants from the German automotive industry, who were also envisaged for the later semi-structured interviews in the case study. Therefore, one more important part of the survey was to get access to participants with exclusive knowledge, confidential insight and relevant information about IT sourcing in their company and in the community. Saunders et al. (2019) addressed three organisational concerns about getting access. Firstly, it is recommended to keep demands to a minimum. Secondly, organisations are less likely to cooperate where the research is related to sensitive topics which might have negative implications on other parties involved. This must be treated seriously, since the research topic with evolving sourcing strategies has economic effects on the employees of a company as well as on IT providers. Thirdly, assurances about confidentiality and anonymity must be clearly provided. Given the sensitivity of the topic, an anonymous survey was chosen, with the assurance that the source of the response would not be identified. As expected, this had a positive effect on the response rate.

However, it must be emphasised that this survey was not considered as mixed methods research. Bell et al. (2018), for example, consider mixed methods as using "quantitative and qualitative research within a single project" (p. 569). In contrast, the survey conducted is to be understood as a separate phase in the case study, whose data are not integrated into the qualitative data generation in the following qualitative expert-interviews. Miles et al. (2018) referred to this as the sequencing of quantitative and qualitative strategies, which are located at different stages of the research process. The survey software JISC was used to obtain a summary of the responses (Appendix 10.5) in order to identify resulting 11 areas of discussion for the subsequent semi-structured interviews. This is to be understood as capturing the "main branches of a tree" and is about focussing on the main topics of interest in the time-limited interviews.

4.4.2.3 Conducting semi-structured Interviews

Yin (2018) views in-depth case study interviews as "guided conversations" (p. 118) that are largely driven by the interviewee, as opposed to structured questioning, which is guided by the interviewer. Lee and Lings (2008) split in-depth interviews into unstructured and semi-structured.

Unstructured interviews are informal and involve a close and direct interaction between the researcher and a respondent or group. This close involvement is needed for in-depth access to issues, people and data to provide a more detailed and nuanced account of one particular question (Walsham, 2006). In contrast to structured interviews, there is no predetermined list of questions to be worked through. However, even in this situation, the researcher must have a clear idea of the aspects to be researched. The interviewee has the opportunity to speak freely about events, behaviour, experience and beliefs related to the subject area (Bell, 2014). The researcher identifies certain topics of interest but does not have a formal guide for the conversation. The conversation can be guided in any direction of interest that might arise (Saunders et al., 2019). Thus, it is possible to generate rich data, information and ideas in these conversations because the level of questioning can be varied to suit the context. Consequently, an unstructured interview is particularly useful for exploring a topic on a larger scale or when the phenomenon of interest is very infrequent (Eisenhardt & Graebner, 2007). However, Flick (2009) explained that the lack of structure leads to a certain disadvantage of this method. Since each interview is usually unique and no predetermined set of questions is asked to all participants, it is usually more difficult to analyse unstructured interview data, especially in terms of synthesising participants' data.

The method of semi-structured interviews has characteristics of both structured and unstructured interviews. Therefore, it uses both closed and open questions and thus combines the advantages of both interview methods. The closed questions can have the purpose of gaining comparative views on a particular issue, process or strategy, and with the open questions an attempt is made to construct or understand considerations behind this view (McLaughlin, 2012). In order to be consistent with all participants, the interviewer has a set of pre-planned core questions for guidance, such that the same areas are covered with each interviewee. As the interview progresses, the interviewee gets the opportunity to elaborate or provide more relevant information (Saunders et al., 2019). The topics and questions to be covered may vary from interview to interview. In a certain interview some questions can be excluded, depending on the specific organisational context that is encountered. The order of the questions may also vary depending on the flow of the interview. By contrast, new issues may arise and additional questions may be necessary to cover research question in the light of certain developments (Lee & Lings, 2008).

Due to the complex nature of the research subject, semi-structured interviews are the most appropriate method of obtaining qualitative data for this study, as they promise the highest possible level of knowledge gained in a flexible way with a manageable research effort. Stockhinger and Teubner (2019) concluded semi-structured interviews are best suited for this purpose as they are effective in identifying intangible factors. This provides rich insights and in-depth answers, which go deeply into the respondent’s own experience, and thus gives them a ‘voice’ in the study (Lee & Lings, 2008).

However, it can be assumed that interviewees adapt their answers to what they think is the level of knowledge of the interviewer (Jönsson, 2010). Following the recommendations of Yin (2018), a detailed guideline for conducting the interviews was prepared which required an intensive theoretical examination of the topic by the researcher in advance to understand the topic, and the interviewee’s specific and situational context. Only with a comprehensive background knowledge can the right questions be asked and followed to their conclusion (Myers & Newman, 2007). Prior to each interview, the annual reports and the sustainability reports of the companies concerned were reviewed in order to have a precise understanding of the company in question.

Analogous to the online survey, the target group for the semi-structured interviews consisted of IT executives from the German automotive industry (OEMs, Supplier and IT sourcing experts) as defined in the case. An interview brief was distributed to 29 companies, which also included a short project description with further explanations and definitions, as well as the areas of discussion for guiding the interviews (Appendix 10.6). In total, 19 semi-structured interviews were performed between February and April 2021. All interviewees were participants from middle and top management level and were directly involved in decision making in the areas of IT strategy, IT sourcing, IT governance, and digital transformation. The representative composition of participants from the German automotive industry was as follows (Table 8):

Table 8: Participants of semi-structured interviews

	CIO’s	CDO’s	IT-Manager	Partner
OEM	2		5	
1-tier Supplier	5	2	1	
Consulting				4
	7	2	6	4

Source: The author

Because of the Covid-19 pandemic, interviews could not take place at the interviewees' location but were conducted as videoconferences and lasted between one and one and a half hours. Interviews were conducted in German and a summarised interview protocol was completed after each interview. With regard to the purpose of this study, during the interviews participants sometimes referred to publicly available corporate documents such as company web pages, presentation materials, annual reports, or other announcements. This documentary evidence has been collected and utilised as well. The author of this study subsequently translated the interview notes into English, and these translations were in turn checked for correctness and adjusted where necessary by a state-certified translator whose native language is English and holds membership of the Chartered Institute of Linguists (CIOL, UK).

4.4.2.4 Conducting second Survey

The practical relevance of the blueprint for future management of IT sourcing developed in chapter seven was reviewed, again using an online survey. The survey comprised six statements and a five-point Likert scale (ranging from Strongly Agree to Strongly Disagree), covering the main elements of the blueprint and ensured an appropriate level of detail and completeness. A total of 19 letters of invitation were sent out, covering the participants from the semi-structured interviews. The invitation letter also included a short interim report of the results from the interviews. The survey was launched in January 2022 and left online until end of February 2022. A total of 17 responses were received.

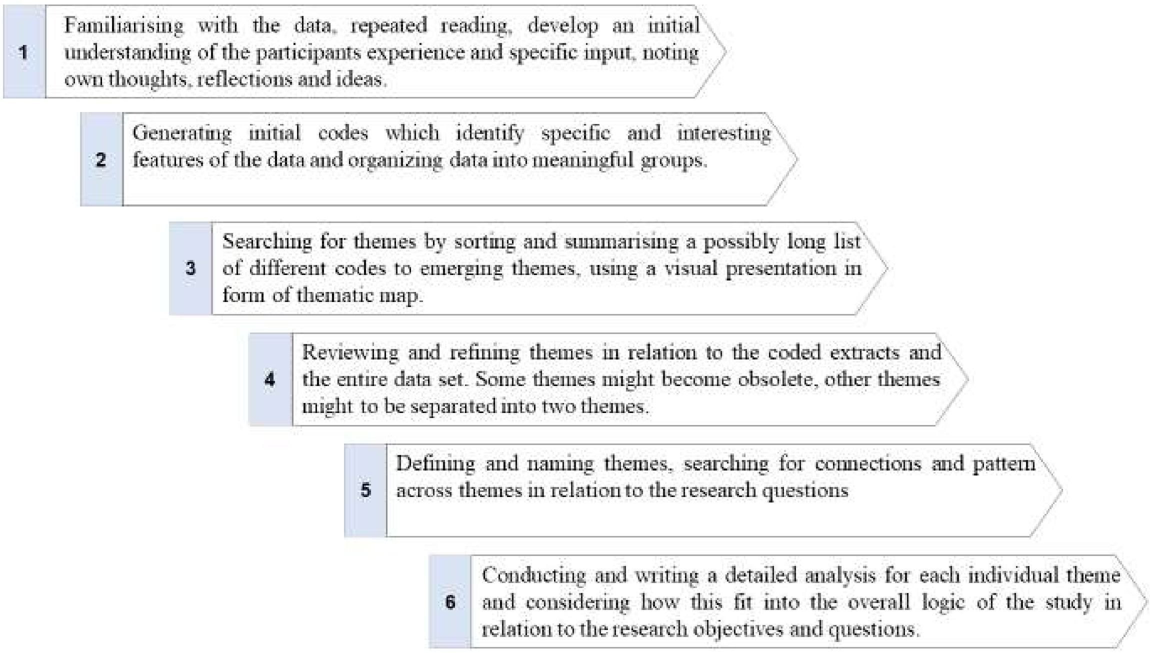
4.4.3 Analysing Case Study Evidence

The literature shows a range of methods for textual data analysis in qualitative research, such as thematic, content, framework, discourse, narrative or hermeneutic analysis (Bell et al., 2018; Blaikie & Priest, 2019; Flick, 2009; Lee & Lings, 2008; Saunders et al., 2019). Yin (2018) and Gray (2019) suggest that analysing case study evidence should have a general analytic strategy to guide decision-making of what will be analysed and for what reasons. However, Yin (2018) states that the analysis of case study evidence is one of the least developed aspects.

Yin (2018) and Gray (2019) offered five analytic techniques, such as pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis, but none of these techniques are practicably applicable to this study. Pattern matching and explanation building compares an empirically based pattern with a predicted one. Time-series analysis and logic models trace events over time. Cross-case synthesis can only be applied to multiple-case studies. Thus, much depends on the researcher's own style of analytical thinking and careful considerations of the interpretations of qualitative data.

As outlined above, semi-structured interviews and the related notes provided free-flowing text for the interpretation of meanings (Guest et al., 2013). Therefore, this exploratory study primarily focused on thematic analysis. The process involved the search for and identification of themes through repeated reading of the notes to recognise pattern within the data (Fereday & Muir-Cochrane, 2006). The raw data were analysed to identify key elements, management strategies, trends and general ideas, which were coded and categorised to represent common themes and find connections (Gibbs, 2018). Following Braun and Clarke's (2006) suggestions, the process of thematic analysis included six phases (Figure 26).

Figure 26: Phases of thematic analysis



Source: Braun & Clark (2006)

The analysis of data was guided by a pre-established / preliminary thematic map (see chapter six). The data can be coded either in a traditional manual way or by using a computer-assisted qualitative data analysis software (CAQDAS), such as NVivo (Bell et al., 2018). Dudovskiy (2018) considered manual coding to be labour-intensive, time-consuming and outdated. However, this procedure has both proponents and opponents (Bell et al., 2018). Specialised software can efficiently scan large numbers of text files for frequently referred words, phrases or topics. In contrast, Guest et al. (2013) stated that CAQDAS has limitations, as there is a risk, for example, that important insights that only emerge from the context will be lost. Yin (2018) highlights a range of issues that the software can only *assist*, but is not a substitute for analytical exploration of case study evidence.

However, in this study the data were manually analysed and coded, even though the study had to deal with a large quantity of rich data. According to Sandelowski (1998), the generation of ideas and themes is a creative process and requires the researcher to move beyond the data in order to make sense of it. Thus, the data were personally explored and interpreted to recognise and understand the contextual meanings in the notes. Each sentence was examined and noted for its relevance to the topic. In contrast to the free evaluation of data, this allowed arguments to find their way into the analysis, which would otherwise have been overlooked because they were unexpected or contradictory (Glaser et al., 2005). Additionally, from a procedural point of view, coding leads to the reduction of text to codes in order to select, focus, abstract and transform data into a consolidated form (Miles et al., 2018). Therefore, when analysing and searching for patterns, it will be not just be the codes to rely on, but always the raw data and context (Guest et al., 2014).

The presentation of the data includes primarily the voices of the participants, the reflexivity of the researcher and a comprehensive interpretation of the data related to the research objectives and questions (Creswell, 2017). The main objective is to present sufficient content and evidence in order to justify that the interpretation is supported by data (Anderson, 2010).

4.5 Trustworthiness of the Study and Ethical Issues

Questions of trustworthiness and authenticity are key considerations in the interpretative paradigm (Guba & Lincoln, 1994). In this study, the researcher had been acting as an insider with an emic position, where the researcher's own values are of importance when generating and interpreting the data as well as presenting the findings. Therefore, the research process was value-bounded, as exploration and understanding were based on the researcher's individual creativity and imagination, background knowledge and abilities to see possible connections between digitalisation and IT sourcing strategies.

However, the author of this study is a professional from the aviation industry and has chosen the German automotive industry as the context for the study. The researcher is free to think and act, has no opinions shaped by years of experience in the German automotive industry, is not occupied with any pre-fabricated ideas concerning IT sourcing, and is not accountable to any company. Moreover, power relationships throughout the interviews will be not an issue. The interviewees were high-ranked decision-makers and were not influenced by the researcher.

Therefore, this position should support the quality achieved in the generation and analysis of the data, interpretation of its meanings and reflections on the findings.

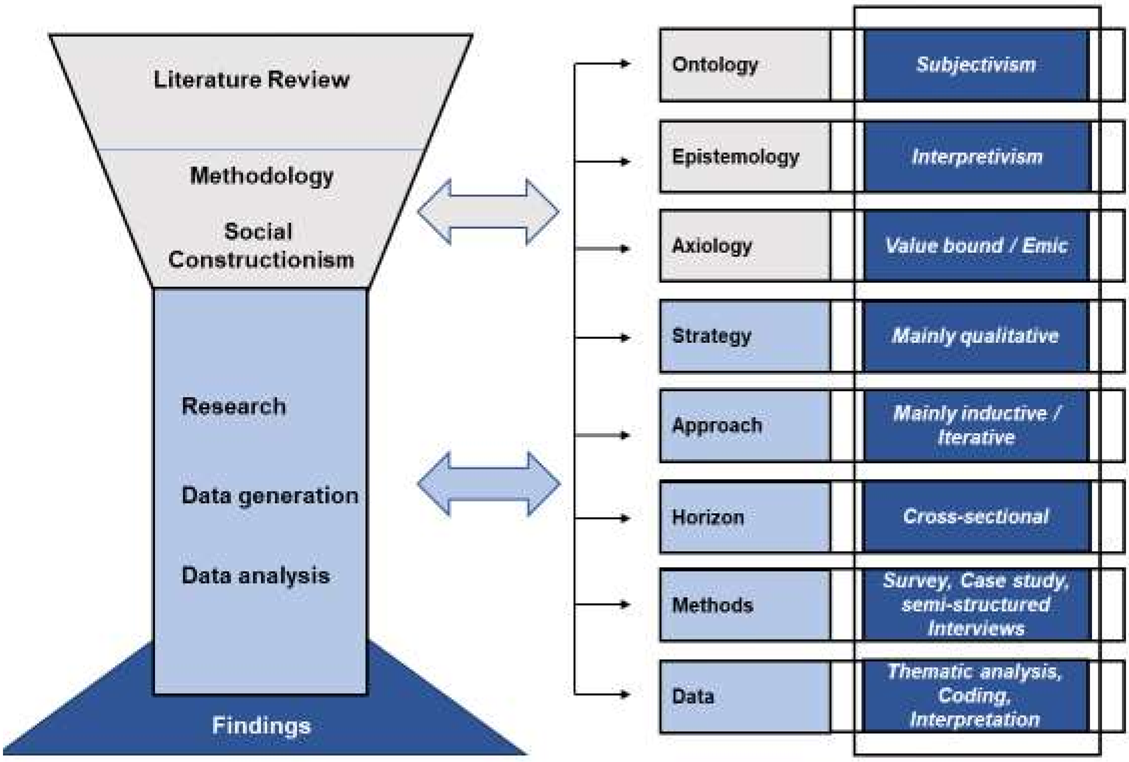
Moreover, as Guba and Lincoln (1994) suggest, trustworthiness consists of four main components: credibility, transferability, dependability and confirmability. Trustworthiness is also discussed by several other authors, such as Bell et al. (2018), and defined as a concept to assess the quality of the findings of an inquiry. Credibility refers to how believable the findings are and whether the findings bear a strong relationship to the data from which they were obtained. Transferability enables future researchers to access the findings and use the approach adopted for later studies. However, the aim of this study was not generalisation and the findings can be transferred only to a comparable context. Dependability is analogous to reliability and addresses the consistency of observing the same findings under similar circumstances, which is, in the traditional sense, not practical in a qualitative case study. According to Merriam (1998), it refers to the extent to which research findings can be replicated and suggests techniques to determine whether the results are consistent with the data collected: Explaining the assumptions and theories behind the study, the usage of multiple methods of data collection and analysis (data triangulation), and a detailed explanation of how data was collected to allow for an audit trail. Confirmability is the degree to which the findings are determined by participants and not influenced by the researcher. This was ensured by the interviewer following research guidelines for interviewing.

Ethical considerations are concerned with specifying the use of ethical and moral values while conducting the research study. Ethical consideration had to ensure that the study adhered to the University of Gloucestershire guidelines, and those of General Data Protection Regulation (GDRP). The participants were not be enforced to participate in the interviews, and could have stopped the interview process at any time. The data generated from the interviews have been stored safely to assure that all confidential information and privacy is maintained. Finally, the findings have been used only for research purposes.

4.6 Summary

The first part of this chapter started with introducing the theoretical foundations of research philosophies and the allocation of methodological fundamentals to the research process, which has led to the research process model for this study (Figure 27). After the introduction of fundamental philosophical choices in social research, two opposed research perspectives were evaluated with reference to their implications for the research problem and process. Some specific characteristics of the two perspectives underlined the basic belief in social science that there is no single right or wrong research philosophy (Connell & Nord, 1996; Holden & Lynch, 2004). Based on the methodological knowledge gained concerning various elements and alternatives, the constructivist perspective with its associated interpretative research methodology was justified as best fit for this study. This is closely linked to a mainly qualitative research and inductive approach.

Figure 27: Methodological fundamentals for this study



Source: The author

Consequently, the second part of this chapter focused on the selection of how to obtain qualitative data. Qualitative research provides a number of methods that have been evaluated in terms of their implications for this study and from which an interpretive single case study design has been selected. This included whether and how to use a case study. Furthermore, it also briefly described the several stages of data collection. Moreover, how the data were analysed and the findings produced was taken into account. Thematic analysis was chosen as most useful in capturing the complexities of meaning within a textual data set. A thematic map was developed, which shows how the textual data obtained was organised and structured. Several aspects concerning the trustworthiness of the study were considered, including the reflection of the researcher of this study regarding her own influence on the data and how the researcher may introduce bias to the results. This has been critically examined.

5 Case Study Findings

The previous chapter described the theoretical approach and how the research was carried out. This chapter draws together the findings from the 19 expert interviews as the main method of data collection. The findings represent, both in breadth and depth, the voices and opinions of decision-makers in the German automotive industry and provide the basis for the data analysis and interpretation in chapter six. Aliases are used to maintain confidentiality.

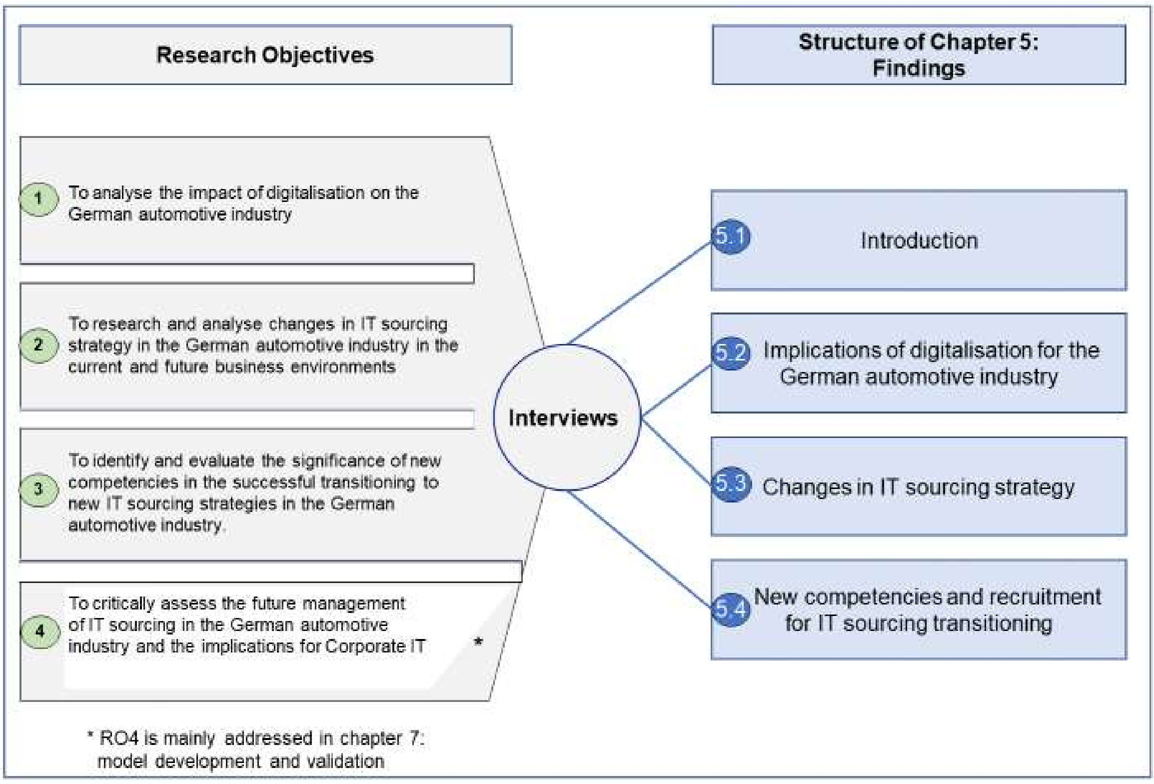
5.1 Introduction

The megatrends in the German automotive industry constitute the contextual framing of this study. Several interviewees underlined their understanding and interpretation of these megatrends and confirmed that the core issues now impacting the German automotive industry are encompassed by C.A.S.E. For example, P09 specified *"there are some big megatrends that are subsumed under C.A.S.E.: Everything is connected, everything is electric, everything is moving towards autonomous driving and this affects the processes, the machines and the new business models. Under these megatrends, the industry will change dramatically*." P01 added that, in addition to the electrification of the powertrain and autonomous driving, digitalisation is the main driver of this change. C.A.S.E. has significant implications for IT. Software is the common theme that runs through all areas. Digital technologies are synonymous with information technologies and P09 emphasised "*the word digitalisation contains two important letters: I and T*."

P09 stated "m*egatrends ultimately change IT sourcing strategies. This can have all kinds of effects."* P17 pointed out that *"the megatrends have a major impact on the IT sourcing strategy, as more IT resources are needed, and of course more specialised resources."* P06 concluded *"megatrends are leading to significant changes compared to traditional IT sourcing strategies"* and added "*as a result of the megatrends, we have to rebuild practically the entire IT organisation."* However, as P09 confirmed: *"IT sourcing is execution and a consequence of strategic decisions that depend on what the digital business model is, how the digital transformation should happen, and how fast it should happen."*

In light of these general statements, the structure of this chapter follows the overarching logic of the research objectives and is also in line with the conceptual framework, which addresses the main elements to be studied: implications of digitalisation, the resulting transformation, the emerging IT sourcing strategies derived from this, as well as the competencies required for the successful transition of IT sourcing (Figure 28).

Figure 28: Structure of chapter findings



Source: The author

After this introduction, section 5.2 addresses the investigation and findings concerning the implications of digitalisation on the German automotive industry. The subsequent section leads to the findings of the resulting impacts on IT sourcing and which IT sourcing strategies are evolving in the three technology fields, which are: digital processes and automation; Car IT / Car software; and mobility services, and concludes with the resulting current and future sourcing mix. The section ends with a consideration of whether IT sourcing can be a source of competitive advantage. Section 5.4. then reports the findings on what new entrepreneurial competencies are required for the successful transition to new IT sourcing strategies in the German automotive industry. This includes the weaknesses of the traditional IT sourcing management to date, the findings on staff recruitment and what action is required as a result of evolving sourcing strategies, and what prerequisites have been specified for a new intelligent IT sourcing. The chapter concludes with a summary in section 5.5.

5.2 Implications of Digitalisation for the German Automotive Industry

This section refers to research objective one and contains two sub-sections. The first sub-section concerns digital innovations, which are essentially characterised by electromobility, the digital car, mobility services and digital processes for further automation within the framework of Industry 4.0. The second sub-section reports on the findings regarding the digital transformation strategies the industry is adopting in response to emergent megatrends. This essentially refers to the threats of structural disruption of previous business models, the high investment required for the transformation as well as the re-positioning of core competencies in the automotive industry to cope with these megatrends.

5.2.1 Areas of Digital Innovation

5.2.1.1 Electromobility

The first area of digital innovation concerns the switch to vehicles with alternative drive systems or electrically (battery-electric or hydrogen-based fuel cells) powered vehicles. The change towards electromobility is so significant that it threatens the existence of companies that do not follow this trend. This is already clear from the regulations of many governments in the developed world. Already 15 countries will no longer allow the sale of combustion engines after 2030. Most interviewees (e.g. P03) confirmed *"that the industry recognises that the end of the previous business models with internal combustion engines is in sight."* One out of ten cars sold in the EU is now electric, and this figure could rise to one out of three by 2025. P13 reported, *"We will also no longer develop new products that are purely for internal combustion engines. All development resources at the OEMs and the largest suppliers have been diverted to the new technologies."* The industry is preparing for the fact that in 2035, hardly any internal combustion engines will still be sold in Europe, and perhaps none at all in the passenger car sector.

Digitalisation and electrification have serious consequences far beyond major brands such as Daimler, BMW, Volkswagen, Porsche and Audi: A completely disassembled combustion engine, with 1200 or 1400 parts, gives the impression of how large and elaborate the supplier industry must be that manufactures all these parts. Behind every belt, behind every seal and camshaft, there is a multi-level and complex network of dedicated suppliers that manufacture and supply the parts to the best quality with the highest precision. P16 emphasised that *"it's all very different with an electric motor."* Many parts are simply superfluous in an electric car - such as the starter, injection system, crankcase, fuel tank and exhaust. A car with an internal combustion engine has thousands of parts in the drive train, an electric car only hundreds - a factor of ten to one. The battery is the most valuable part of the e-car, accounting for about a third of the total value added. However, the batteries will not come from Germany - like the motors - but from Samsung and LG Chem in South Korea or CATL in China. The Stuttgart region illustrates the challenge of the transition to electrification. Daimler employs 19,000 people there in the development and production of combustion engines. At Porsche, as well as at Bosch and others, the focus is still on combustion engines. The whole region around Stuttgart has a cluster risk. More than a third of the value added in conventionally powered vehicles is accounted for by the "powertrain", i.e. everything that generates power for the drive. Around one third of the suppliers' workforce is involved in this product.

Moreover, P02 and P18 confirmed that electric cars initially generate less profit. P18 referenced the example of Daimler's new electric S-Class. At a price of 120,000 euros, the car would generate about 5,000 to 10,000 euros less profit per vehicle than the combustion engine variant. This was reasoned by P18 as due to the expensive battery, the costs of which are only expected to decrease significantly in the coming years due to economies of scale in mass production. In addition, P02 pointed out that the ramp-up of electrically powered vehicles is at the same time inevitably associated with a decline in sales of high-margin vehicles with combustion engines. In view of these factors, Daimler's strategy, for example, would be to rely on mixed forms of petrol and electric drive to secure high returns and at the same time an ecological balance. P18 added that *"in the next few years, the 'electrified combustion engine' business will be the cornerstone of the cash flow"* for Daimler.

In addition, P02 stressed the fact that the electrification of vehicles will seriously change the profitable after-sales market. With electric vehicles, the many sales outlets, workshops and service stations will disappear, as will the profitable sale of spare parts. OEMs estimate a 50 per cent drop in sales in the aftersales market. Moreover, the business disruption experienced by car dealers will be many times greater than for car manufacturers. It was noted that digitalisation and electric cars are putting workshops under pressure: One reason for this is that the maintenance costs of electric cars are only half those of petrol and diesel cars. Moreover, increasingly intelligent driver assistance systems should ensure that accident rates fall by 10 to 20 per cent by 2030. Technological progress is thus creating tougher competition among independent dealers and repair shops. The approximately 36,600 car dealerships and workshops in Germany, which together employ about 436,000 people, are already experiencing a tightening of the market. In this context, P13 and others stressed the significance of Volvo's announcement that they want to switch completely to e-cars by 2030. Cars with combustion engines and hybrid vehicles will only be built for another eight years. In addition, the carmaker's sales model will also be reformed - from now on, the brand's e-cars will only be available for purchase online. An indication of the future: *"Instead of investing in a shrinking business, it was decided to invest in the future - electric and online."* Direct selling via the internet constitutes a fundamental challenge to the current retail model.

In fact, as P16 observed, all car manufacturers are working intensively on the shift in their drive concepts. Hybrid vehicles, which are the first step towards electrification, have laid some foundations in recent years and improved the understanding of electric drives. However, P18 specified that the current hybrid boom is being fed by purchase premiums and tax incentives, adding: *"The environmental friendliness of hybrids is highly disputed.*" As soon as the battery is empty, the cars run entirely on petrol – and, due to their higher weight, sometimes even consume more than conventional combustion engines. P18 further observed that *"with regard to drive concepts, there is a fierce debate in the German automotive industry on how technology-open the industry needs to be*." The corporations are fighting hard to find a common master plan to cope with the economic effects of the new drive concepts, as well as against the climate crisis and new rivals like the digital newcomers and Tesla. There is the Volkswagen Group, which rejects any openness to technology and has focused its corporate strategy exclusively on battery-electric cars. By contrast, there are BMW, Daimler and large suppliers such as Bosch and Continental, who are not only pushing for battery-electric cars, but also pursuing avenues including alternative drive systems such as fuel cells, and synthetic fuels (so-called e-fuels). These companies are of the opinion that those who want to tighten climate targets and achieve them faster should not limit their options at the same time. For these companies, the future of mobility is also electric from today's perspective, but for zero-emission drives they are pursuing two approaches: Battery-electric and fuel-cell drive systems, which are powered by a fuel cell and liquid hydrogen. More specifically, the vehicle's fuel cell uses hydrogen as one of the elements in an electrochemical reaction that generates electricity. Simply, for electric vehicles that use hydrogen and fuel cells to generate their own electricity, a battery comes into effect whenever additional energy is needed in the drive operation. For Volkswagen, hydrogen is demonstrably not a climate solution. Above all, the much higher energy consumption in the production of hydrogen-based fuels is a major problem. Since it sometimes consumes more than ten times as much electricity to produce the hydrogen, it is much more energy-efficient to use battery cells.

Several interviewees underlined that "*there are also immense economic interests at stake*." The Volkswagen group, as a mass producer, can only increase profits if it concentrates on a uniform type of drive concept throughout the group and can roll it out in millions of units. The situation is different for the suppliers. At present, they are still profiting from selling as wide a range of technologies as possible. If, in addition to purely battery-electric drives, alternative drives such as fuel cells or synthetic fuels were to establish themselves on the market, they could continue their profitable legacy business with complex components. P18 stated *"They do not believe in a fixed end date for petrol and diesel engines, because these engines would still be needed on other continents."*

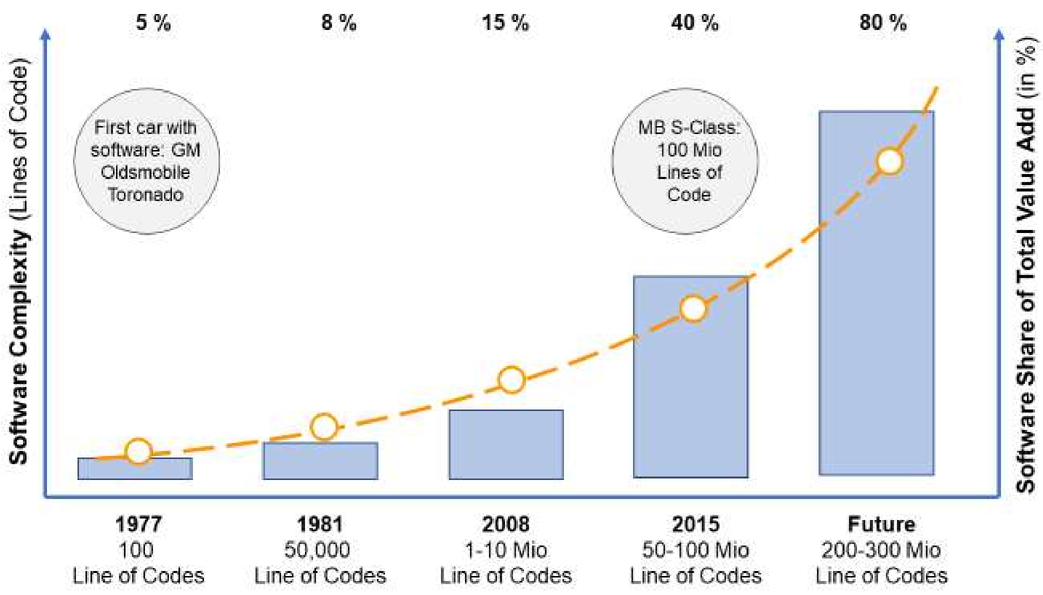
P16 emphasised it is not the electric drive alone that will determine the future, but also intelligent driver assistance systems, the ability to build self-driving cars, to network them and to develop profitable mobility services. These innovations will predominantly focus on the new electric vehicles. Customers of classic combustion models will only have access to these technologies and services on a very small scale. The OEMs would have to make additional high investments to bring the combustion models up to the latest technical standards. As the end of the combustion engine draws nearer, companies are more likely to decide against these additional investments.

5.2.1.2 The Digital Car

The second area of innovation triggered by digitalisation concerns the "digital car." P16 stated that *"the automotive industry, but also companies previously outside the sector, are working hard on software solutions, driver assistance systems and other technologies that will enable* *connected, highly automated and even autonomous driving."* The most prominent theme is to create a software-defined vehicle architecture for these high demands.

P02 added: *"Creating an autonomous vehicle is perhaps one of the automotive industry's biggest computing challenges - it's a tremendous software effort."* P01 explained further that *"IT will become the defining technology in the automotive industry and the majority of manufacturers in 2030 will be IT companies with connected car production."* Some visions of the future were provided to underline what connected vehicles really mean: Devices in the Industrial Internet of Things and rolling platforms for collecting data, which are the foundations for the future billion-Euro business in the ecosystems for mobility services. The interviewees agreed that electromobility, digitalisation, vehicle networking and autonomous driving functions will dramatically increase the proportion of software in future model generations. P18 offered an insight into how the automotive industry is undergoing a transformation process decade by decade, from a hardware manufacturer to a software provider (Figure 29 illustrates the importance of software in vehicle (lines of code) and share of total value added).

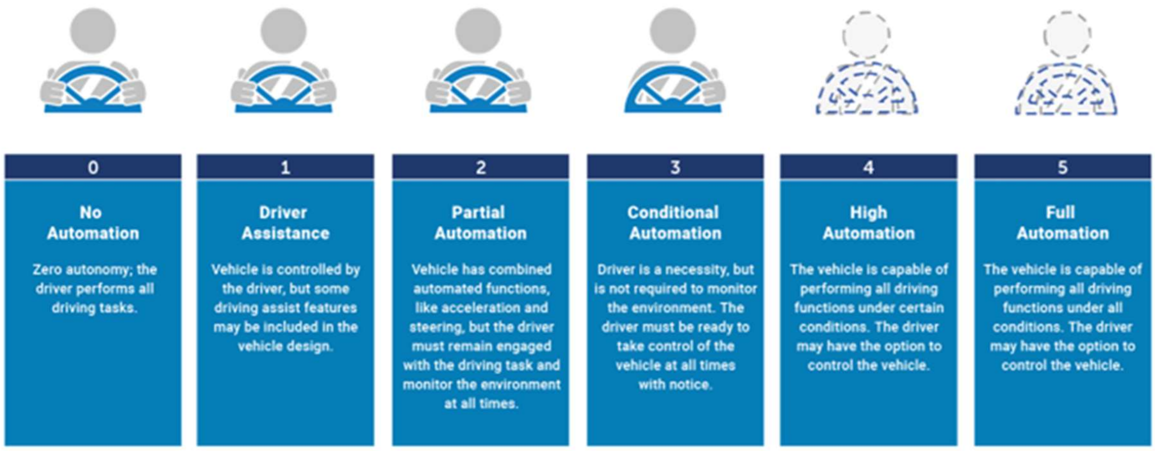
Figure 29: Importance of software in cars



Source: Findings; Seiberth (2015)

Until the 1970s, the automotive industry was classic "old economy", but already in the 1980s, things were starting to change: Electronics made its way into the industry. Fuel injection suddenly became electric, and software found its way into the car, albeit still at a very low level. In the next decade, electronics became more and more powerful and the software share in the car slowly increased. Finally, since the beginning of the 2010s, hardware has become less and less important, whilst electronics and software have dominated. The transformation of the automobile into a mixed hardware and software product has gained more and more momentum. P18 referred to statements made by Daimler that there were around 100 million lines of code in their S-Class vehicle back in 2015, and this would already have been a complex IT product. In the next few years, a tripling of lines of code in the car is expected - also against the background of electromobility and autonomous driving. Daimler informed that the new S-class, which was launched in summer 2021, is the car with the most comprehensive automated driving functions at this time. The car is described as the first "level 3" vehicle. The Society of American Engineers [SAE] (2021) has classified driver automation into six levels (Figure 30). Most manufacturers are currently in transition from level 2 to 3.

Figure 30: Levels of driving automation



Source: SAE (2021)

Interviewees explained that the future software in vehicles will consist of different layers. One layer comprises software modules that OEMs use to individualise their operating system, from the powertrain to infotainment and assistance systems. Here, individual brands differ remarkably. Other layers, such as the basic software of the control units and so-called middleware, regulate basic tasks of control units and vehicle computers that are not perceived by the driver. For example, they manage processor performance and memory space or determine how control units communicate with each other or with the cloud and exchange data.

P02 stated: *"we assume that the software share in cars will increase by a factor of ten in the next ten years due to new functions."* However, estimations vary. Some scenarios assume that by 2030 the industry will have up to one billion lines of code in the car - especially if autonomous driving functions are added at levels 4 and 5. How many lines of code there will actually be in the end will also depend heavily on how much functionality runs directly on board and how much is calculated in the back-end systems.

The industry has long since had to develop software efficiently. P18, for example, referred to Continental with its approximately 45,000 engineers, one third of whom work in product IT and software. While hardware will also remain important for a very long time, the share of engineers in product IT and software is likely to rise to 50 per cent. P18 stated further that manufacturer must now increasingly transfer the hardware processes they have learned over decades to the software. "*This is easier said than done, because in contrast to computers or mobile phones, safety-relevant functions in cars must work 99.99 per cent of the time: No customer wants to experience a reset or an unprovoked emergency braking at 130 km/h on the motorway*." P18 added that "*the car is now considered the most complex electronic device with 6 times more lines of code than a commercial aircraft*." By comparison, there are supposedly only 14 million lines of code in a Boeing 787. "*To drive fully autonomously (SAE Level 5) under all traffic conditions, human cognitive abilities must be taken over by artificial intelligence."* This requires centimetre-level localisation with intelligent maps updated in real time via the backend. In addition, the on-board information must be constantly updated with fast data transfers (e.g. 5G with 10 GBit/s) and the vehicle architecture must compensate for a failure of technology (sensors, control units and software) through redundancy with error and protection mechanisms. P18 also stated "*the challenge is to integrate these software modules and develop an integral software architecture that can serve as a platform for digital functions developed in the future*."

However, a large part of car software today is distributed across many different ECUs with embedded software from different suppliers. The in-house share at the OEM represents only certain integration tasks. Interviewees from the OEMs confirmed that OEMs want to develop more software themselves but also want to reduce their effort at the same time. P18 noted "*that is not a contradiction. It is the solution. Today we have the main burden with the networking of hardware and software in the car. Just one example: currently up to 70 ECUs have to be networked, running software from 200 different suppliers. We spend a lot of energy on technical integration and work a lot on the basis of third-party developments*." With C.A.S.E., the OEMs have set a new strategic course in the direction of future technologies for highly automated/autonomous driving and have recognised that software is part of its core competencies and, as a result, the share of in-house software development will massively increase. The focus of developments is on software-defined vehicle architectures and the operating systems for connected vehicles. "*We have to be the ones who develop the software, who set the standards and make it available for all brands and suppliers*."

P05 objected that *"all these statements that the car of the future should be imagined as a smartphone on four wheels are also rather inappropriate,"* and *"it would be much more appropriate to view the vehicles as internet participators .... or internet-of-things devices."* P01 called the car of the future an *"impressive edge device."* Given the enormous computing requirements of fully autonomous vehicles, high-performance AI supercomputers capable of processing data in real time are needed. Such platforms consist of tightly linked hardware and software and provide a safe driving experience through a combination of deep learning, sensor fusion and all-round vision. In addition to software development, machine learning and neural networks play an important role in the realisation of solutions such as automated driving. The demands on the computing power in the vehicle for higher levels (from SAE level 3) are many times greater than for the current level of driver assistance systems.

P02 viewed the digital car as technically predetermined for a central role in global networking and illustrated the enormous amount of data that is produced there. An Airbus A320 collects about 10 gigabytes of data per flight hour, whereas an autonomous vehicle in driving mode will produce about 4,000 gigabytes of data per day according to estimations. Even today, a vehicle has the computing capacity of 20 PCs. The data is collected by 60 to 100 sensors - this number is also likely to double in the next few years. In addition - depending on the type of vehicle and its equipment - there is data from up to eight cameras. As P02 remarked, "*All this makes the vehicle the ultimate mobile device."* P16 reaffirmed that these data volumes will continue to grow rapidly because more and more vehicles are equipped not only with cameras, but also radar systems and lasers. All these systems produce data. "*The driver assistance computers have to trigger the right response. The software thus controls the car's hardware. The volumes of data generated by such processes sometimes push networks and platforms to their limits*."

5.2.1.3 Mobility Services

The continuous collection and ongoing analysis of vehicle data serves the central purpose of monitoring and maintaining vehicle functions. However, the possibilities for further intelligent use of this data go far beyond this original purpose, as completely new products and services can be developed within digital ecosystems, based on appropriate platforms. The automotive sector sees itself as the industry that already has the most data available, and will have even more in the future with connected cars. Powerful backend systems need to be built to process the data, and the ambition is to monetise this data in new digital business models. In this context, the third area of innovation triggered by digitalisation emerges, in the form of data-driven business models and related mobility services.

Interviewees stated that in the future, the car will be the interface for services, embedded in an ecosystem that combines technology, innovation and collaboration to enable mobility at the right time for the right purpose as a seamless part of daily life with maximum customisation and flexibility. P02 emphasised that this *"networking does not stop at the traditional sector boundaries."* Therefore, data-driven business models integrate value-added components from different sectors, for example: travel and transportation, IT, retail, financial services, media, and consumer electronics. Instead of focusing on the sale and maintenance of cars, car manufacturers will have to address the sum of these direct and indirect business possibilities in the future.

As reported above, modern vehicles already collect a vast amount of data about themselves as vehicle lifecycle data and, with the widespread availability of driver assistance systems, increasingly more about their environments as well. Several interviewees underlined the new relevance of data for the future digital business models. P09 emphasised *"data are the absolute core of a company's value creation, and nothing else*." They are not a piece of software, this are just shells of the onion, but at the centre are the data. P16 stated that "*the automotive industry has an incredible amount of data, it's more data-rich than almost any other industry.*" The industry has huge volumes of data that are generated within production, huge volumes of data that are generated in development and testing, huge volumes of data that are generated in the use of products, both in the components and in the overall vehicle. And these are complexities and interrelationships that no other tech player has in that form. P16 further added *"this is a world that is much more complex than when Amazon predicts what Mr. Huber will order next"*. A machine tool has 3,000 parameters. If a company cannot control and also optimise these data, it will never produce a reasonable product. If a company understands this, it will also know what the product or the vehicle is doing in operation. Or why it does not do some things as calculated or expected. Only in this way can a company develop a know-how that differentiates. P09 stated that *"the companies have to be the master of their data"*. If they do not understand the principle or do not manage it and do not set up the necessary activities to both understand, integrate and secure their data, then they will lose competitiveness.

P01 specified that "*the shift from a hardware-based to a software-based economy must be made.*" Cars may still look like cars in the digital world, but the big change is how they become the core of a digital ecosystem in which a wide range of new services evolve around mobility. P11 observed that *"something very important has changed in our company and in the entire industry: We are becoming data-driven."* Now even the CEOs understand that they must become aware that data is emerging as the most important asset in the company. This data-driven orientation is the future. That is why the industry is now working on recognising data as an important asset outside of the existing products and services, and trying to derive profit from it. Interviewees asserted that future product success in the world market will increasingly be determined by software, information technologies and digital ecosystems. P01 summarised the situation thus: *"What we are saying is that with the emergence of platforms, power structures in the market are shifting"*, and *"data as a resource, and platforms as the infrastructure for its use, are changing the order of the economy."* At the heart of digital ecosystems are open platforms that use high-end technology to connect people, organisations and resources within an interactive ecosystem, and get the exchange of data and goods up and running and generate many new services.

However, P02 concluded that intelligent use of this data in *"connected mobility services are still a relatively new business field for the German automotive industry and are currently not part of its core competency."* The majority of OEMs do not yet have extensive practical experience with such mobility services. P02 noted that in terms of their mobility services, car manufacturers are not yet making a profit, and it is not yet clear for the industry whether and how the high investments in ecosystems will pay off. In some cases, they are currently withdrawing from such business models. A prominent example is the mobility provider Share Now, a joint venture of BMW and Daimler in the field of car sharing. Share Now, in which BMW and Mercedes have merged their companies Car2go and Drive-Now, was founded in 2019. Both groups have now made a change in strategy and are concentrating all resources on electromobility and digitalisation, such as operating systems for connected cars. The car companies are also inevitably having a harder time with car sharing. Mobility services outside the automotive industry have the mission to noticeably reduce individual car use, whereas P02 further added *"car companies are in a dilemma because reducing car sales is not a strategic cornerstone."*

5.2.1.4 Digital Processes and Automation

Almost all interviewees confirmed the importance of the IIoT technologies to develop platforms for manufacturing, in order to network production facilities worldwide. IIoT combines a variety of digital technologies as part of Industry 4.0 or the so-called Smart Factory to further increase the flexibility of production. They regulate the flow of data between plants and control all logistics for parts, procurement, production and distribution. Digital twins will also run on them in the future, allowing them to monitor and support production in real time. P16 reported on how Siemens and Daimler are cooperating on the digital car factory. In this project, a fully digitised model factory is being developed for the Mercedes plant in Berlin-Marienfelde. This Digital Factory Campus is to become a pioneer for all 30 Mercedes plants worldwide.

Interviewees underlined that the German automotive industry already has years of experience with digital technologies and mentioned a variety of examples, such as Virtual Reality and Augmented Reality, as well as 3D, simulation of crash-test conditions, as well as the simulation of the manufacturing and assembly lines. Smart factories already combine a variety of Industry 4.0 applications, such as robots connected to the internet, and the use of high-performance computers (edge computing) for machine learning and data analysis to monitor the real-time status of all machines for the prediction and reduction of unplanned downtime (predictive maintenance).

However, P05 noted that IIoT combined with "*digital assistance systems, data analytics, artificial intelligence and machine learning are rapidly changing the value creation processes in industry.*" P05 also emphasised that the central issue of Industry 4.0 is the transformation process from individual, human-controlled manufacturing steps to networked digitised production. The real and digital worlds are merging through digital solutions for autonomous, networked ecosystems in which data is seamlessly linked, and more intelligent processes are emerging. Another central element of the digital factory includes complete digital factory planning and simulation with the help of the digital twin. Industry 4.0 development is based on 3D models of plants, machines, equipment and products and a sophisticated VR application for simulating work processes. P02 added that "*an important focus is on the Industrial Internet of Things, big data and analytics, artificial intelligence and cognitive computing. In other words, the manageability of huge amounts of data with the vehicle at the centre of the Internet of Things.*" An emphasis is placed on the combination of digital technologies as IIoT together with big data analytics, and AI is considered an important lever. P02 also noted, *"put simply, IIoT collects the data and AI interprets it: Everything that can be networked will be networked"*. However, as P16 stated, *"implementation is not that simple. Because what is now to be networked via the internet, especially the production and logistics facilities, must now be integrated much more intensively with the rest of the company's IT."*

In summary, all IIoT initiatives are aimed at further increasing flexibility in production to cope with the full range and variance in powertrains. This is especially important when models with combustion engines and battery electric drives are to be built in the same factory or even on the same assembly line. With regard to supply chains, P18 expects a value chain with significantly leaner structures for pure e-vehicles. In order to secure value added creation and employment depth, car manufacturers will increase their vertical integration for the new components, which will lead to intensified pressure on suppliers. P18 argued that the advancing automation in production also reduces the benefits of relocating production facilities abroad. P18 also stated that this trend will accelerate with the Coronavirus pandemic, because of the shutdown regulations *("which will be with us as long as it is not clear how long the virus will be with us* *and how durable the available vaccines are and, above all, how quickly and to what extent they will be available to all countries in the world"*). Consequently, the relative cost of workers versus robots will rise. This will accelerate automation.

5.2.2 Digital Transformation of the Industry

The megatrends and digitalisation are part of a transformation process, which, as noted by P9, *"has to happen in a coherent transformation model that serves as a blueprint or roadmap."* This is how to move the enterprise from the current mode of operation (CMO) to future mode of operation (FMO). All of this must interact in such a way that it is reflected as quickly as possible in the product, the process, the business model and the people. Interviewees underlined that it is important to bear in mind once again where the German automotive industry has come from, the situation it faces, and the structural changes it is undergoing as a whole. Basically, the German automotive industry is fighting on two fronts: On the one hand, it is in the middle of the transition to e-mobility, and at the same time it has to manage the next technological change, which is turning very successful car manufacturers and suppliers into software companies. P12 stated that, in other words, "*the whole thing should no longer be called the automotive industry, but the mobility industry."*

This transformation must take place in the dimensions of processes, product and business model. It also has implications for the dimension of people and, of course, in a larger sense, culture. For P15, it is important to complete the transformation in steps that make it possible to carry out and allow for a change without creating a collapse of the system. However, P14 stated that it is already clear today which companies will survive and which will not. *"Above all, it is the speed of change that determines whether a company can adapt and survive."* Anyone who concentrates on hardware alone will have no future. This was reinforced by P09: "*This is a parallel transformation that has become a real brutality because of this parallelism, a breadth, a force that has not been there in this form in the last hundred years, not since the beginning of the industry."* P15 concluded that the most exciting question is how to transform something within five years in a company that has been established over 100 years. The conclusion is that companies will need to transform. P09 emphasised that *"it's of no use just saying that we'll have a study done when we see a problem, and then we can always think about how we can act in two years' time."* P11 added that the big challenge is to benefit from the whole transformation, by, for example, identifying appropriate use cases and projects to deliver such benefits. The companies all know that they have to move in this direction. As P11observed, *"they all know that they need perseverance, that it won't happen overnight,"* and "w*e don't think they're all going to get it right"* (on a supplier level). This is a whole new environment; whole new products that are being developed, and not all of them will succeed.

However, the statements of the interviewees revealed that there is a very different understanding of whether the changes can be compared with the previous decades-long and ongoing evolutionary transformation and do not pose an absolute threat to the industry, or whether they are rather disruptive in nature. This was commented on by the interviewees in different ways and with a wide spread of opinion, as can also be seen from the responses to statement five in the online survey.

5.2.2.1 Interviewees' Understanding of Evolution and Disruption

As regards the nature of change, P01 stated *"we keep two things very much separated: disruptive versus transformational"* and added *"disruptive is actually an ugly word and doesn't play as big a role in reality as many people think. Our topics and focus are much more on the notion of transformation rather than disruptive."* It was underlined that digitalisation is fundamentally associated with greater changes than was the case with other technologies or megatrends, but whether these are transformative in some cases or disruptive in other cases depends on the company in question. P01 further added "*those who have already invested constantly in state-of-the-art technologies in the past in order to constantly improve their processes will not call many things disruptive. Disruptive has become such a buzzword, you have to be very careful with it. That is less present in the business world than transformation."* The concern is that change should be more of a continuous process. *"With transformation, we want to prevent ourselves from becoming obsolete and being replaced by the competition or having our business model destroyed."* The company in question understands disruption as being when an existing product is almost completely replaced by another. There is no continuous evolution of a product, but rather a new technology has completely replaced the previous product. This is not seen with the car. In contrast, "*the car replaced the stagecoach. That was disruptive."* Even a self-driving car is not a fundamentally new technology but a further development of existing vehicles. Even if the car in the future becomes more and more a rolling data centre, a moving IP address, it is still a car.

P03, on the other hand, noted that *"the term disruptive is used over and over, but whether you like the word or not, if it applies to any industry, it's the automotive industry. You can't get more disruptive than this."* Others expressed the view that disruption is a marketing hype, and that developments would be largely evolutionary. This was reinforced by P05: *"Nothing here is disruptive at all."* Electromobility, for example, is primarily an environmental issue. P06 views autonomous driving as disruptive, but not electromobility. E-mobility is actually a necessity that companies should have started much earlier, but which no one has really tackled, because of the high investment required and the initial loss of revenue. In contrast, P14 stated "*from our point of view, these technologies and megatrends are disruptive."* It is seen as more of a radical change, especially for parts of the supplier industry. There is being discussed with the federal government to create a rescue agency for the supplier industry, because there are concerns that some suppliers will disappear because they are unable to cope with the transition to the new technologies.

P01 stated that *"the German automotive industry has been undergoing these IT-based transformations for decades"* and added *"we don't work with paper and pencil, and over the decades we have developed highly efficient processes and systems that have made the German automotive industry a world leader."* This was reinforced by P10: *"We didn't develop the car on a whiteboard before, and we didn't staple it together in the basement."* P06 concluded *"some of the new digital technologies are disruptive, but most are not. IIoT is not disruptive, these are developments that have been going on for years. AR/VR can be disruptive, depending on how it is used."* P13, on the other hand, maintained that digital technologies may be all-important for their respective purposes, but they have nothing to do with disruption. Digital technologies are all evolutionary developments, and many of them are not fundamentally new. P06 added that *"the cloud is not a disruption either, it's just a different model."* P19 named quantum computing (solving complex problems more efficiently and quickly), blockchain (transaction histories are visible to every participant in the network) and immersive experience (VR and AR are changing the way to interact with the digital world) as disruptive. IIoT and Industry 4.0 were named as evolutionary. P08 observed that *"this discussion, whether disruptive or not, essentially depends on what level of maturity a technology currently has. A technology is* *quickly described as disruptive if it is available but not yet mature enough,"* where the nature of what is possible is not yet clear, and the adaption to specific use cases is not proven. These statements of the interviewees also spanned the following opposing views on threatening structural disruptions of business models due to the megatrends and digitalisation.

5.2.2.2 Threat of Structural Disruption of Business Models

Most interviewees shared the view that the German automotive industry is on the verge of an upheaval the likes of which it has not seen in the past 100 years. The transformation in the automotive industry over the next ten to fifteen years will be beyond comparison with developments up to now. P13 stated that "*the switch to electromobility is the least significant issue here. This is a technology that we have mastered*." A new drive technology is not a particular challenge, and vehicle construction will not change significantly as a result. Digitalisation and the topic of software as the second fundamental change is the greater challenge for the automotive industry overall. If the cars of the future develop more and more into a permanently networked mobile device, automotive manufacturers will be faced with much more fundamental changes in their own processes. Autonomous driving with the "software stack" of a car operating system plays a central role here. P13 added *"important for this are the advances in artificial intelligence. This means that computing power increases tenfold every two years*." This will provide the necessary computing capacity for the foreseeable future to be able to use the large volumes of data gathered from image recognition and processing. Image recognition that replaces the human eye is what makes autonomous driving possible in the first place. Software in the car is set to become the most important revenue driver over the next ten years. New services would play a major role in enabling the market for individual mobility to grow strongly in the future. This also explains why IT players such as Apple or the Chinese Internet group Baidu, for example, are making great efforts to enter the automotive business. These companies, with their great software expertise, anticipate the opportunities that will arise in mobility in the coming years as a result of the strong increase in the use of IT.

Interviewees also confirmed that, until recently, the German automotive industry believed that vehicle connectivity, digital networks, and software- and data-driven digital services would primarily be used to further perfect its real-world, conventional cars. They also added that they did not question their traditional business model, which revolves around selling cars for individual mobility. In consequence, the industry is still heavily invested (including labour) in end-of-life business models, technologies and products. P01, in reference to autonomous driving, stated that this does not start with the robot car without a steering wheel and driver, but is already developing from numerous increasingly intelligent assistance systems. These can be offered to customers as additional options, enabling manufacturers to improve their market positioning and refinance their development investments. The latest features are first launched in the premium class and then migrate, bit by bit, to the other market segments. P01 remarked that *"the gradual development of autonomous vehicles is thus in line with the classic innovation approach of the automotive industry."* This is based on the general view that disruption is always an extreme process, in which everything that has existed up to now is replaced. This can make sense in some cases, but in most cases a steady transformation is more effective. In contrast, P10 insisted *"we see the two topics of electromobility and autonomous vehicles as a disruption."* Everything around vehicle connectivity presents significantly different challenges to those of the past.

P19 further explained a view on the classic innovation approach of the German automotive industry and argued that "*digital technologies are rather evolutionary in the sense as it is interpreted and also implemented by the automotive industry. This is always associated with the central question of what it will achieve, and in particular demonstrably achieve*." Before investing, it must be proven that digitalisation, in combination with change and new technologies, really delivers added value. "*It is evolutionary because the methodology used to evaluate the success of new technologies is the old metrics: What does it cost, what is the benefit, and this thinking actually only allows for evolutionary development*." That is the conservative approach which can still be seen in the automotive industry. There are not ad-hoc decisions without knowing how an investment will pay off in the future. "*The automotive industry is still too caught up in the classic thinking patterns."*

However, participants stated that the German automotive industry was late in recognising and addressing these challenges and especially underestimated software as a future key technology in cars. Moreover, P13 stated that the industry "*didn't want to admit how new software-driven tech players were entering the market."* P06 indicated that the industry has failed to recognise these software revolutions that are emerging with digitalisation and, above all, in the context of connected cars and automated and autonomous driving. P01 stated *"Until now, we had a familiar world of global competitors, car companies after all."* With digitalisation, autonomous driving, the electric car, the mobility of the future, software is becoming the key technology. Newcomers from outside the industry in the U.S. and China have placed digitalisation, and software itself, at the centre of the new mobility. Software is not an add-on, but the centrepiece of the vehicles and new business models. Unlike the move to electromobility, the competition for software development is not, with the exception of Tesla, coming from within the automotive industry, but from powerful and financially strong IT players from the US or China, such as the Google parent company Alphabet, Apple, Microsoft, or Alibaba and Baidu.

They not only want to bring the internet into the car, but also control its core functions with their operating systems. Rumours that Apple could soon develop vehicles with superior IT are taken extremely seriously in the industry. Google parent Alphabet has long since begun to transfer its software dominance from the smartphone to the car. The Android Automotive operating system controls not only the infotainment in the car but also the air conditioning and seats, for example. Google's offer is tempting for the manufacturers because the group offers them the software for free. PSA, General Motors, Renault-Nissan and Volvo have already announced their intention to use Google's operating system. This will save significant development costs, but will mean they will not have the opportunity to profit from data-driven services and software-updates from their own operating systems. P02 summarised the situation thus: *"There is already a massive battle going on. The German car industry is late to the game, it completely underestimated the software revolution until a few years ago."*

P06 observed that *"tech players have already recognised much earlier where traffic or mobility of the future is heading."* These companies have long since started using their software dominance to develop operating systems that act as the brain and central nervous system controlling all functions for the connected car as progress is made toward highly automated and autonomous driving. With more than 10 years of research, millions of test kilometres accumulated, superior IT, and billions in investment, they now are far ahead of the German automotive industry. P06 further pointed out that these fast-paced technological developments go far beyond the traditionally existing strengths of the German automotive industry and "*the industry has fallen behind the tech players, which is now taking its toll."* P05 noted that *"the tech players have a lead in autonomous driving"* and the German automotive industry *"currently has competitive disadvantages in the area of automated/autonomous driving ... and the industry has a lot of catching up to do."*

P01 suggested that these technology companies have an advantage over the German automotive industry in that they have no history, no 120 years of hardware-centric automotive engineering. Tesla, for example, first developed software for its car, i.e. the central computer in the car, and then built a car around it. If Apple really does manage to launch the iCar, which has been under discussion for some time, they will first develop the software, i.e., the on-board computer and the operating system for the car, which they will couple with their Apple operating system to try to create a monopoly position, as was the case with the iPhone. Then they will look for a *"sheet metal bender"* to supply them with the vehicle, yet continue to control the core functions of the car with their operating systems.

P13 considers that *"the danger of disruption exists somewhere else entirely. The German companies are leaders in traditional hardware and components, but not in the collection and analysis of large volumes of data."* These tech players are shifting the balance of power in the market, because the car operating system protects the interface to customers, and thus access to valuable data. This constitutes a high risk of disruption for the German automotive industry, with it becoming marginalised, rather like Foxconn in the mobile phone market. (The Taiwanese contract manufacturer Foxconn produces millions of iPhones for Apple, but receives only a fraction of the margins that Apple achieves, because Apple occupies the customer interface with its operating system, where the money is earned). The great danger is that the car companies will lose control of the data and thus the interface to the customer. P13 concluded *"those without data are powerless."* Data is becoming the central driver of mobility competition. The mobility market will be dominated by those companies that have a head start in customer access and knowledge of customer needs, because they can access utilization data and patterns and have corresponding learning curves. In contrast, car manufacturers are still unable to fully exploit the potential from the customer interface and customer relationships. This is now becoming increasingly evident with digitalisation. First and foremost, car manufacturers are still engineering-driven companies that focus on the product rather than the customer.

Apple, Google and other tech players, on the other hand, are considered unbeatable when it comes to customer contact. They have been collecting and analysing data for more than two decades - and know consumers' preferences better than any industrial group. The tech multinationals know when their customers get up, what music they listen to, where they spend their time - and they predict which product or service they can sell them next. P13 stated "*BMW or Daimler, on the other hand, didn't know for a long time exactly who was driving their cars. They had outsourced contact with customers to dealers."* In this context, it was argued that *"the high risk is that we* (the OEMs) *become a pure hardware supplier,"* because in the future new revenue will only be generated via this interface. P01 added "w*hile Tesla, Google, Apple, and Microsoft have started on the greenfield in terms of software, we first have to make the painful and very capital-intensive transformation from a traditional carmaker to an integrated hardware and software company and mobility provider. If we don't get that done quickly enough, it will indeed be disruptive,"* and then the industry will be relegated to being a producer of car bodies. Admittedly, this is a horror scenario for the German automotive industry, which is so used to success. P01 further commented *"no matter how much German engineering expertise we have, the software giants will win the race."*

In contrast, P03 expressed the view that the effects on the automotive industry are of an evolutionary nature, but it is also not the case that the industry has a lot of time and can calmly consider what the tasks today are, what would have to change, what will have to be done in the future. P09 stated that *"speed is still an issue: Can we manage to build up this software know-how fast enough?"* P02 added "*it is only disruptive if we don't adapt to it in time."* P08 noted *"digitalisation creates pressure but also opportunities to develop new digital business models."* This was reinforced by P12: *"We see the megatrends as enablers for serious changes."* P15 noted *"digitalisation is nothing more than a new start for relatively difficult, large, old organisations, because these structures and entities are no longer suitable for the future."*

5.2.2.3 Investments for Digital Transformation

P02 stated *"the most difficult challenge is to finance the very large investments needed for digital transformation."* P09 added *"when we consider the sums that are currently being invested in the development of electric motors, batteries and hybrids, it's a huge undertaking."* P03 observed that digitalisation has led to a reallocation of investments among automotive companies in the direction of electromobility and software. Digitalisation means that a completely new distribution of investments is necessary *"now the billions are going into IT and* *software."* P01 pointed out that the electrification of the *"powertrain and a digital vehicle architecture are mutually dependent."* The specific characteristics of electric vehicles require that the vehicle becomes much more integrated into its environment. *"Therefore, the company is focusing strongly on the topics of software and digitalisation as well as electromobility, and investing billions over billions in this area."* P05 insisted that tier-1 suppliers, such as Mahle, ZF and others, first have to manage a much larger corporate restructuring because they are very much confronted with legacy issues related to combustion engine technology. This requires a massive counter-investment strategy, which costs a lot of money that first has to be earned. At the same time, the market for suppliers of combustion engines is also declining. That is why the big challenge in the supplier sector is to financially master digitalisation and its associated transformation.

However, interviewees remarked that the financially strong IT players are in a better position, because they do not have a legacy automotive industry to deal with. In contrast, the German automotive industry will have to continue to finance the digital transformation from its cash flow and profits from business models based on conventional vehicles in the coming years. This, in turn, is coupled with a drop in sales due to the pandemic, a decline in sales of vehicles with traditional powertrains, lower margins, lower value creation in electromobility, and the loss of revenue in the aftermarket. Only limited capital is available for the necessary investments in digital transformation and new business models. Equity in the automotive industry will generate significantly weaker returns over the next five years. P02 addressed it as the crux of the matter: How to manage the future conservative development of the existing model (with which the money is still made) and, at the same time, the transformation into digital business models (where it must be decided early on if an innovation works and will prove itself commercially). *"To find out, high investments are necessary, which you have to earn with the existing model. That's how we have to look at this transformation in the automotive industry, which is always so easily spelled out."*

P02 realised that *"every cent that we can save is valuable money that we need for transformation."* P05 added *"costs remain a dominant topic everywhere. And in the current economic situation anyway."* However, P06 observed *"it's also always the same pattern: When there is a crisis, costs are cut and projects are discontinued. There is a lack of sustainability to invest in the issues of the future despite the crisis."* P16 added *"the balancing act is that we* *have to keep up the pressure to innovate despite the critical economic situation"* whereas *"the crisis is spurring the need for change, as the megatrends in the automotive industry continue to unfold."* Running costs have to be kept under control, while continuing to invest in important digital initiatives. P04 commented: *"We are in an economic restructuring phase, and one of the top priorities is to maintain budgets."* Thus, as P08 noted *"almost all car manufacturers and suppliers have announced staff reductions amounting to six figures in total."*

P15 raised the topic of how to reduce the assets of the existing plants after digitalisation or automation. *"The large corporations all have the same core problem: They have a high asset lock-in."* Enormous investments in assets have been made over the last two decades; and now the question arises as to how these assets can be reduced at the speed required by digitalisation. There is a lack of imagination. P15 estimated that closing a plant in Brazil which would no longer be needed after digitalisation would require hundreds of millions of Euros. In a Gigafactory with a batch size of 1 as a result of automation, 150 plants are no longer needed as at present; the company can get by with 70, as emphasised by P15 who stated "*it's not our job just to bring beautiful technologies into the plants, but to answer all the other related questions as well."*

5.2.2.4 New Core Competencies in the German Automotive Industry

The German automotive industry has recognised software as a key technology for its future business models, and that digitalisation and software will dictate long-term success in global markets. Therefore, the automotive manufacturers have made a strategic shift to increase their in-house activities in IT and software. P16 noted that *"digitalisation has put the question of core competencies in a new light."* P03 stated that *"the trend toward building core competencies is clearly moving in the direction of car-IT. In the future, the product will be defined by IT and software. That's why we have to demonstrate core competencies here."* P02 stated "*we have identified the networking of our factories with IIoT solutions and, above all, car-IT as a core competency. We aim to achieve 40 per cent in-house performance, otherwise we don't maintain control or have any real competency",* adding that "*automobile manufacturers who see themselves as digital companies in the future would actually need a minimum internal performance of 40 per cent in this field."* This was reinforced by P05: "*For*

OEMs, the programming of the code (for car-IT) *will increase over time. That is ultimately the core of value creation and thus the competitive advantage."*

P11 noticed that, until now, the software for the car has come primarily from suppliers and service providers. OEM manufacturers write perhaps only 10 per cent of the necessary codes. But a "software-defined car" requires a central operating system instead of over a hundred small control elements. P09 added "*it is likely that OEMs will again have to build up more core IT in-house resources compared to suppliers."* Suppliers provide complex components that are coupled with product-IT, the complex programming of the ECUs. The OEM assembles this complexity into an overall product, which also has to be orchestrated. This means that much more must be built up on OEM level, more in partnership and also more in software architecture thinking for the entire vehicle. P16 observed that this change has also long since reached the suppliers. *"In addition, the transformation to electromobility is reshuffling the cards in terms of value-added shares between automobile manufacturers and suppliers."* Bosch, Continental and ZF offer the central on-board computer, including software, and thus the future brain of the car. By building the powertrain, they are pushing into the automobile manufacturers very own domain, engine construction. The two most important parts of the value chain in the electric car after the battery are therefore fiercely fought over between car manufacturers and suppliers.

P09 noticed that the awareness and understanding of these perspectives and interrelationships now exists in most companies. No company in this industry doubts it anymore. Even the big suppliers like Bosch know this. Bosch, for example, has come a long way, with 20,000 software engineers, and Schaeffler and others are also moving in this direction. They won't become pure software powerhouses, but they will very much develop the software around the products and intertwine it with the products, and step by step expand their business area. However, problems can be seen with the smaller companies.

5.3 Changes in IT Sourcing Strategy

The previous section reported on the impacts of digitalisation on the German automotive industry and established the baseline for research objective two. This concerns how digitalisation and the corresponding digital transformation strategies will lead to changes in IT sourcing strategies in the current and future business environments. This section starts with a review of the general statements of the participants on IT sourcing strategies in the light of digitalisation, and then reports in detail on the emerging changes in the three technology environments of digital processes and automation, car IT, and mobility services based on platforms and ecosystems. Collectively, this results in a new IT sourcing mix with projected changes for 2021 to 2026.

5.3.1 General View of IT Sourcing in the Light of Digitalisation

P06 stated *"with megatrends and C.A.S.E., IT sourcing takes on a different dimension….and is leading to significant changes compared to traditional IT sourcing strategies."* P12 added *"with digitalisation the sourcing strategy must be completely reconsidered."* This was reinforced by P02: *"In the context of digitalisation, a completely new way of thinking is also required for IT sourcing."* Many other decisions that have changed in the course of digitalisation play a role in sourcing decisions: security and risk management, programme and portfolio management, data and analytics, and enterprise architectures. Consequently, there are a whole range of factors that have an impact on IT sourcing and current strategies must be completely reconsidered. P12 confirmed that *"the transformation to a software-enabled company requires re-thinking the topic of IT sourcing in a wide variety of ways."* P11 added that *"due to digitalisation, new opportunities have arisen, the world has changed, and therefore a digital transformation strategy is needed and, in the end, also a different sourcing strategy, because it is a matter of providing the necessary resources and skills."* This was underlined by P05 that *"one of the challenges on the way to becoming a software-enabled company clearly relates to IT sourcing management, i.e., the provision of the necessary resources and talent."* P01 and P12 also noted that the new focus is on sourcing the relevant resources and talent, building new core competencies and capabilities, and the formation of strategic partnerships. It was stressed by interviewees that IT should not only focus on its classic hardware and infrastructure issues, but also consider how the required skills can be sourced. Because, if it is the case that IT and software play this central role in the processes, in the products and in the ecosystems within the framework of digitalisation, "*then we are very quickly at the question of where the resources and skills for this come from."* P02 summarised some of the many questions involved: "C*an we do it ourselves, do we want to do it ourselves or are we dependent on others? Does the group have the right resources and skills to meet such strategic requirements? Do we have to buy it from outside - at least for a transformational period of time? Where can we find specialised partners? Or can we reallocate internally.*" For IT sourcing, this means the constant question of whether the companies have mastered the technologies (already), whether they want to or can do it themselves, or whether they would be better off bringing in specialists from outside instead of generating fixed costs.

5.3.2 IT Sourcing in the Three Technology Environments

5.3.2.1 IT Sourcing for Digital Processes and Automation

In the area of digital processes and automation, known as traditional IT, outsourcing was particularly pronounced among OEMs, but less so among suppliers. Traditional IT comprises the support of previous and still existing business processes with both proprietary and standard software, as well as the operation of the infrastructure, such as data centres and networks. The ratio of insourcing to outsourcing has evolved over the last two decades to be, on average, 20 to 25 per cent insourcing and 75 to 80 per cent outsourcing, based on the IT budget of OEMs. On the one hand, interviewees declared that the intention is to strengthen in-house software development, especially in applications that are directly visible and tangible to the customer (the so-called user experience). This is to be achieved by reallocating resources when phasing out outsourced legacy systems. Furthermore, partnerships with tech players are needed to further advance the digital / Smart Factory and digital production platforms.

Contrastingly, it is a common understanding within OEMs that commodities such as infrastructure will continue to be a candidate for outsourcing, especially driven by the increasingly broad possibilities of cloud sourcing. Companies no longer want to devote resources to running their own data centres. This seems to mark the end of the classic data centre. P13 mentioned the prominent example of the transformation of Daimler's entire IT infrastructure to Infosys. To this end, both companies have announced a long-term strategic partnership. This collaboration is expected to offer strategic advantages to both sides: Daimler will expand its IT expertise and Infosys will further strengthen its automotive know-how. The Daimler deal with Infosys is seen as an example of an attempt to rid itself of infrastructure ballast. P13 noted *"this has nothing to do with innovation, but Infosys can scale more easily and perhaps also modernise the legacy world more easily."* Whether Daimler's approach should be seen as pioneering a new trend toward complete infrastructure outsourcing remains to be seen. It is also possible that this deal is simply attributable to the pressure of cost cutting programmes. P02 also underlined that in traditional IT the company will continue to look for standardisation and outsource everything that can be bought better on the market. "*Through our global presence, we are able to work with providers anywhere in the world"*. Therefore, all commodities are outsourced. This applies above all to infrastructures, where consolidation is also urgently needed. P02 concluded further that "*infrastructures are constantly growing and creating more and more complexity."* Cloud concepts and hyperscalers must help consolidate the infrastructures of the company (note by the author: The term "hyperscalers" is used with reference to the large internet services companies that are dominating the cloud). However, P03 stated that looking at the trend in the overall market, it is not the case that all companies are now completely outsourcing their IT infrastructure. *"It's more like housekeeping over and over again. IT departments are getting bigger and bigger, the infrastructure in the company is getting increasingly more extensive and no one wishes to become unnecessarily inflated."* Then, after a corresponding growth process, it is likely that a further decision will be taken to outsource certain things. This is a recurring process. In turn, new things are built up again in other places, producing an effect similar to a cycle, rather than a curve that is close to approaching 90 or even 100 per cent. P06 stated that these approaches to outsourcing do not necessarily improve performance. The problems remain the same and the resources freed up cannot necessarily be used for digital issues. *"In some cases, such outsourcing deals can be seen under the constraint of group-wide headcount reduction. That means turning headcounts into budgets."*

Conversely, the statements of participants representing OEMs and tier-1 suppliers differ significantly in the ratio between insourcing and outsourcing. P15 characterised the classic tier-1 suppliers such as ZF, Mahle, Conti, Bosch etc. as large conglomerates that represent an alliance of medium-sized companies. One cultural characteristic of their basic structure is a very high level of decentralisation. P11 confirmed that suppliers work even more traditionally and do a lot in-house. This was reinforced by P14: *"In traditional IT, we do around 70 per cent in-house."* P15 added: *"so historically, we still do a lot internally."* However, P04 opined that it can be assumed that many suppliers will no longer be able to provide IT services exclusively in their own data centres and via their own infrastructures. P06 summarised that in this area, *"outsourcing volume is far from exhausted."*

P10 confirmed that in the last five years, backsourcing was considered for a number of services that were visible to customers and that had been developed with partners. Examples are the vehicle configurator or certain web pages. *"Here we are directly in front of a customer with a very digital presence, where the requirement is to make quick changes."* The consideration of doing it internally again is much more pronounced than a few years ago. However, given the current economic situation and the focus of all resources on automated and autonomous driving, most interviewees have crossed backsourcing off their list of priorities. P10 admitted further *"we don't see any major backsourcing actions at the moment. There would have to be a very good business case before we invest money and resources here that we urgently need elsewhere." "This is not an issue in the current situation, although it would be necessary in some places. But due to other priorities, such considerations are relegated to the sidelines at the moment."* "*This would only be done if outsourcing had gone completely wrong or if they thought that they could save a lot of money by insourcing." "With traditional IT, there is no backsourcing. We leave that as it is. There is nothing that is strategically important."*

In contrast to the previous IT sourcing strategies in the area of digital processes and automation, increased activities for value-added sourcing and participation in start-ups or their acquisition can also be seen. The examples mentioned of key motives for collaboration with technology companies, start-ups or even within the industry are: access to mission-critical information technology; manufacturer-specific control of technological developments; research partnerships; software development with alliances and contributions in open source; service chains; after-sales services, logistics platforms; telecommunications; and risk sharing.

P06 confirmed *"that's why strategic partnering is also becoming an important lever. We therefore work a lot with start-ups. And we work with other companies who are developing something for us and in which we have a stake."* In this process, the company takes a 15 per cent stake to secure critical knowledge. There is a start-up with about 25 people, highly qualified data scientists, and the company is in the process of acquiring a 50 per cent stake in the company so that they can retain and keep the resources and qualifications. P06 also stated *"in this context, we have already started co-innovations through investments in start-ups and will need to consider further partnerships and relationships with a new network of sourcing partners."*

Technologically, cloud sourcing is the main means for further outsourcing to achieve additional efficiencies. The main reasons for cloud sourcing include, in particular, the resulting elasticity and scalability of service provision. Many companies took the view that in a volatile market with dynamic changes, a pay-per-use model fits much better than rigid on-premises structures. In general, most companies asserted that they are following a multi-cloud journey. All standard software such as HR, finance, parts of product development, logistics, production and sales as well as infrastructure will be moved to the cloud. Production-related applications, for example, are more likely to be moved to the private cloud. Hybrid cloud models are the first choice to avoid vendor lock-in, and to maintain both independence and competition. P07 stated that *"the cloud is our most important backbone for digitalisation of our business. First and foremost, because of the scalable services."* With the data from the cloud, the company gets real-time information about manufacturing operations, meaning they can make decisions immediately, and damage evaluations can be done in real-time with the cloud data. For the digital IIoT applications, the real-time data from the cloud are essential. It would be of no use if the company only had the data a few hours later. In case of doubt, the company would have to stop production directly. It cannot be imagined how that would work without the cloud. P10 added that "*cloud is exciting, where we have to react quickly and have fast-growing volumes. Wherever we generate large amounts of data, but of a temporary nature, we will certainly have more public cloud."* The principle of what comes from outside, comes into the cloud, certainly also plays a role here.

P01 noted "*we will intensively use managed cloud services in combination because they offer numerous possibilities,"* and added *"we use the scaling and elasticity advantages of the large hyperscalers."* This makes the storage and processing of even large and changing amounts of data more agile. Depending on demand, further capacities can be added and performance can be guaranteed at a continuously high level. This high-performance cloud computing integrates classic managed services infrastructures into a high-performance cloud environment. *"Agility, flexibility and scalability of corporate IT are easier to realise with the cloud."* P03 opined that cloud sourcing will be the preferred model and the reason is that a cloud market has developed which offers the necessary scalability. This market also provides the necessary network effects. There is a cloud market that a single company can no longer replicate. A very stable and attractive offering has now developed that meets the criteria mentioned. This business model is so established on the market that no company actually needs to invest any more to replicate this business model. A common understanding is that the cloud is becoming the dominant topic for outsourcing for several reasons. One is certainly costs. Other aspects include greater flexibility and higher speed. In other words, what the cloud offers is not something the companies would be able to provide in-house. P11 noted that each of the digital technologies has implications across IT strategy and IT sourcing. For example, the moment the first projects with AI, advanced analytics and machine learning are started, the company has to deal with the cloud in order to ensure that these technologies can access the corresponding data lakes. *“And then we are forced to outsource and work with partners or providers like Amazon AWS or Microsoft Azure, which are experts in this area. We can no longer manage this on our own.”*

Although further aspects on the use of different cloud approaches with public, hybrid or private clouds were raised by the interviewees, they cannot all be reproduced here due to the thesis word limit.

However, with cloud sourcing, interviewees also report some scepticism about business cases with high expectations of cost reductions. Interviewees opined that in some cases, the promises of flexible hyperscalers infrastructure provision in the cloud are seen as “*colourfully drafted, over-promised and under-delivered.”* P04 commented that “*we often have the impression that management and business are flirting with the cloud because they believe it will help them reduce internal IT with it.”* For top management, there are concerns that cloud sourcing only involves running costs and leads to a reduction in capital expenditure.

P13 observed that “*with the hyperscalers, there is a lot of talk about agility and cost benefits if we migrate our applications to the cloud,”* and added “*but we have to realise, it doesn't automatically get cheaper with the cloud.” P13* also stressed *“that's probably due in large part to the fact that we haven't done our homework before. So far, only very few cloud investments have paid off as expected. One of the biggest problems is that we find it very difficult to move away from legacy systems.”*

It is not uncommon for companies to have many backend legacy systems that have been running for 20 years, which are not suitable to operate from the cloud. “*We do not manage to clean up the legacy world before we start migrations to the cloud. Those who try to do so will hardly feel any cost effects.”* These usually highly customised and sophisticated applications are often business-critical and require a high maintenance capacity. Adapting the processes and the IT systems used for this purpose is extremely costly due to the scope of the programmes and the complex and often still poorly documented processes and systems within their technologies. *“This has resulted in an enormous variety of technologies in the data centres, which can only* *be operated securely at great expense."* Therefore, expensive standardisation and consolidation must be undertaken before thinking about migration of these applications to the cloud. Most interviewees explained that it needs high investment and transformation processes to streamline legacy systems and lift and shift for operation in the cloud, or the phasing-out of legacy systems. Companies also concluded that decisions to move existing applications and infrastructures to the cloud rarely lead to real cost reductions, when all aspects are taken into account. These decisions are more strategic in nature, and designed to focus attention on topics related to digital innovation.

P06 confirmed that *"the success of cloud sourcing strongly depends on whether the legacy systems are cloud-capable. This is easily said: We will push the legacy into the cloud. But is definitely insufficient."* P09 views it as *"a plethora of issues."* All companies operate in a challenging legacy world. *"Bringing innovation into this legacy and shutting down some things is a hell of an expensive business."* P09 further commented *"so, if you want to migrate an old SAP R3 system to SAP HANA, these are usually projects that cost hundreds of millions. You can't migrate 1:1 and do it in the same context, that doesn't bring any value, but only high costs for lift and shift."* IT providers are promising a great deal in terms of cloud migration of their applications. This is a topic where providers such as SAP, for example, strongly recommend and demonstrate the advantages with the arguments listed above including the claim that companies can retain their current software status and never again experience the problem of maintaining several hundred million legacies in the basement. However*, "cloud sourcing will not become cheaper in this context, rather more expensive."*

Again, P06 underlined that the expectation is to get rid of complex legacy systems or infrastructures and that the IT provider can *"clean up the mess and does it for less"* is unrealistic. Legacy systems are often not in an appropriate state for cloud sourcing. *"We have a legacy world that is not up-to-date in some cases, that is three or four versions behind the current release, and then it cannot function in the cloud."* Nevertheless, these systems have to be developed further because ongoing operations have to be ensured. *"So, in fact we would have to invest in streamlining the legacy systems before moving them into the cloud."* In other words, *"the old paradox: In order to save money, you first have to invest money."* But that money is usually not available. As a consequence, this outsourcing may free up resources, but not the budget

P08 noted that "*there is a widespread expectation that the cloud business will pay off simply by pushing existing infrastructure to a superscalar - that doesn't work." C*loud is not by definition a substitute for infrastructure capacity, power or speed. What is also needed is not just an internal strategy with the expectation that "cloud only" or "cloud first" will solve all the problems. It must be clarified which cloud models are suitable for which requirements. Therefore, cloud adoption requires a thorough analysis of the requirements, assessment, migration strategy and consolidation as well as a clear strategy as to which workload and which applications go to which cloud or remain in the data centre. P08 stated further "*this is something that many avoid, that they have not done their homework, and then also transparently look at whether we need all the ballast that we are dragging along here, and do we have to transport it from one data centre to another data centre."* Thus, it is only with a clean-up and optimisation of the existing infrastructure and applications landscape that the effects of a cloud migration occur. The plan to replace isolated computing capacity using old servers and workloads by consumption-based cloud technology may only work *"if the company has not done its job before and has a lot of very old or poorly running infrastructure in the basement."* But most of the companies have been constantly optimising this for years, so that their servers run at 80 per cent capacity. This means that there is no great effect if it is now suddenly consumption-based out of the cloud.

P16 observed *"if proprietary systems are used instead of cloud resources, there are usually physical reasons for this."* When developing and testing new hardware, for example, latency times play a decisive role due to the large volumes of data. In such cases, a dedicated data centre in the immediate vicinity is the better choice. This is also where the field of application for edge computing arises. With the increase in devices, machines and sensors, the amount of data is rapidly expanding. Even the most powerful networks usually take too long to transfer the data to a data centre or the cloud for analysis. Video transmission, augmented reality and remote data access are also taking commissioning, maintenance and repair to a new level. For these technologies, companies need two characteristics that seem contradictory at first glance: decentralised, cloud-based data management and cross-regional networking on the one hand, and reliable real-time capability with the lowest latency and security on the other. To resolve this, there is Edge. This is driven by bringing computer power as close as possible to the point of action. Modern manufacturing, after all, is driven by the fact that companies have an incredible number of endpoints that are becoming increasingly intelligent. Consequently, they produce and exchange large amounts of data and require real-time capability with low latencies. This was reinforced by P08: "*There are still topics that are not at all suitable for the cloud, either physically or in terms of speed, or in terms of the pricing model, because there is not that much volume for uploading and downloading and it would be completely unreasonable to pay for that.*" And there are on-site premises that simply make sense because otherwise the proximity or network issues would get out of hand.

Hybrid cloud models are seen as the best choice to avoid vendor lock-in. Most companies follow a hybrid cloud architecture and basically have all cloud hyperscalers on board, including AWS, Microsoft and Google. Flexibility and resilience are seen as the two very key advantages in multi-cloud concepts to be able to quickly adapt infrastructure requirements to changing business conditions. In addition, redundant design and backup strategies are essential when business-critical workloads move to the public cloud. However, P02 noted the cloud providers offer many provider-specific additional functions, which are almost impossible to understand with the existing competencies. P13 stated that *"hyperscaler offerings vary widely, making it difficult to move from one cloud to another."* The computation, storage and networking capabilities of hyperscalers are at a high level, and they do not differ much in these respects. However, each provider has sophisticated, differentiating services, overseeing hybrid cloud models with almost limitless possibilities, and understanding the many build and deploy approaches offered within these models is not easy. One provider, for example, offers its advantages in the processing of mass data, while another scores points in fields such as AI and machine learning. P13 noted further *"in our opinion, there is a lack of standards in the multi-cloud world."* All participants felt that. Systems run one way on platform A and quite differently on platform B, and this poor interoperability is a real problem. The cloud providers have really good and world-class development platforms, but the interoperability between their clouds does not work at all. Basically, companies would be forced to completely rewrite applications if they wanted to switch platforms. P13 concluded *"cloud providers are sometimes deliberately pursuing a lock-in strategy. A lot of governance is required here. We need to know where our data is, we need to control it, and we also need to be able to restore it quickly in an emergency."* Therefore, as part of governance, companies are required to have mechanisms in place so that they can move data back and forth between different cloud worlds without much effort or additional costs. "*But who likes to hear the word governance. There's always the fundamental conflict with agility. One is almost always at the disadvantage of the other.*"

P08 and P10 noted that in reality, a common misunderstanding is that unlimited resources are available with the cloud. This can lead to uncontrolled and expensive growth in the consumption of cloud resources. Appropriate volume management and control is therefore required. In other words, a highly competent central unit is needed that takes in the various demands, serves them quickly, automates them, and has cloud governance and control that monitors consumption. Otherwise, cloud becomes a huge cost trap when everyone in the company is free to approach the hyperscalers of their choice on the basis of a framework agreement.

5.3.2.2 IT Sourcing for Car IT / Car Software

Among OEMs, the current ratio of insourcing to outsourcing of car software has evolved over the past two decades to an average of 10 to 20 per cent insourcing and 80 to 90 per cent outsourcing. At present, software in the vehicle is distributed across many different ECUs with embedded software from various suppliers. The OEM's own contribution relates only to certain integration tasks. P16 stated that *"the OEMs write perhaps only 10 per cent of the necessary code."* That is why tier-1 suppliers have developed in exactly the opposite way for Car IT, alias product IT.

With C.A.S.E., the German automotive industry has set a new strategic direction in future technologies for highly automated/autonomous driving, and has recognised that software is increasingly becoming the key differentiation criteria in the automotive industry. The focus of developments is on software-defined vehicle architectures and the operating systems for connected vehicles. P10 stated that in terms of IT sourcing, the focus is first and foremost on everything that happens around the vehicle. This is certainly a major challenge, because a great deal was done externally in the past. *"But we are also benefiting from a certain technological disruption, because the current operating system of the car will not work in the future. This puts us at a digital-technological crossroads, where we say we'll do the new things ourselves."* However, they cannot get by without partners, due to a lack of expertise in software development for connected cars and a lack of speed. Thus, value-adding sourcing becomes the most significant organisational element in this field.

P14 confirmed that the industry has now concluded a whole series of strategic partnerships in connection with Car IT and automated / autonomous driving. P03 added that "*the new demands* *from the megatrends require partnerships."* This can also be seen very clearly with the topic of electrification, and how OEMs need partners to develop car operation systems, for battery technologies, battery management or distributed charging infrastructures, all of which are also related to IT. Therefore, the need for value-added sourcing arises from these megatrends and the new technologies. "*The technologies are also changing dramatically fast and the OEM's can no longer catch up and invest on their own."* It was also mentioned that there are new players in the market that do not produce cars at all, but only take care of the technology of autonomous driving. The OEMs need to partner with them because they cannot invest as much on their own and, above all, they cannot be as fast as these tech companies. P03 argued that *"the industry can't do it alone anymore. The market has changed too much for that."* This was reinforced by P06: *"Hardly any car manufacturer is strong enough to cope with the market power of the large software groups."* There is no alternative but to partner with these companies from outside the industry to complement the companies' own strengths and build up new business. This applies above all to the networking of vehicles and autonomous driving. In addition, software solutions must be developed around safety and the standardisation of data exchange when millions of vehicles are moving autonomously in traffic. The existing rules are changing. P06 added *"we need these tech players and start-ups as partners because we are lagging behind in these new core functions."* The automotive industry as a whole recognised these developments years ago, but did not react. In other words, there was no timely investment in resources and new expert know-how to prepare for these new topics. This gap is now being filled by the tech players, who are becoming new, previously unknown competitors, and who at the same time are needed as partners to build up competencies. P06 further noted "*of course, these are completely different sourcing strategies."*

P10 referred to Volkswagen, for example, where the basic assumption is that they are big enough to stand up to digital competitors. However, this requires them to join forces, which is reflected in the newly established car software organisation (recently renamed as Cariad SE. Cariad is an acronym for "Car, I Am Digital"). In the past, the product engineering organisations of the Volkswagen Group were brand-focussed. The Group is now faced with a massive challenge to seek cross-brand synergies, to bring an operating system into the vehicle on which brand-specific services can then be implemented. This bundling of forces is one of the key aspects and key changes that automotive groups are currently experiencing. P10 specified further "*and, of course, that's also part of a sourcing strategy ultimately, because the car* *software organisation is an internal supplier for the brands. But it's a wholly owned subsidiary. And that is, of course, an important insourcing aspect, that the company actually takes software development into its own hands, especially where vehicle IT is concerned."* However, this does not imply that the OEMs are now doing everything themselves. Moreover, that is not even possible given the battle of talents and the limited resources available in the market. The companies have to enter into strategic partnerships and cooperate with many other specialised companies. Volkswagen also plans to acquire the camera software division of lighting and electronics specialist Hella. With this takeover, Volkswagen is continuing its "*strategy of developing essential software components internally in the future."*

In order to be able to offer customers automated driving functions more quickly, the Volkswagon Group is expanding its cooperation with Microsoft, which has been in place since 2018, to develop an "Automated Driving Platform." To achieve this, the Group needs the American technology giant's expertise in cloud computing and software engineering. In addition, Microsoft will share its expertise in artificial intelligence. Microsoft's intention is to get into the autonomous driving vehicle business itself and is participating in a parallel $2 billion funding round for Cruise, a robo-taxi company owned by General Motors. P06 added that Microsoft wants to be the next tech company to enter the self-driving car business. The company has been testing its vehicles in San Francisco for years and has already presented a prototype of an autonomous taxi without space for a driver. Cruise was given permission in 2021 to send cars onto the streets of San Francisco without a safety driver behind the wheel. Among other things, Microsoft wants to bring services from its Azure cloud platform into the partnership - which Cruise will mainly rely on in the future. In addition to the parent company GM, the Japanese carmaker Honda is also participating in the financing round.

Interviewees also mentioned strategic partnerships with other manufacturers, which in the meantime have also been reported on in the sustainability reports of the companies concerned. Daimler also plans to deploy its own Mercedes Benz Operating System for its passenger cars by 2024 ("Windows for Mercedes"). Together with the Californian company, Nvidia, a software-defined vehicle architecture is being developed for the Mercedes-Benz brand, that will enable the automatic driving of known routes. As a result, intelligent vehicles will take control of the car from 2024, and should enable all Mercedes-Benz buyers of all models to drive regular routes automatically. In line with the German automotive industry's classic approach to innovation, an important milestone has been reached with the launch of the "MBUX Hyperscreen" in the new electric S-Class in summer 2021. According to Mercedes, it is the most intelligent screen that has ever been part of a car. It is both the brain and nervous system of the car and is based on the MBUX project, the acronym for Mercedes Benz User Experience, which was launched in 2018. Until recently, Mercedes and BMW were also exploring joint development of automated driving technology, but that partnership was suspended last year in favour of the cooperation with Nvidia. Nvidia is also engaged with other car makers in the US.

Major automotive suppliers, such as Bosch and Zahnradfabrik Friedrichshafen (ZF), want to become suppliers of software products in the future and have also launched development partnerships for new software platforms. In addition, Microsoft is contributing its Azure data cloud system to the development cooperation, in addition to its software expertise.

Daimler's Truck division has entered into three strategic partnerships for the development of highly automated and autonomous trucks. Waymo, a subsidiary of Google's parent company Alphabet, has to date been considered the world leader in the development of software for self-driving cars. Based on chassis from Daimler's U.S. Freightliner brand, the "Virtual Driver" will bring Waymo's in-house artificial intelligence solution to the vehicles. P13 informed that *“Waymo is a word creation from the English vocabulary for way and mobility. The company is developing the world's most competent driver, and that is no longer a human, but a computer that scans the environment with cameras, laser scanners and radar and uses algorithms to decide how to react.”* Additionally, the Truck division acquired a majority stake in the US start-up Torc Robotics. P06 concluded that “*own engineers are not progressing fast enough*.” Above all, the truck maker lacks the right software developers. *“There are weaknesses when it comes to agile, fast software development for Car-IT.”* 'By joining with Torc Robotics, Daimler acquired access to people with know-how. In addition, a partnership with the US company Luminar Technologies has been established. Luminar is the world's leading provider of lidar hardware and software technology, a new radar technology for object detection in autonomous driving.

P05 noted that, technologically, the cloud is becoming one of the dominant topics for several reasons. There are several drivers of technology, simply because it is the only way to have permanent connectivity via the 5G network. *“One is Car2Car communication and the other is Car2X communication.”* Car2X-communication enables users to see the car on the data level before they can even see it physically. To do this, drivers must somehow be on the road in a networked space that makes this possible. The only way to do this is through wireless networks with a cloud behind it for data exchange. This was reinforced by P02: *"External cloud-based services will increasingly be part of the vehicle architecture."* These services not only serve the vehicle passengers, but also enable in-vehicle maintenance and software updates. The architectures support over-the-air (OTA) software updates and allow software patches to be read in via a secure access point and then applied incrementally to the vehicles' ECUs or car operating system. The patch process and software configuration of car operating systems and ECUs must be managed and controlled by the OEM/dealer via cloud resources, avoiding mismatch or insecure configuration. These architectures are already integrated into production environments. In addition, vehicle management, maintenance and monitoring are increasingly cloud-based, especially for commercial and business use. Vehicles, drivers and passengers need architectures that can connect across a wide range of infrastructures, such as roadside WiFi portals. P02 concluded *"all this is only possible on the basis of high-performance cloud platforms. Strong IT partners make this possible."*

5.3.2.3 IT Sourcing for Mobility Services

Compared with the sourcing strategies for car IT, the participants perceived a different situation for mobility services based on platforms and ecosystems. P02 concluded that *"we will mainly work with platform providers, because the decisive factor for the success of a platform is its size. In addition, there is a striving for monopolisation that is already rooted in the platform idea."* Interviewees identified three effects which have an impact. Network effects: As the number of participants increases, the attractiveness of an ecosystem increases for both providers and users. The greater the customer reach, the more attractive the platform is as a sales channel for providers, and vice versa: The broader and more attractive the offer, the more attractive it is for the customer. Economies of scale: With increasing reach and market penetration, transaction and information costs decrease. Larger platforms can offer their products and services more cost-effectively. Learning effects: With growing user numbers, platform providers also have more and more data at their disposal. Data analysis can be used to tailor offers individually to customers and thus permanently expand and improve the offer. The whole thing leads to a self-reinforcing cycle. The more relevant the data and the higher the data analytics competencies, the more accurate and attractive the offer becomes. P02 added *"it is* *important that we build open platforms, i.e., marketplaces that can draw on a large number of players."* Amazon or Apple were used as examples. It was the diverse range of apps that turned the iPhone into a successful business model. Apple concentrated fully on its core competencies and left the ability to develop powerful apps precisely to those who know something about it. By bundling them in its own marketplace, however, Apple is still the master of events and gatekeeper for the main product, the iPhone.

Clearly, car manufacturers are facing strong competition from specialised mobility providers and start-ups. Only a few car manufacturers will be able to build up the competencies and resources to successfully stay in this new digital business model. Accordingly, further cooperation between OEMs or consolidation in the mobility sector can be expected.

P13 noted that in ecosystems and mobility services, too, the automotive groups will need innovation partners to act as key drivers of the companies' progress. In this respect, the companies will concentrate on a maximum of 20 per cent in-house development. The ecosystems are fed by many players and need a high level of penetration to make them attractive to providers and customers. This is where the hyperscalers are needed, because they provide the technical foundations with their large cloud platforms. P03 opined *"with platforms and ecosystems, we will see very strong outsourcing."* Initially, the car manufacturers will develop the platforms themselves and introduce the prototypes. But once they have achieved market penetration, i.e., a certain maturity, they will increasingly switch to outsourcing. *"That is why the current outsourcing volume in this area is probably rather below the 50 per cent quota, but here, too, outsourcing is a growing business."*

P12 stated *"So overall, we think we have to assume that car manufacturers will become part of a new value chain* (in case of mobility services)*, which will influence the sourcing mix. Here, it depends on how we completely re-define core competencies. We believe that we will have to outsource more and more in order to cover the value chain."* This was reinforced by P08: *"The platforms and ecosystems don't really have the direction yet that would be needed. Currently, we develop 20 per cent internally and 80 per cent comes from external platform providers."* For P19*, "mobility services predominantly imply value-added sourcing."* P02 added *"as far as platforms and ecosystems are concerned, we will have to see how this develops in the company over the next few years. This is an important topic for the future, but at the moment the focus is very much on car IT."* This does not yet have the status it perhaps should have. It was summarised that no company in the German automotive industry is strong enough to take on the market power of the digital tech players in building ecosystems, and they rely on partnerships. As P03 stated *"platforms and ecosystems are not a core competency."*

However, the most important aspect for automotive manufacturers in building such platforms and ecosystems is to keep control of the interface with the customer, and thus orchestrate the platform. Therefore, as P06 insisted, "*the discussion has to be much more focused on how can we generate additional revenue through the intelligent use of IT."* There is therefore a need to focus more on digital ecosystems to generate additional value for the customer, jointly with the aftersales market. Moreover, this industry has a tremendous amount of data about the product, but the sale of the vehicle is done by the dealers and only they have extensive data about the customers and what happens to the vehicle after it is sold. With appropriate ecosystems involving dealers, fleet managers, service stations, etc., a new business model would emerge that would generate both new revenue and customer benefits. If these interfaces are taken over by others as part of the ecosystems, which is very much the case with the many mobility service providers that already exist today, it would be a losing proposition for the automotive industry. Consequently, the industry will have to do more in advance to build up know-how and develop useful software components for platforms and ecosystems on their own.

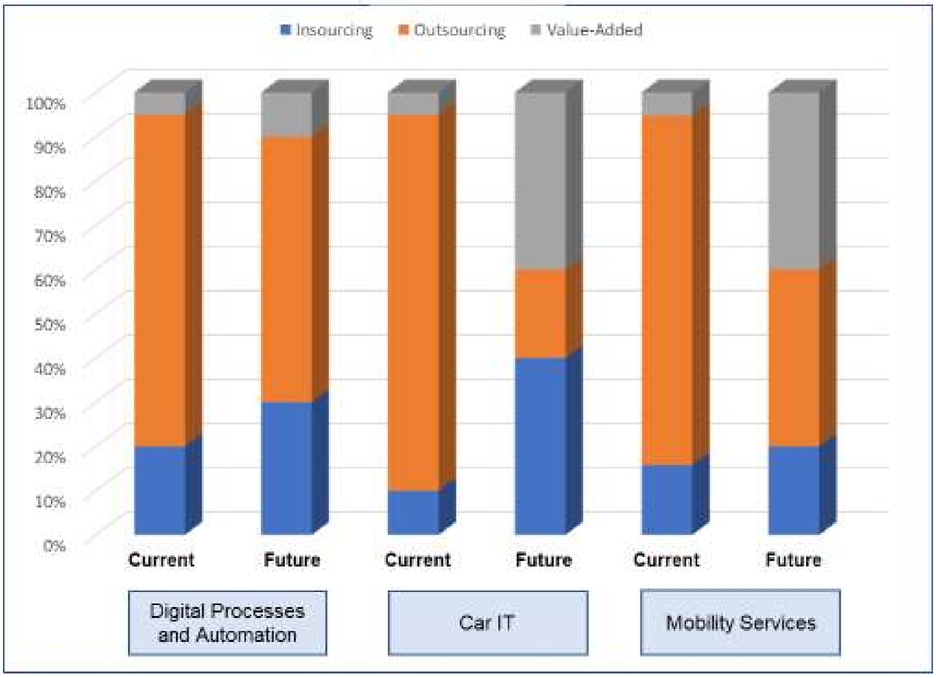
5.3.3 Current and Future Sourcing Mix

Based on the participants' individual estimates of current and future budget allocations with the expected ratio between insourcing and outsourcing, the following projected change 2021 to 2026 can be derived (Figure 31).

Selected excerpts from the corresponding notes and quotations on IT sourcing for digital processes and automation as well as on car IT can be found in Table 9.

In sum, these budget allocations determine shifts and new priorities in IT sourcing for the next five years. In addition to strengthening core competencies and investing in more in-house software development, the industry needs partnerships, to a considerable extent, in order to tackle future challenges such as connected cars, highly automated/autonomous driving, and attractive cross-industry platforms and ecosystems for future mobility services.

Figure 31: IT sourcing projected change 2021 to 2026



Source: The author

In the technology field of digital processes and automation, the insourcing budget will increase marginally on the one hand, as certain digital topics will again be developed increasingly in-house. In outsourcing, a budget shift to value-added sourcing is to be expected due to the drivers of Industry 4.0 and the complex activities for networking of the factories. At the same time, further outsourcing of commodities and, above all, of infrastructures is to be expected, which will be realised primarily through cloud sourcing. The bottom line is that the ratio of insourcing on the one hand and outsourcing / value-added sourcing on the other will not change budget-wise.

For Car IT, insourcing and value-adding sourcing is becoming the most significant organisational element in this field. The share of in-house software development will be massively increased. However, the industry cannot manage without partners because they lack expertise in software development for connected cars and speed. For mobility services, outsourcing and value-added sourcing will be dominant strategies.

Table 9: Interview statements: expected ratio IT sourcing

Interviewee	Notes and quotations regarding IT sourcing for digital processes and automation	Notes and quotations regarding IT sourcing for car IT / Car software
P01	• "*In digital processes and automation – or enterprise IT, as we call it – we are at about 30 per cent make and about 65 per cent buy. Always in relation to the IT budget. We have little value-added sourcing or strategic partnerships in this area, maybe 5 per cent.*"	• The company wants to increase the share of in-house software development for its cars. From 10 per cent at present, it is to be increased to at least 60 per cent.
P02	• Overall, we are still moving in the range of 70 to 75 per cent outsourcing. • *"We have identified the networking of our factories with IIoT solutions as a core competency. We aim to achieve 40 per cent in-house performance, otherwise we don't maintain control or have any real competency."*	• The problem is that the entire embedded software, i.e., the number of control units installed in the vehicles, which are individual computer systems for driving and safety functions, come from individual suppliers and we have the effort to integrate all of this. *"That should and must change with our shift of strategy."*
P03	• For traditional IT, it is relatively stable. Not much will change there. It's a stable market where a large part of the IT is outsourced and will be so in the future. • There is always one thing to start from: If something is no longer considered to be competitively differentiating, it will be outsourced. • There has always been the trend for automotive companies to involve many external resources, i.e., to	• Car-IT is a core product. That is why the many thousands of additional IT specialists are required primarily in the software organisation of car-IT. If the OEM decides that IT in the car is suddenly the decisive topic, the core competency must also be there or be built up.

	have low vertical integration. *"Division of labour has always been a dominant theme."* The current issues are stimulating and boosting this trend even more". • When it comes to digital processes and automation, there is no reason to build up additional core competencies and expand/inflate the organisation compared to today. There is no reason to do so. • *"A company no longer needs to have a data centre to get server capacity or storage capacity. Companies can save that money."*	
P04	• Current ratio of insourcing to outsourcing is about 30 to 70. • Increasing trend towards outsourcing.	•
P05	• *"In traditional IT, outsourcing will continue to increase."* • *"To put it bluntly, traditional IT is a stagnant topic."* There is outsourcing and there is the corresponding outsourcing management. • In the backend area, everything is moving in the direction of the cloud.	•
P06	• "*In some cases, we still operated things ourselves that are now candidates for outsourcing. This means that the outsourcing volume is far from exhausted here*". It	•

	is no longer justifiable for us to operate a data centre or networks ourselves with some thousand employees." This will be outsourced as a whole.	
P07	• With traditional IT, 10 per cent own resources, 90 per cent outsourced. In product IT, it's the other way around: internal budgets are 90 per cent and external budgets are 10 per cent. • "*In the meantime, we have moved a large number of activities to the Amazon Cloud. We had put too much into IT in-house development. We lost time with that."* • "*Now we have realised that our added value does not come from this IT development, because there are companies out there that can do it much better than we can.*"	• *"This is relatively simple. In product IT, internal budgets are 90 per cent and external budgets are 10 per cent."*
P08	• *"In traditional IT, 80 per cent outsourcing. This will not change."* • *"For OEMs, outsourcing was the predominant sourcing strategy."*	• *"With car-IT, we estimate 50/50."*
P09	• It is likely that OEMs will again have to build up more core IT in-house resources compared to suppliers. • *"If we look at the core capabilities of various IT organisations, i.e., if we look more broadly across the*	• It is likely that OEMs will again have to build up more core IT in-house resources compared to suppliers. Suppliers provide complex components that are coupled with product IT, the complex programming of the

	industry and do not focus on one company, then the IT core capabilities of many OEMs are almost zero."	ECUs. The OEM assembles this complexity into an overall product, which also has to be orchestrated.
P10	• *"In the case of enterprise IT, i.e., the classic commodities, almost 90 per cent of value creation takes place externally. At least."* • *"That's why we decided to bring IT development expertise back into the company. So really just the opposite of the previous strategy. For certain topics, we are doing it ourselves again."* • *"Everything that we are re-defining as a digital service today is developed internally."* • "*We have also considered backsourcing for a number of services that are visible to customers*." • *"The declared intention is to strengthen in-house development, especially for applications that are directly visible and tangible for the customer"* (so-called user experience). • There are also topics for insourcing relating to digital production, in order to achieve greater efficiency, higher quality, greater cost-effectiveness, and greater transparency in traceability. • *"Of today's outsourcing volume, we have around 20 per cent in the cloud."* But the future volume will be very much public cloud. "*Wherever we generate large amounts of data, but of a temporary nature, we will*	• *"In vehicle IT, the factor is also high, it has to be stated quite clearly. We estimate 40 per cent internally and 60 per cent externally, but with the clear goal exactly reversing that."*

	certainly have more public cloud. But where we are very close to production, that will be more in the private cloud, in the local instance."	
P11	• The suppliers work even more traditionally and do a lot in-house. • "*Previously, we outsourced individual functions or applications from the business processes*." With cloud sourcing, outsourcing will become more important and increase. But it will not grow exponentially in terms of volume.	•
P12	• For a long time, traditional IT was dominated by mega-outsourcing. • Starting at the end of the 90s, everything that could be was outsourced. For a short time, there was also the idea of outsourcing IT completely so that nothing more had to be done with it. • However, this then changed, some of it was taken back and attempts were made to revise these core competency decisions. • For the ratio between insourcing and outsourcing, this means in summary: for traditional IT, 40 per cent in-house and 60 per cent outsourced.	• For car-IT, the target is 80 per cent insourcing and 20 per cent outsourcing

	• Overall, the trend is probably further in the direction of outsourcing and cloud sourcing, especially for infrastructures. • *"We are now in the third phase, in which OEMs are setting up their own software units, of course also with the help of partners, but more in led by the OEM."* • Traditional IT service management is increasingly moving to cloud solutions that challenge the company's own data centres.	
P13	• In traditional IT, the current relationship will change only marginally. • In software development, some topics will perhaps be done more in-house again, but infrastructure will continue to be a candidate for outsourcing, especially driven by the increasingly broad possibilities of cloud sourcing • Outsourcing was particularly pronounced among OEMs, but less so among suppliers. *"On average, the OEMs only had an in-house share of 20 to 25 per cent at the peak. The majority of the work was outsourced to a vast number of IT providers."* • However, a turnaround has been taking place for the last two years.	• In car-IT, the OEMs have been hiring thousands of software engineers for 2 years because they have declared this to be their core competency. Here, the companies are aiming for at least 40 to 60 per cent in-house development.

P14	• *"In traditional IT, we do around 70 per cent in-house."* • *"The automation technologies like IioT are our core competencies," there is no fundamental change in the sourcing strategy."* • *"In the case of infrastructure services, outsourcing will continue to increase. That's something we don't need to have in house anymore."*	• *"In product IT, we do about 80 to 90 per cent in-house."*
P15	• *"So historically, we still do a lot internally. In software development, we have 50 per cent internal and 50 per cent external resources. In the traditional operations area, we still have 80 per cent internal and 20 per cent external."* • The goal is to perhaps to bring the ratio in the operations area closer to 50:50. • And in the innovative area of software development, it would be more in the direction of 80 per cent internal and 20 per cent external.	•
P16	• *"We don't want to make any estimates for the future now, because we first need a phase of reflection. Digitalisation has put the question of core competencies in a new light."* • Rather more outsourcing with cloud sourcing.	•

P17	• “*In classic IT, i.e., digital processes and automation, when it involves classic IT infrastructure such as data centres, network infrastructure, etc., there is certainly a focus on outsourcing. The focus is clearly on buy*.” • In the future, companies will no longer operate their own data centres, but will source these services from the cloud. And *“cloud solutions are always buy solutions.”* • “*Today, unlike the OEMs, it is 50 % in and 50 % out*.” • “*For the future, however, we see 20 % in-house and 80 % outsourcing, similar to the OEMs. And not completely fragmented with many partners, but with a few partners, i.e., share. This is mainly about commodity issues, where it’s a question of who supplies the most cost-effective offer*.” • Or alternatively commit to technology stacks and then do this with Microsoft as a strategic partner, for example.	• “*Here it’s about the IT competencies or software for the industrial product, because here it is necessary to differentiate from the competitors. That will certainly always be internal in order to have the competitive advantage*.” • A lot of source code has to be generated here, and of course all these functional developments will be done together with partners. • “*For example, we have a partner with an offshore development centre in India with 500 people who develop our embedded systems. But the intellectual property and the work on the idea as well as the software architecture will always be our core competency. So here we estimate 40 % in and 60 % out*”. • “*However, in the future this will tend to 30 % in and 70 % out due to the constantly increasing volume*.” • Megatrends and digitalisation lead to investing more in software development, including software maintenance. “*This is simply no longer possible with our own resources.*”
P18	• Above all, IT security is indispensable in a digitalized company: “*Here we will invest more in cyber and information security. In addition, we will also increase our spending on business intelligence and analytics*.” The use of cloud services and cloud-based applications	• “*Today, we have an in-house share of less than 10 %. For the future we want to achieve an in-house share of software development of more than 60 %.*”

	will also continue to increase strongly. "*At the same time, we are increasing investments in process automation, artificial intelligence / machine learning and digital workplace*." • "*In contrast, we will spend less money on infrastructure and data centres*." • "*Of course, this is all in addition to the high investments in car IT and car software as well as in electromobility*."	
P19	• "*In order to meet the requirements of digitalisation, it is necessary to be able to scale the provision of services. Digitalisation is thus a driver for higher insourcing, outsourcing and value-added sourcing*." • "*Traditional IT – currently very much outsourcing, in future more value-added sourcing and outsourcing*."	• *"Software in the car – currently very much insourcing, in future more value-added sourcing as well."*

Source: The author

5.3.4 IT Sourcing as Competitive Advantage

The interviews proceeded with a consideration of whether IT sourcing can be a source of sustainable competitive advantage and how the companies monitor the extent to which digital transformation and innovation has been successfully supported by appropriate IT sourcing strategies. This was commented on by the interviewees in different ways and with a diversity of opinion, as can also be seen from the response to statements 14 - 16 in the online survey (Appendix 10.5). The interviewees represented views that can be summed up in two contradicting answers: First, IT sourcing has nothing to do with competitive advantages and if it does, then only under certain conditions; and second, IT sourcing is definitely a source of competitive advantage.

P14 argued that poor sourcing definitely results in disadvantages and, conversely, good sourcing naturally leads to advantages. "*However, we would not argue that this has anything to do with competitive advantage or disadvantage*." P07 opined *"we believe that the only way to win in competition is with convincing products. And nothing else*." IT sourcing is also important, for example, to reduce costs, but that is not so much relevant for competitive advantages. Companies have to sell the value of new products, which is much more important in a competitive environment than trying to reduce costs marginally with IT, or one buys IT a little more efficiently. P13 stated that "*it is difficult to say whether a competitive advantage is achieved through intelligent sourcing. In the past, rather not*." Basically, IT sourcing is the consequence of an overriding business strategy aimed at competitive advantage. In this respect, IT sourcing was more of an execution. "*Generally speaking, however, IT sourcing can have the potential for competitive advantage, but not automatically*." Sourcing alone will not improve performance or create a competitive advantage. The same is true for any other resource or capability in a company. Several factors always have to come together. P13 further added "*first and foremost, this relates to our culture, how we want to work with partners and IT service providers in the future."* P12 noted that "*viewed in isolation, IT sourcing is not a competitive advantage*." IT sourcing must align with IT strategy, and this in turn with the digital transformation strategies. If all other activities build on this, if these strategies fit together 100 per cent, this would represent a sustainable competitive advantage. P03 opined that "*it is really hard to say whether IT or IT sourcing is a driver and trigger for the competitiveness of the automotive industry*." The production lines have to run. However, they also come to a stop often enough because supplier parts have not arrived or because the IT has failed. Hence, it is difficult to argue that VW is less competitive than BMW because BMW's production lines are down less often. This could change for the future with autonomous driving and connected vehicles, but that has not yet been proven today. This is only a hypothesis. If the services and the product depend more and more on IT, - i.e., how reliable, how innovative, how dynamic – it will of course also be relevant to competition.

In contrast, interviewees argued that IT sourcing is responsible for acquiring digital capabilities. IT sourcing managers must embrace this strategy: that acquiring technical capabilities has the greatest impact on a company's competitiveness, whether through revenue growth, collaboration between the company and its vendors, or adding value to the customer through adapted business model innovation. P02 emphasised that "*this strategy means that companies need to acquire skills better, faster and smarter so that they can compete better, faster and smarter*." This may or may not include cost savings. In fact, focusing on cost savings can be disastrous in certain situations if it drives the wrong decision and clashes with speed or capability. For almost every company across all industries, differentiation and customer experience create competitive advantage, unless the strategy is driven by price leadership, as P02 commented "*but we are not Aldi*." Therefore, in the current environment, P02 further added "*IT is a critical success factor in knowledge management and should play a dominant role in corporate decision-making processes*." Companies need to buy this knowledge intelligently and retain it, and those who do not succeed in doing so will certainly be at a considerable competitive disadvantage. Thus, it can be assumed that the digital transformation of the automotive industry is a knowledge-based issue. For the generation of new knowledge about the possibilities of digital technologies and the corresponding new orientation of digital business models, knowledge and competencies are the central resources for sustainable competitive advantage. And this must be guaranteed through sourcing. P02 concluded "*in the new era of digital transformation, the role of IT sourcing is becoming increasingly strategic*." In the ever-evolving world of digital transformation, IT management faces the constant challenge of enabling the digital business strategy and thus the competitiveness of the company. In the area of sourcing and supplier management, digital transformation presents both challenges to be overcome and opportunities to be seized. A company needs to develop the ability to define an appropriate sourcing strategy, manage the selection and integration of IT suppliers and ensure the delivery of innovation and business value, while taking into account digital impact considerations.

P17 pointed out that in the medium or long term, IT sourcing will lead to a competitive advantage or disadvantage when it comes to having the right resources, and in the right quantity. For this reason, it is a strategic question, or rather a shared strategy, to have both core resources in-house and to be able to become flexible and expand very strongly through sourcing with partners. At that point, IT sourcing becomes critical and decisive for competition. This will be important for the automotive industry, both on the product side and in the entire value chain. "*Anyone who doesn't do the homework and doesn't procure these resources via strategic partners or intelligent networks will find themselves in a situation where they have a knowledge gap in the medium term*." P19 added that *"intelligent IT sourcing and strategic sourcing initiatives lead to cost reductions, risk minimisation, increased stability and quality improvements*." Hence, this is already relevant to competition today. Moreover, this is even more important considering the direction of megatrends and digitalisation in the automotive industry.

P01 also emphasised that IT sourcing is certainly a source of sustainable competitive advantage. Without the targeted provision of competencies, skills and resources to implement digital technologies, the digital transformation process is not going to happen. "*Without the necessary talents and competencies, we will not achieve the goals and will be ground up between the software monopolists*." P05 added: If automakers manage to attract the right people and talent through partnerships, as Mercedes did with Nvidia, for example, that's a competitive advantage. "*And if they manage to adopt these resources and talents exclusively for themselves, that's even more of a competitive advantage*." Good and digitally competent people are the most important factor when it comes to moving the automotive industry forward digitally, and regaining digital sovereignty. P16 underlined that the industry is characterised by very complex processes, for which highly specialised software support as well as highly qualified human resources are indispensable if the companies want to shape the digital work environments of the future. "*If we can use intelligent sourcing to secure the appropriate resources and talent for this, which are a scarce commodity and are not available in abundance, this will definitely give us a competitive advantage. It's not called the war for talent for nothing*." So, anyone who secures the best talent and staff resources clearly has a competitive advantage. P08 also stressed that "*it's all about digital enablement, shortage of resources, battle for talents, etc*." Progressing with a reasonable sourcing model ensures deliverability. A company that does it worse will deliver slower and more poorly, and on that does it better will deliver faster and with higher quality. "*If we add the dimension of cost, which is also a limited resource, especially nowadays, it is very much about the efficient use of resources to get the maximum return*."

P15 and others focused on the cost issue as well. "*Sourcing has a direct impact on the cost structure of IT services*." If the cost structure is not optimal, then IT changes the calculated costs of the product. P15 added "*we are burdening the business and burden its competitiveness in the market. In other words, if we don't have a reasonable grip on IT costs and optimise them, we make our business uncompetitive*." P04 also argued that smarter sourcing would give the business a competitive advantage in this cost- and price-aggressive market.

5.4 New Competencies and Recruitment for IT Sourcing Transitioning

This section refers to research objective three and the biggest differences between traditional IT sourcing processes and the elements that will contribute to a company's success in the 2020s. This leads to new entrepreneurial competencies for the successful transitioning to new IT sourcing strategies in the German automotive industry.

5.4.1 Weaknesses of Traditional IT Sourcing Management

Over the past two decades, the dominant sourcing strategy of the OEMs has been outsourcing, including many hundreds or even thousands of individual, larger and smaller IT providers, specialists and consultants. P08 observed that multi-supplier management has become one of the main tasks of the internal IT organisation. P01 noted that the control of these many providers was mainly influenced by commercial issues such as supplier selection, contract design, cost and budget control, pricing, quality control and the like. P10 added that with an in-house share of 20 to 25 per cent, an IT organisation can no longer design anything, but only manage it. P01 admitted *"in the pricing process we also played quite a bit of our market and purchasing power."* P12 reflected how IT purchasing has been done over the last 20 years: "*An OEM rarely negotiated with an IT provider at eye level. There was always a hierarchy played out and the OEM dictated and demanded, do it."* This was reinforced by P08: "*Some of the companies still have a strong traditional purchasing mindset that puts providers under a lot of pressure. They* *are still of the opinion that every provider is prepared to do anything, as long as he can decorate himself with the OEM's brand."* P02 added "*yet in parts of the industry, IT sourcing managers still focus on cost savings and cost avoidance, as well as compliance and risk diversification as primary goals."* While these operational measures are critical, they fail to consider how effectively IT sourcing contributes to the transformation of the business. In fact, there is a massive disconnect between traditional IT sourcing processes and the elements that will contribute to a company's success in the 2020s.

P10 stressed the fact that outsourcing also leads to the whole issue of employee leasing, cooperation with external parties and compliance, which ultimately causes problems. It is very difficult for an agile world to function with external parties, "*because we are very much obliged here, and we always try to be overly correct, to carry out control of the externals, always communicate through a middleman, you don't talk directly to the developer, it always goes through an interface, there are lots of auxiliary constructs, but none of them work very well."* P04 observed that these are reasons why management, in part, does not really like stronger ties to IT providers, because there are always discussions concerning the violation of regulations on external labour. The IT management therefore makes special efforts to meet the set of formal requirements. "*We do our best to cooperate well between the internal and external staff, that the internal colleagues get along well and creatively with the external ones, that the work is really mutually challenging and supportive."* This is the method of dealing with the situation. If IT can build a good relationship between internal and external employees, if the internal colleagues get along well and creatively with the external ones, if it really is mutual cooperation that challenges and encourages each other, then that is a good way to go. But that is not always to be assumed *per se*.

P10 raised the point that "*a fundamental problem has been the extreme dependence on external providers."* P02 added "*we have perfected our multi-provider management and measure KPIs, service level agreements and much more with dashboards, but it is still questionable in many cases who is actually in the driver's seat and who is sitting next to the driver. Sometimes, as we have to admit, we are just sitting next to the driver and have lost control."* As a result, a wide diversity of different IT technologies has become established in the company that have to be managed in operations. The initial situation in IT sourcing is such that companies are still struggling massively with legacy issues. Companies still have to manage thousands of contracts with IT providers. Each provider has its own culture, methods and technologies. It is in the nature of the business that the providers also have an interest in being in the business for the longer term. Longer-term relationships with IT service providers are of course positive, but at the same time this has created large knowledge monopolies with the providers. P02 concluded *"we have lost know-how about the content."* This is especially true for the many legacy systems that still exist, which still have to be functionally expanded, maintained and operated. P10 also touched this point and stated *"we realised that the dependencies on IT providers leads to a knowledge monopoly outside the company, which makes us unable to act and ties us to partners who then finally have control over us."*

P08 opined that the previous approach of working with multiple service providers for the past 20 years no longer functions. *"The classic customer/contractor roles that the companies have so well established no longer fit."* P08 further commented that the risk of vendor lock-in was unreflectively overestimated, and an analysis and subsequent review of outsourcing decisions in terms of total cost of ownership (TCO) rarely took place. This was emphasised by P15 by reporting *"first of all, we firmly believe that we all need to move away from the old outsourcing models. The old outsourcing models might have been successful in the past but they will not be successful in the future."* They are not suitable for creating a sensible set-up because they actually only ever create a conflict between a seller's profit thinking and a buyer's price or cost thinking. This tension is simply no longer acceptable. P15 concluded *"and that's why we believe that outsourcing is fundamentally wrong in this full outsourcing concept. We are absolutely certain that we need a proper partnering model in the sense of an extended workbench."* P15 added *"we need a partnering model in which the partner is as responsible for the cost and therefore price effects as we are for his profit margin",* and made the further point that "*if the partner provides services for us and we do joint developments, we also enable them to make some kind of profit, otherwise it's not a reasonable model*."

In line with this, P12 noted two contradictory views. The automotive industry needs these partnerships, i.e. this value-added sourcing, because the automotive industry does not have the skills, the know-how, nor the access to new technologies. "*But they don't master such partnerships, they can't and they never could. That's the simple realisation."* P06 also added *"co-development is something we have never seen before in traditional IT."* P05 reported that OEMs have stumbled over their own size and arrogance many times. *"Cooperative ventures* *with other manufacturers or suppliers have usually failed because the OEMs always put their dominance first and insisted on a majority stake in the joint venture in question."* This has led to claims that the German OEMs are not team players, always want to dominate the partnerships, which was not acceptable to their partners. Amazon, for example, does not initially see itself as a peer, i.e. as a supplier, which is a different intellectual approach. P05 added *"then Amazon says, you don't need to bother us about logistics, we're the world champions in that area anyway. We move many more packages around the globe during the day than an OEM material or something like that."* To map this all together in an effective way, car manufacturers will need a higher-quality and more intelligent way of managing their partners in the future. P03 summarised, for example, if the company has only ever considered the service provider as a supplier in IT sourcing, has only ever paid attention to the issue of purchasing the cheapest unit costs and is now supposed to do value-added sourcing with the same team, it will be difficult. Therefore, the real challenges are leaving the old paths and pursuing new approaches, building knowledge, and learning new methods and approaches. It was also added that transformation is nothing new anymore. The industry is in a position to deal with transformation. The companies also basically know in which directions they have to go and what mechanisms there are for this, but the implementation, the doing, is the big problem.

In addition, IT sourcing management is generally seen as a function of Corporate IT and this organisation, in turn, still does not have the status in most companies it should have. P06 observed that not so much has changed: The strategic importance of traditional IT is often still recognised and it is therefore often treated incorrectly and continues to be massively associated with costs. It was added that traditional IT is still seen in this back-end role. P06 felt that *"IT is still not properly understood as the enabler or the change agent that helps to change the company culture."* P04 claimed that it's still about the decades-old discussion. *"In this respect, we are still far from digital transformation and digital entrepreneurship."* The close involvement of IT in the strategy processes is missing, the consideration of IT as a partner (and not just as an internal service provider), the early involvement of IT in new topics, the company's orientation as to where IT should develop is missing. IT does not even get the chance to develop in the areas of digitalisation.

Of course, digitalisation teams have been established in the companies, but not in IT departments. These teams are organisationally very close to the board, but work quite separately from IT. This leads to conflicts because many topics are not coordinated with IT in time and cannot be implemented. At the same time, IT is chronically overburdened operationally and understaffed, and therefore cannot participate properly in the digitalisation issues. In the context of digitalisation, the Board must become aware that a new interaction between business and IT is necessary. There is no holistic understanding in management about the use of digital information technologies and how the company needs to be transformed to take advantage of the opportunities of digitalisation. Just implementing teams and installing individual digital solutions will not be enough. P08 reflected *„our IT understanding is still in the "old economy."*

This was also emphasised by other interviewees, e.g. P06. Management has still not recognised the power of information technologies. Furthermore, if they have recognised it, they lack the consistency to act and, above all, the investments to make it the basis of new business models. The focus is still on the engineering of hardware and from there IT is simply expected to deliver its support. It has not been understood that IT will have to be integrated in a completely different way in the future. This can be summarised as a whole, the will is there, but the knowledge of how is lacking. Above all, there must be a different willingness to invest in IT. P06 admitted "*for decades, we have built up a backend, i.e., legacy system world, and have always just packed more on top of it without ever really cleaning it up. You can compare this to a damp cellar that is slowly rotting the house from below."* At the same time, IT has all these new requirements from digitalisation, and now the question is how to manage this balancing act between cleaning up and working on the new issues at the same time. P06 stated further *"IT doesn't get an extra budget for this either, because the management thinks it's already too expensive."*

P14 concluded that another challenge is the involvement of IT and the organisational model of how IT is set up in the company. This concerns how IT is recognised as a partner for the business, and is no longer just seen as an internal service provider or as a cost factor, and so on. Thus, it is of significance that IT is simply seen as adding value and should be prepared with the appropriate resources to guide or even drive the digital transformation.

P03 also stressed *"we should say goodbye to the discussion and the term 'roles' in IT or sourcing management. That is the wrong approach."* This is such an evergreen topic in the IT journals that has been discussed constantly for many years, for example: The new role of the

CIO; does the organisation need the CIO at all anymore; will the CIO be replaced by the CTO or CDO, and so on. Every year there is new coverage in the magazines without anything having changed substantially. Whether there is now a new name for the CIO is unimportant. The important thing is to deal with the new constellations of digitalisation and IT sourcing. P15 emphasised that *"as far as the competencies for IT sourcing are concerned, we don't see any major changes. If a CIO doesn't have these skills today, the company would already have a problem."* Interviewees added that, after all, multi-supplier management belongs to the core competencies that the CIOs have had to develop over the last five to ten years, because these sourcing models are actually standard. That is nothing new. In the past, CIOs have already taken on a generalist role. P15 stressed that the problem is this strong orientation as a service provider. "*We have to define ourselves out of this role and take a more entrepreneurial approach. That we are not just service providers, but service generators. We have to get into the position of a classic business manager who not only carries out delivery, but ultimately also conducts digital product development and also has to sell it."* That is a challenge that many CIOs are not up to. Because they have never been in this holistic business responsibility. However, arguably no CIO would be capable of running a business holistically or being responsible for it. P15 claimed *"that's what we need to be able to operate in the future as digital enablers, to be responsible for the workforce of a company."*

5.4.2 Staff Recruitment

An area of discussion also included the question of dependencies on external resources and whether there is a shortage of qualified experts, which thus could represent a major impediment to digitalisation and hinder the speedy implementation of digital innovation projects. The online survey confirmed that it is a clear strategic goal to have the key IT capabilities and related resources for digital technology deployment in-house in the long run.

P01 confirmed that there is significant competition in recruiting appropriately skilled and experienced staff. "*But we don't want to emphasize that a lack of qualified employees is preventing us from implementing digital innovations*." Companies are aware that the availability of appropriate talent is a key differentiating factor for the digital transformation and have started to develop strategies and initiate measures ranging from training, to retraining, recruitment, and outsourcing to address this through organisational measures. "*We are an* *attractive employer - and without sounding particularly arrogant now - the following still applies to the automotive industry: The best are attracted by the best*." P09 added "*the big challenge for global IT sourcing is to identify the right basic know-how in the regions and bring it into the company. When a company has skilled people, it attracts more skilled people. Then you create momentum, which quickly achieves the necessary critical mass. The important thing is to be able to inspire these people*."

By contrast, P16 stated that German automobile manufacturers are having a hard time finding talent. This is also due to years of outsourcing IT. "*We lack the know-how for innovative digital software solutions in many places*." The German automotive industry has world-leading engineering skills for driving experiences. In the future, however, skills that have so far tended to be found in the software technology industry will become increasingly crucial. Until now, the software for the car has come primarily from suppliers and service providers. The carmakers must quickly build up capabilities for this and programme themselves. P16 observed "*but it is doubtful whether there are enough skilled workers in Germany and Europe for every carmaker to develop its own car operating system*." A lot of skilled manpower is needed for the permanent maintenance and further development of an operating system. P13 stated "*we in the automotive industry estimate that we need around three quarters of a million software specialists to meet the demand for digital software development*." P16 added that "*the German manufacturers probably have no choice but to forge alliances in order to compete with the American and Chinese tech giants*." Car manufacturers are no longer as attractive to young talent as they used to be. They are more likely to be drawn to one of the tech companies. Here, they can quickly assume a lot of responsibility. In contrast, the automotive industry is still organised hierarchically in many cases. It is also still too accustomed to gradual innovation. However, young people are very interested in holistic mobility concepts and the car is a subordinate part of this. P16 noted further "*we still recruit our IT specialists very strongly from our own junior staff or from universities*." At Tesla, for example, the IT experts come from Silicon Valley, from tech companies like Apple, Google or Facebook. There is a different culture in the Valley.

For digital ecosystems, and when it comes to turning the product into a service, or integrating the service into a new business model - which then plays a completely different role in an ecosystem - then the industry has completely different challenges, and it is by no means enough to have only software engineers. Therefore, the industry is looking in particular for business modelers and data scientists and, building on that, AI experts who can understand and deliver the appropriate algorithms, but also cloud specialists, IT architects, experts for cybernetics, and security specialists. P17 stated that especially in software development, it is important to have people who are also familiar with modern cloud technologies. "*The demand is huge. The same applies to the field of data engineering and data analytics. Or the skills to generate value based on data through higher algorithms*." This was reinforced by P19: "*The lack of skilled workers is an important strategic challenge. The pressure of digitalisation leads to an increased need for professionals with expert know-how in areas such as artificial intelligence, RPA (Robotic Process Automation), cloud models, data science, etc.*" These are the most mentioned job profiles besides software engineers. Data scientists are particularly in demand for the analysis of large volumes of data from a wide variety of data sources, such as keyword big data, using methods from mathematics and statistics. In the run-up to this, there is a need for data engineers who first prepare the data and build and maintain the corresponding databases or data lakes. P09 defined these functions as data masters, data engineers, design thinkers and digitalisers who are very familiar with the business and able to understand the data and convert is into value creation. "*The most important aspect is data, which is at the heart of digitalisation. All software depends on what data is available and what value can be generated from the data*." The basis of new mobility is data. This requires a four-digit number of people to be built up for big data projects. There are some good skills and hot spots in the AI environment in Germany, but still, the bulk of expertise is in China and in the US. Therefore, the companies have to think about how they want to work with tech companies on these different technologies. P09 concluded "*first of all, that definitely means partnering. But it also means reversing past trends, such as very high outsourcing, and bringing core value creation back into the company*."

P07 also reinforced this: "*Without this data scientists' know-how, digitalisation in our company would be very limited*." This is one of the most important areas to develop intelligent products, and it requires skilled product engineers with specialist knowledge. For the company in question, the data scientist is more of a product engineer who understands the components he or she is analysing and can then translate that into statistics and actual programming as well. "*These three factors, domain knowledge, statistics and programming skills, make a real data scientist in our view*." P07 added that there are very few people with this profile. The companies cannot acquire them on the market; they have to develop them within the company. In contrast, P15 stated "*we do not see the dependencies on external resources as critical. We get skilled* *experts, just not in the standardised countries*." In fact, in Mexico, for example, which some people still see as a developing country, the company gets better educated students than in Germany. Arguably, Germany has failed over the last 10 to 15 years to adapt its entire education system to this new challenge of digitalisation.

However, most interviewees reported that the companies invest heavily in training the next generation of software developers, data scientists and the like and thus for shaping the next generation of mobility and technology use by taking different approaches. BMW, for example, has opened a new research and development centre in the north of Munich. Here, 4,800 vehicle developers are to transfer BMW from the metal age to the digital age. P19 added "*targeted recruiting, flexible working time models, promotion of professional and personal development, as well as the expansion of the international footprint via DevOps Hubs are used to address the shortage."* P18 referred to Volkswagen, which has founded its own software company. Its focus is on electrification, automation and digitalisation. Around two thousand engineers and developers will work on a company-owned software platform. Volkswagen has agreed on a partnership with Google to jointly promote education and training in the range of automotive software applications, cloud computing and sustainability.

5.4.3 New Entrepreneurial Competencies in IT Sourcing

P13 stated that *"we need to adapt our traditional outsourcing strategies and develop partner ecosystems in which each member delivers added value."* The company needs the co-evolution of capabilities and business specialisations. Based on this, different types of IT outsourcing relationships and supplier governance structures need to be created for each specific partner. In any case, automakers as well as their partners need very strong complementary capabilities to make relationships successful. This includes new forms of openness and collaboration, where new or sometimes normally competing players gain mutual benefits by working together on specific activities. Therefore, in the future, IT will have to organise and manage advanced forms of sourcing with international tech players in order to close existing resource and competency gaps and thus achieve competitive advantages that cannot be achieved individually. P13 concluded "*IT providers become innovation partners to act as key drivers to move companies forward."* Very few companies will have the technological know-how needed to make their digital IT innovations successful. *"The partners filling the competency gaps will increasingly* *participate in the business success of the innovations developed*." P10 added that in view of the many challenges posed by digitalisation, the aim is to strengthen the company's own performance. The central elements of the strategy now also include an overall view of IT with changes in portfolio management, agile project management and consistent supply.

However, as P06 noted, people from tech players are true professionals who know their business really well. *"If you want to work with them as an automotive company at eye level, you need to have in-depth knowledge of these software topics, otherwise we won't be taken seriously and won't be in a position to have any say at all."* These are new procedures, because these companies also work quite differently. *"We are not used to that."* The previous sourcing models were based on the motto that the company buys employees with a certain skillset from IT providers and they develop something for the company. Traditional and established providers have also tried to get involved in these new software topics, but these providers are largely out of the picture. P06 further confirmed: *"this means that these megatrends are also leading to a massive change in the provider landscape that we previously had."*

P13 stated that the potentially difficult relationship with innovation partners, like those with the international tech players, and building innovation networks can be very difficult because of their multi-layered nature. *"These partners cannot be managed like a traditional IT supplier."* So, from that point of view, it cannot be argued that digitalisation can be managed with the same team and the existing or adapted organisations. It doesn't work with the same organisation and the same structure as is used today. Companies have to come up with new organisational models. P16 concluded "*a lot depends on digital leadership"* and provided his view on digital leadership in order to describe the requirements for a digital leader. Therefore, it will be important to break away from the image of the classic manager. The main task of the classic manager is the (economic) management of the company and ensuring its ongoing operation. Their daily tasks are characterised by a strong operational focus, such as delegating tasks, managing resources and making decisions, as well as monitoring results. In contrast, digital leadership in the so-called VUCA world focuses less on operational business and more on guidance in the digital transformation. The term VUCA is an acronym formed from the words volatility, uncertainty, complexity and ambiguity. There are a few key differences between digital leadership and traditional management: Networking people across hierarchies instead of traditional management with permanent, hierarchy-oriented positions; enabling learning and support instead of traditional management with rules and consequences; innovation, growth and creation of something new, instead of efficiency and optimisation of what already exists. The digital age no longer allows clear connections between cause and effect, as the world has increased in complexity and instability.

P06 observed that *“the sourcing models already launched with the new partners need to be better established. The fact is, we can't dock on with the old structures. We have to build up competencies and knowledge in order to work with the new partners and define who has which responsibilities. In the past, it would have been precisely the other way around.”* And above all, IT sourcing management are not used to the cooperation with new partners. *“We can't always apply our classic thinking, we are the best anyway, we know everything better, so the IT provider doesn’t have to explain anything to us.”* P08 added that this requires *“new management qualities and skills in co-developments with strategic partners are required.*” The financially strong tech players are unimpressed by the traditional market power of the German automotive industry and do not see themselves as suppliers. Therefore, one of the most important prerequisites will be for the German automotive industry to build up technical expertise as a software-enabled company so that it can work on eye level with the tech players in joint development projects and be taken seriously. A second important prerequisite for IT sourcing management is the ability to reach sustainable agreements with partners *“instead of just dictating prices to suppliers.”* P08 also explained *“the cost view must also be enriched and expanded from the vertical to the horizontal view, i.e., real TCO considerations and not this silo thinking in individual technologies.”* That is also a new skill. With the new topics and digital business value streams, as well as the different development phases and operating cycles, there is tremendous pressure to think outside the box, think bigger, and think in terms of delivery value chains rather than only in separated technologies, functions, and silos.

Other interviewees emphasised that, of course, even with partnering a contract is needed, there will always be an expectation on both sides. In addition, if that is not clarified, there will be problems. This is where new skills for contracting and alignment come into play with partner management. P08 opined *“simply saying we have to work with start-ups, with the hyperscalers, we are now going into crew creation, into partnering, is not sufficient.”* Thus, it has to be contractually agreed that it also works when things turn down. That is a skill that is not widespread enough. Domain expertise, contracting, and of course being up-to-date at the provider interface with regard to technology. Technology is developing at an incredible speed, so internal skills are needed to maintain pace and to know what is possible, and which technologies can be procured via sourcing or must be held internally. P08 further stated the importance of "*always being the overall architect of the IT technologies and not allowing an infrastructure circus via the many different providers.*" P01 added that "*we will continue to work with a variety of external partners and large or specialised IT provider. We will continue to live in a world based on division of labour and do not want to do everything ourselves.*" That means *"we have to make sure that everything fits together technically in the end and that we don't end up in an uncontrollable technological mess. When it comes to IT sourcing, we have to keep a very close eye on the entire IT architecture of the company."*

P09 and P17 argued that first and foremost, the basis is a technology radar that identifies which technologies and architectures are needed. There are topics like IT, security, infrastructure with cloud, the architecture of business process automation as well as the issues like big data and semantics, the whole forest of information, of data, that has to be brought together in some way in a model including the burden of legacy systems, as a large amount of data resides in thousands of heterogeneously developed systems and databases. The technology radar reflects what is happening in the different dimensions. Based on this, it can be analysed which technology is best delivered by which provider and determined which technology bucket is sourced and how, what is built internally, where new agile methods for software development are established, and how it all interacts. "*On this basis, it is necessary to consider how it can be implemented step by step in the product, in the process, in the business model.*"

In this context, P14 also emphasised that, above all, new competencies or skills are needed to design contracts with the powerful hyperscalers. *"They are hardly willing to adapt their contracts to the specific needs of the customers. Due to the market power of Microsoft, Google, but also SAP, contract negotiations with these tech players are usually very one-sided."* P09 concluded that *"this working together more closely, but at the same time not being crushed by a tech player that has a market capitalisation that is a factor of ten higher than that of the German automotive industry, that is a very important capability which is not there in this form today."* In these environments, companies must think very carefully about who they partner with in the medium and long term. There is a widespread and not unjustified fear of Google, Apple, Microsoft and also Amazon. Consequently, it is necessary to consider exactly what a sourcing strategy looks like in the various technology areas. P19 asserted that "*the digital transformation, especially into the cloud, is making sourcing projects more and more complex*." P18 also agreed that "*an important aspect in the decision whether companies move their applications to the cloud is the question of the contractual relationship. There are already concerns that there will be higher dependencies on the cloud provider*."

P15 and others raised the whole issues of process harmonisation and standardisation which is a prerequisite for digitalisation. "*Like many of our competitors, we still have a very decentralised and functionally oriented corporate structure with chains of heterogeneous applications."* As a prerequisite for digitalisation, these must first and foremost be standardised, "*which also means that we have to discipline ourselves."* We are currently building a new digital core. At present, P15's company has around 115 different SAP landscapes spread across the entire Group. This does not deliver data consistency, which the company urgently needs for digitalisation capabilities, Industry 4.0, etc. P15 decided *"we need to reduce the complexity of the application landscapes in order to achieve data consistency."* P16 emphasised that *"cloud computing, robotics, artificial intelligence, etc. are also changing the character of our previous sourcing model."* Technological developments are increasing the pace in IT and influencing the entire IT processes and governance. P16 also demanded "w*e first need to get a picture of where we can further standardise and automate our service provision and then, on this basis, consider how we can meet the required flexibility, speed and controllability of IT. This will then result in a new portfolio or sourcing mix that supports the digital transformation."* Interviewees concluded that expensive standardisation and consolidation must first be started before thinking about digitalisation and, for example, migrating applications to the cloud.

In addition, it has become apparent that portfolio management is gaining new importance as a prerequisite for qualified sourcing decisions. P10 confirmed "*as awful as it sounds, that was new."* Acquiring a corporate portfolio that allows the companies to prioritise topics that come from different business functions or brands within the Group is a new approach. The procurement process still plays a very large role because a lot of internal suppliers, subsidiaries, and joint ventures are handled via the same procurement process for compliance reasons. P10 further claimed "*but now we have a portfolio decision prior to the procurement process, which is something we did not undertake in the past."* This is now also a question of IT competencies in the narrower sense. Decisions that are made on the basis of the issues that are relevant to the business strategy, with a consistent portfolio management and differentiation between what and how to source in a practical way, results in sourcing that has the desired effects. *"In the past, this was completely neglected because, in principle, everything was outsourced."* With the portfolio management and a corresponding new IT sourcing organisation, this has naturally taken on a new significance, with more methodical questions being asked about how the IT service is to be provided. In any case, there is a need to realign the established sourcing strategies to be more aligned with the wider strategic role of sourcing in the digital context. P06 noted that *"the focus will have to be on important issues such as the development and applicability of different sourcing models and the viability of sourcing as an option to address internal competency gaps."* P10 once again underlined that the sourcing decision ultimately determines the collaboration model behind it, and it is a trade-off between the strategic use of the resource on the one hand, and speed on the other. P10 demanded further "*but we have to hit the right targets. That's why portfolio management is so important, that we focus on the right topics for in- or outsourcing."* And here, of course, sourcing is crucial for further success in the respective areas. So, the portfolio has become wider. "*In the past, the decision was, after we had outsourced everything anyway, let's put it out to tender and give it to the cheapest."* A new dimension has been added with the consideration of how deep the vertical range of IT service should actually be in the respective field of activity.

P13 emphasised the importance that in the future, executives in IT must be able to better articulate the value of digital technologies for the future of the organisation. They must have the appropriate vision and communicate their visions of how the company should shape the digital transformation. Processes need data and generate data themselves and as P13 added, "*technologies process this data, bringing the digital twin of our real world to life."* The complexity and number of processes, data and technologies are constantly increasing and are subject to constant change. Therefore, it is important to maintain control over processes, data and technologies. *"What companies will need in the future are digital twins of people, things and processes across company boundaries."* Data that represents the digital twins. Technologies that bring them to life. Processes, data and technologies need to be managed, monitored and their changes controlled. To meet these requirements, coexisting interfaces between the physical and digital worlds are needed that can be used anytime, anywhere and securely. The tasks of IT will become the management, monitoring and control of changes to processes, data and technologies. The technologies themselves will come from the specialists in the market. The important thing is to retain control over the compatibility and interaction of the solutions and to offer the business functions a broad portfolio of processes, data and technologies that they can shape independently and agilely. Under these conditions, the existing sourcing models also need to be questioned. P06 added *“we still have sourcing models for the old world, traditional IT, but they need to be reviewed to see what contribution they really make and where we are just following wrong expectations and making things up.”*

P17 insisted that regardless of IT sourcing management, traditional IT must move closer to the business. Currently, most IT is still characterised by the typical organisations of Taylorism. *“The classic approach: IT is attached to the CFO, the focus is on low costs for the operation, and IT is trimmed to efficiency. Which is not bad per se. However, we are firmly convinced that the current organisational model for digitalised IT must change to a decentralised or federal IT.”* The companies therefore need small, lean, business-oriented IT units that not only understand the IT problem and solve it from their IT perspective, but also understand how the business works and what the solution must look like from a business perspective. P17 concluded: *"IT must be moving much, much closer to the business.” That its value or* success *is not only measured by the fact that an efficient and inexpensive IT solution has been developed. But a solution that satisfies the customer 100 % functionally and solves the real problem. Therefore, it is necessary to move away from such a centralized model, where IT is always very far away from the real business.”*

P15 suggested going some steps further and declaring the CIO to be the company's Chief Human Resources Officer. The statement is based on what a CIO manages and what an HR director manages. The bottom line is that the CIO manages the operational resources of intelligence and technology. The HR person manages the human resources. These are increasingly converging. P15 argued “*who will actually manage the digital resource in the future?”* In addition, this digital resource is not always technology, it is also people, like a data scientist. So, the question would be who actually manages the digital workforce? P15 contended “*the future CIO is the workforce manager.”* The workforce manager defines exactly the workforce that is required for the operational processes. And that actually has to grow together, because otherwise there is a competing system within a company. P15 further stated “*there should no longer be differentiation in the allocation strategy. After all, we have to use the asset* *that is best for the task at hand*." This is sometimes a technology and sometimes a human being. There would be no dividing line, they coexist.

In summary, this chapter presented the results of the 19 semi-structured interviews based on eleven areas of discussion. The data collection from CIOs, CDOs and other experts provided an up-to-date and realistic insight with regard to the transformational power of C.A.S.E. and how the impacts of decarbonisation and digitalisation place new and competing demands on IT sourcing. The mix of OEMs and tier-1 suppliers, complemented by industry knowledgeable sourcing consultants, allowed the capture of the full range of commonly shared and differently held views in the industry regarding current situations, challenges, goals, threats and concerns related to the research objectives and questions. The analysis of these findings now follows in the next chapter.

Appendix 10.7 provides additional perspectives from the interviews. These concern the need to reorganise the interface between software and hardware development, which are following different technology cycles.

6 Analysis and Interpretation

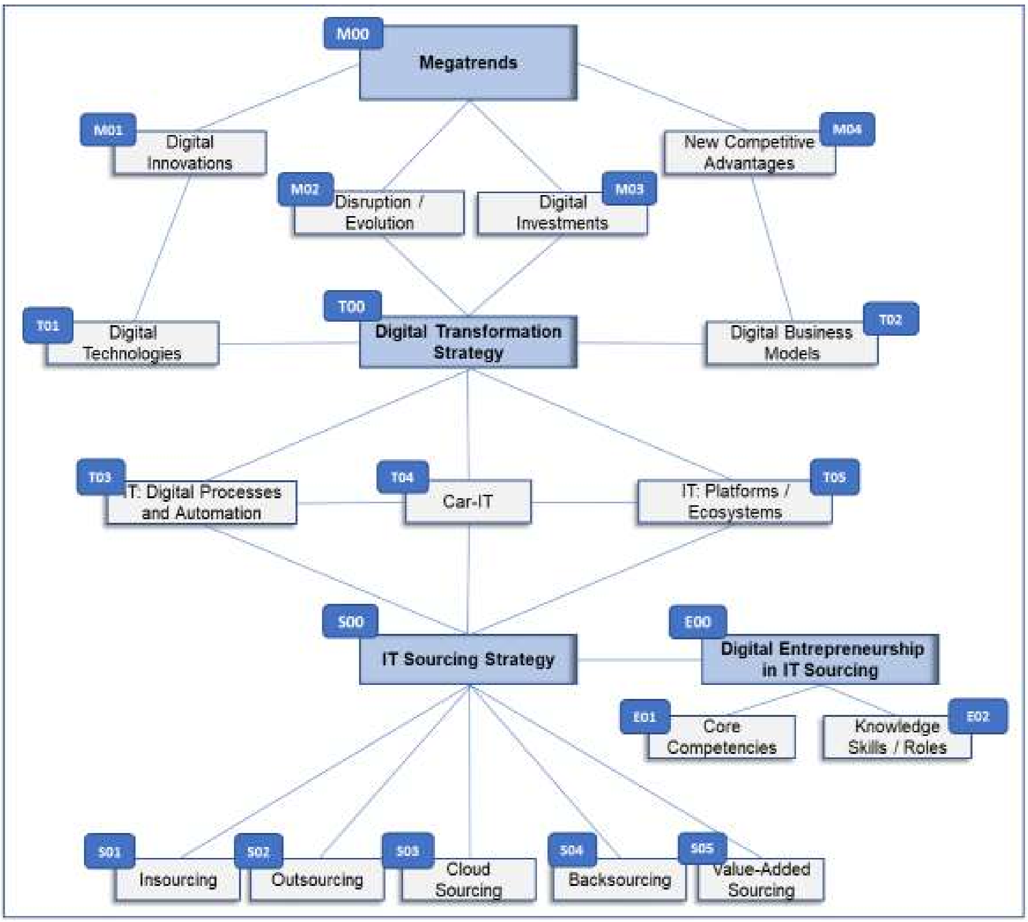
The previous chapter presented a comprehensive overview of the findings from the semi-structured interviews. This chapter now contains a qualitative analysis and interpretation of the findings and identifies important themes of relevance to the research objectives.

6.1 Introduction

Thematic analysis was used because it is a systematic and rigorous, yet flexible, method to analyse large and complex qualitative data sets. It also offers benefits to the researcher, as the research has to take account of many context-relevant factors, and the data obtained must always be understood in relation to the context of their production. In a first step, the interview notes were manually reviewed line by line, through reading and re-reading the segments of data, in which relevant meanings were highlighted and numbered with a seven-digit label. The make-up of this label consisted of a two-digit abbreviation for the interviewee, a reference to the area of discussion and a sequential number of answers, so that a reference to the source could always be established (for example MA05A03). The labels referred to sentences or complete paragraphs, in order to maintain the relevant context. The total of more than 150 pages of interview notes resulted in about 850 labels.

In a second step, the conceptual framework was widened into a so-called "thematic map" (Figure 32), and each element was given a code. Then, through reading and re-reading of the interview notes and labels, each label was assigned to a code-combination to firmly establish in what context a statement was made. For example: One interviewee made a statement as follows: "*What we outsource today is, of course, very operational. In other words, the classic data centres*." Another interviewee stated *"infrastructure will continue to be a candidate for outsourcing, especially driven by the increasingly broad possibilities of cloud sourcing."* Both statements addressed the fact that IT infrastructures (and data centres as part of IT infrastructures) are being outsourced. However, the first statement is rather general, while the second statement addresses more specifically that outsourcing of infrastructures (including data centres) takes place through cloud sourcing. Therefore, in order to differentiate between these two statements and their respective contexts, the first statement was given the code combination S00+S02 and the second label S00+S03. In addition, a statement such as *"digital technologies require enormous investments*", if provided with only a single code, would not differentiate the specific context compared to similar statements. Therefore, it was double-coded with the combination M03+T01. The next statement "*digital transformation requires enormous investments*" was, in turn, double-coded with M03+T00.

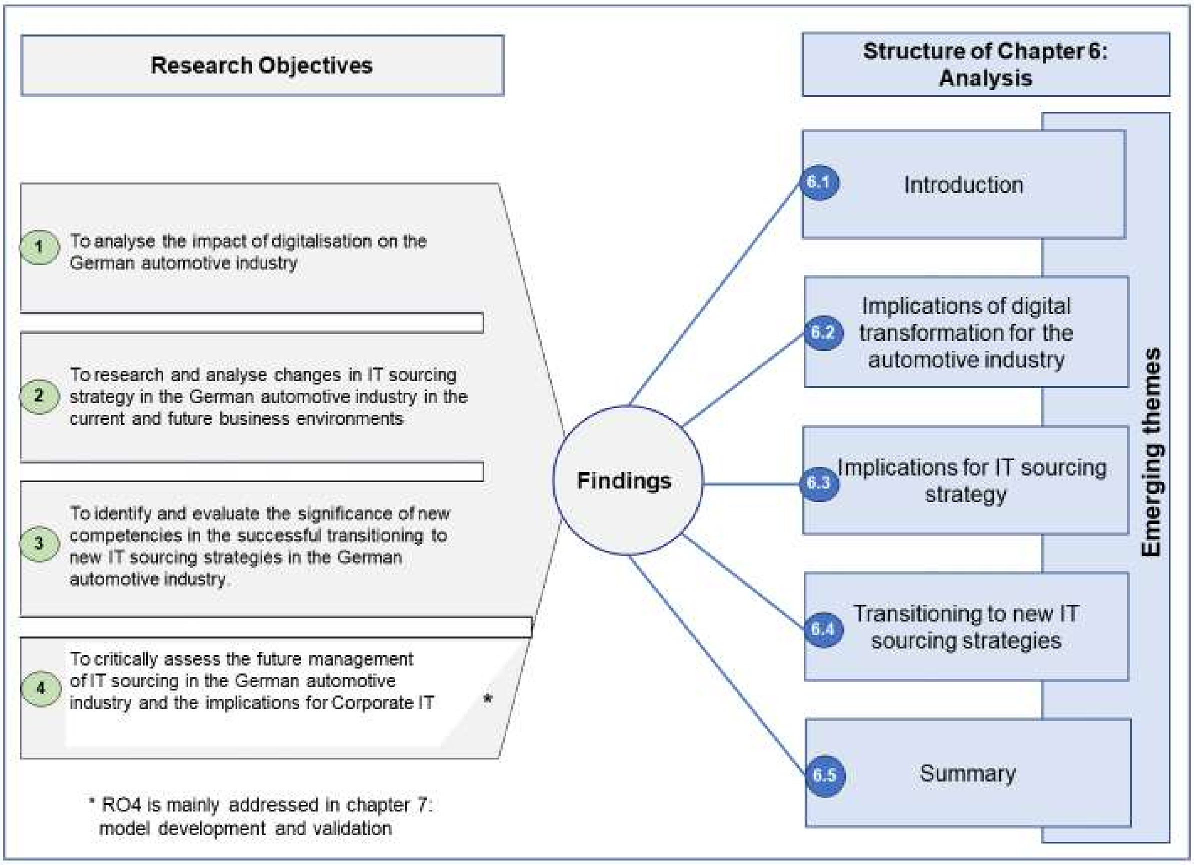
Figure 32: Thematic map for data analysis



Source: The author

Rather than using one computer programme to analyse and chart data and construct emerging themes, Microsoft Excel was used to organise the labels and code-code combinations. The matrix was constructed as a basic grid, with each row and each column representing the same codes. After labelling and coding, the data segments were copied and transferred to the corresponding cell in the Excel spreadsheet. Organised in this way, the analysis allowed for traversing horizontally and vertically through all columns and rows and for the systematic interpretation of the findings, as well as the search for, and of, emergent themes by reading across the different cells. As regards what counts as an emergent theme, the number of supporting statements was not critical - the number of statements does not make an emergent topic more or less important. A topic becomes significant if it identifies something that is related to the research questions (Gray, 2019). Appendix 10.8 provides an example of the Excel sheet for data analysis.

Figure 33: Structure of chapter analysis and interpretation



Source: The author

After this introductory section, the analysis of the findings as well as their interpretation is discussed in the following three sections (Figure 33). These three sections refer to the three relevant research objectives. Therefore, section 6.2 addresses RO1 and provides a summarised insight into the emergent themes derived from the implications of digitalisation for the German automotive industry and the resulting transformation strategies. Section 6.3, in turn, addresses

RO2 and reveals emergent themes in IT sourcing to meet the demands of the transformation strategies. There then follows a discussion of emergent themes for the successful transitioning to new IT sourcing strategies in section 6.4, including the significance of digital entrepreneurship, which addresses RO3. Finally, a summary of the chapter is provided in section 6.5.

6.2 Implications of Digitalisation for the Automotive Industry

Theme 01: The German automotive industry is undergoing the most far-reaching transformation in its history

P14 emphasised that the whole transformation of the automotive industry involves two dimensions: its scale, but more importantly, the speed of change required for the automotive industry which will decide the future position of the industry in the market. For most interviewees, the greatest challenge was how to transform something, within a few years, in a company that has been established for over 120 years. Some interviewees admitted to a lack of imagination.

The dimension of this change has not only some technical aspects but also a broad cultural one, related to the self-perception of this industry. Some participants referred to the 120 years of successful hardware-centric automotive engineering. For over a century, the German automotive industry has set international standards in automobile manufacturing. German pioneers and engineers, courageous entrepreneurs, visionary designers and highly competent and skilled workers have decisively shaped the industry. It was an era in which German automobiles became the epitome of top-quality workmanship worldwide, a time when Volkswagen, Mercedes-Benz, BMW, Porsche and Audi became ambassadors of Germany, and prestigious objects globally, with their finely tuned combustion engines and powertrains becoming models of industrial excellence. The German car was at times considered "the car" *par excellence*. This era is coming to an end.

P09 maintained it is the parallelism of electrification and digitalisation that creates a force that has not existed in this form since the beginning of the industry. Firstly, electro-mobility will significantly simplify the vehicle architecture in terms of hardware, and will have a profound impact on automotive value chains and employment. Incidentally, it is not yet clear whether the battery-electric car is really the ultimate solution to all the environmental problems associated with individual mobility. In the current transformation phase, an increasingly wide range of drive variants with electric as well as hybrid drives have emerged alongside the existing combustion engines. Despite all efforts to switch to zero-emission mobility, the industry estimates that there will still be a very large number of vehicles with combustion engines on the roads in 15 years' time, if not in Europe, then in other markets around the world. Such markets will not have an established and consistent charging infrastructure for electric cars in 15 years.

Secondly, interviewees admitted that on the way to the "digital car", enormous technological hurdles must be overcome by many parties involved in the overall mobility system. Road traffic is characterised by millions of constantly changing and unfolding situations and unpredictability. This requires decisions in fractions of a second, and all decisions have immediate effects on other road users involved. For the development of highly automated and autonomous vehicles (level 4 and 5) up to market maturity, further technological steps are initially necessary from different industries. These include hardware and software components such as the various sensor (e.g. radar or lidar) technologies, computing power, human-machine interfaces, software platforms, connectivity/connection of cars to the internet and high-resolution map data for precise location determination, as well as artificial intelligence to improve the software algorithms. Participants pointed out that in 20 years, fully automated vehicles will still be sharing the road with cars that are still completely controlled by humans. The decision-making processes of humans and digital algorithms differ greatly. Harmonising these different technology standards in a way that ensures a high level of road safety is highly complex.

The German automotive industry will have mostly achieved the double transformation from combustion engine to electric and digitalisation with its new strategies by 2030. Interviewees estimated that the automotive business in the 2020s will be dominated by the duality of pure electric vehicles and vehicles with "electrified internal combustion engines." They also assumed that the development of highly automated and autonomous vehicles (level 4 and 5) will focus predominantly on electrically powered vehicles. Overall, the trends are themselves highly dynamic, and digital technologies have rapid innovation cycles. As P01 noted "*flexibility is another reason why we want to be very active in shaping digital transformation*."

Theme 02: IT becomes the core competency of the automotive industry

The previous core competencies of the industry have become almost meaningless; the industry is being forced to establish software development as its new core competency. P01 and others claimed that the industry has been undergoing an IT-based transformation for decades, and this has made automotive processes highly efficient, which has turned the German automotive industry into a world market leader. P18 suggested that, especially in the field of car IT, purely analogue vehicles have not existed for decades and that a car, especially in the last decade, has already become a complex IT product. Other interviewees argued that until recently, the German automotive industry viewed software as an add-on to further perfect vehicle connectivity, digital networking and software- and data-driven digital services, and did not question the product itself. However, despite the high relevance of IT for innovation and process efficiency, the interviewees confirmed that the industry has been late in realising what digitalisation, and all the related digital technologies, really imply. P08 emphasised that software has become the centrepiece of the vehicles, IT has become a product. The quality of the software, rather than the motorisation or the design, will become the decisive factor in the competition between car companies in the future, according to the participants. P19, in line with other interviewees, added that overall digital technologies change the business and are the business at the same time. The new business models are digital and are primarily software. It was noted that as IT becomes core business, this constitutes added value and a differentiating factor. Interviewees concluded that this delayed perception of IT as a business / as a product has left the industry lagging behind new competitors outside the automotive sector.

Theme 03: The German automotive industry is behind the competition

New market players, especially from the IT and data economy, are changing the classic market structures in the German automotive industry, which is lagging behind this new competition. P06 explained that large American and Chinese technology companies recognised earlier the immense business opportunities offered by future mobility, and have been developing software operating systems for highly automated and autonomous driving for years. Their calculation is that the future profitable business will be done by those companies that attract passengers to fleets of robot taxis and digitally entertain them with music, videos and other services during the drive, support them with software while they are on the road, or sell them goods as well as services online. They assume that these services in the cars of the future will offer more added value than the sale of hardware in the context of individual motorised mobility. P13 emphasised that these companies are using their software dominance to shift the balance of power in the automotive market. P06 concluded that these fast-paced technological developments go far beyond the traditional existing strengths of the German automotive industry. The industry urgently needs to make up for a technology deficit, otherwise the digital future and the competition for technological supremacy in future mobility concepts will only play out between the USA and China.

Most interviewees pointed to the advantage of the financially strong technology groups in not having to deal with a 120-year history in the automotive business, not having to replace an existing automotive business model, but being able to invest their financial resources exclusively for the purposes of future mobility services. P09 and P18 referred to the capital markets' view of the automotive industry. Stock market ratings indicate that investors have less confidence in the "old car industry" on the way to the connected electric car than, for example, Tesla, which is worth three times as much on the stock market as Volkswagen, Daimler and BMW together, although the German car manufacturers sell many times as many cars. A comparison of these manufacturers' stock market ratings with the American technology groups is even more striking. Interviewees underlined that it is much easier for these technology companies to access capital and to promise their investors high returns.

Theme 04: The German automotive industry needs to finance an immense capital investment

In contrast to the large American and Chinese technology companies, high cash flows from the combustion business are paramount to finance digital transformation in the German automotive industry. Most participants underlined the lack of alternatives for the German automotive industry. By 2030, the global market for electric vehicles will have caught up with combustion engines in terms of sales. Revenue and profit pools of the business model will gradually shift by 2030: First from the combustion engine to the electric car, and later, when autonomous driving offers additional revenue, to software and services (e.g. Volkswagen, 2021a).

In consequence, besides the high investment for electromobility and digitalisation, the industry has also to invest in the current business model for a certain period of time in order to keep it competitive, even though the market for internal combustion engines will decline over the next ten years. Fewer models and variants, with bundled production at sites specifically geared to this, are the strategies for continued flow of revenue from the diesel and petrol business, even though their unit numbers will represent only about half of all vehicles sold in 2030.

OEMs and suppliers will invest €150 billion in new technologies by the middle of the decade. A third of this will be invested in software for connected cars and automated driving. New and existing production facilities are being equipped with IIoT technologies to increase flexibility due to the new electric variants and hybrid vehicles.

Additionally, P14 reminded that all companies have the same problem, with a high asset lock-in. The industry has made investments in factories around the globe over the last two decades. Many factories are no longer needed with the phasing out of combustion engines. Newly required factories for battery production will not compensate for this surplus of existing factories. P14 estimates that in individual cases, almost half of the factories will become redundant and the industry lacks the imagination of how to downsize factories abroad. Other interviewees also confirmed that high investment will also be required for the shutdown of existing factories.

Interviewees also illustrated the cumulative effects of a drop of sales due to the pandemic, a decline in sales of vehicles with traditional powertrains, lower value creation in electromobility, lower margins, and the upcoming loss of revenue in the aftermarket. This inevitably leads to a situation where only limited capital is available for transformation. As a consequence, P18 and most of the other interviewees underlined that almost all companies have set up further programmes to reduce costs, increase efficiency as well as to streamline the conventional automotive business to significantly higher operative return on sales. P02, P04 and P05 pointed out that costs remain a dominant topic within each decision made in the industry. P16 warned against the reflex to stop important transformation projects for these reasons and cited the need to find a balance that maintains a focus on innovation despite the difficult economic times. However, cost discipline is partly understood as an opportunity for “house-keeping” and eliminating ballast, which has not been feasible so far. P14 confirmed that part of the current homework is to seize the opportunity to streamline and not drag ballast over into the future business model.

In consequence, this industry is characterised by massive initial and sunk costs. In this context, interviewees referred to publicly available corporate documents of how OEMs and 1-tier suppliers have started to divest activities (portfolio shake-out) that do not have a promising future (Table 10).

Table 10: Examples of portfolio shake-outs in the German automotive industry

Daimler announced that transmission production for compact cars and mid-size models will be transferred to supplier Magna in the next few years.
Last year, **Daimler** launched a cooperation with its Chinese partner and shareholder Geely, for compact combustion engines.
Bosch and **Continental** are also in the process of selling plants for internal combustion engines.
The chemical group **BASF** is preparing to withdraw from its extensive business with exhaust gas catalysts with the loss of 4,000 employees, in view of the upcoming changes in the market for combustion engines. The spin-off is presumably a preparation for a sale of the division.
As part of a consolidation programme, **Schaeffler** is focusing its automotive division on electric drives and is closing 12 locations in Germany that produced parts for internal combustion engines.
ThyssenKrupp, on the other hand, has launched a strategy called "Last Standing" and is interested in taking over such activities because they are expected to be profitable business for the next 20 years.

Source: The author

Theme 05: The industry must constantly develop and introduce innovations, following its classic innovation approach

The themes outlined above indirectly shed new light on whether the megatrends in the form of digitalisation and electrification are disruptive for the German automotive industry or of an evolutionary nature. All interviewees shared the view that the German automotive industry will change fundamentally in the next 10 years. However, the majority of participants from OEMs and tier-1 suppliers emphasised that these changes have not been caused by a revolutionary disruption, but rather by a continuous transformation. Digital technologies are predominantly not seen as disruptive, they are all very important for their purposes, but not fundamentally new.

Electromobility, regardless of all other economic impacts, has been mastered from a technical point of view. Even the absolutely most outstanding key discipline and challenge of developing the software technologies for autonomous driving by the end of the decade is not seen as disruptive, although threats from the newcomers in the market, such as the American and Chinese technology groups, are imminent. P02 summarised that it only becomes disruptive for companies if they do not have the competencies and financial resources to react in time and with the required speed. Other interviewees have gone beyond this, and consider digitalisation to be an opportunity to overcome organisational legacy structures in large companies that are no longer suitable for rapid adaptation to megatrends.

However, the view regarding transformation is that the automotive industry has no alternative but to follow the classic innovation approach. The interviewees underlined that the industry is still heavily invested in a business model with combustion engines (including employment) and has to finance all innovations and organisational realignments from this end-of-life business for as long as possible. With the classic innovation approach, innovations are gradually introduced to the market in order to fulfil customer demands, but also to finance the next innovation with a return on sales. Other interviewees pointed to the common misunderstanding that the perception of digitalisation is mostly shaped by disruptive business models, breakthrough technologies and visionary CEOs. In contrast, the German automotive industry seeks to apply one thing at a time, but fast. For P06 and others, there was no doubt that digitalisation will lead to new business models. However, they favoured that the major challenges be tackled on a sound basis. Unlike newcomers, the German automotive industry has to master new business models while continuing to operate its existing business activities.

6.3 Implications of Digital Transformation for IT Sourcing Strategy

Theme 06: Accelerated insourcing for competition-differentiating car IT / product IT

With C.A.S.E., the German automotive industry has set new strategic directions for the accelerated development and adoption of digital innovations. The industry recognised that software is increasingly becoming the key competition-differentiating criteria and the performance of the groups depends on their own share in software development. The focus is mainly on software-defined vehicle architectures and car operating systems for connected vehicles, as well as for IIoT solution for connected production. The companies have been setting up new business functions for digitalisation and software, hiring thousands of computer scientists and software engineers, or training existing employees with the necessary technical qualifications to meet the new requirements. Speed, reactivity and flexibility are some of the key words. In contrast, as P16 observed "*automotive companies tend to be as steady as a waterfall*." However, the groups have already taken important steps and organisationally separated the development of car software from traditional car engineering, since software follows much faster innovation cycles. These functions have been organisationally separated from corporate IT as well.

Interviewees provided documentary evidence of the size of these new functions. In Volkswagen's newly founded car software organisation CARIAD, for example, around 4,500 engineers and developers are currently working on a standardised software and technology platform for all Volkswagen Group brands, comprising a standardised operating system, a standardised E/E architecture and an automotive cloud. In addition to other new organisational units for digitalisation, Mercedes-Benz AG has appointed a Chief Software Officer (CSO) outside of Corporate IT, who also has overall responsibility for C.A.S.E. relevant developments. The CSO has currently announced the foundation of the "Mercedes-Benz Electric Software Hub" and plans to hire around 3,000 software and IT specialists in Germany as well as in the existing global R&D locations Berlin, Tel Aviv, Seattle, Silicon Valley, Beijing, Tokyo and Bangalore. The purpose is to accelerate the development of the software-defined architecture of all future Mercedes models with the Mercedes-Benz Operating System (MB.OS). BMW, as another example, has opened a new research and development centre in the north of Munich, employing 4,800 vehicle developers who are to transfer BMW from the metal age to the digital age.

The three large tier-1 suppliers: Bosch, Continental, and ZF, have long had large software units for the previous programming of ECUs and also have extensive expertise in developing the software for automated and autonomous driving. For example, Bosch employs 34,000 software engineers for product IT, compared to 8,100 employees in Corporate IT (IDG, 2021). ZF employs over 9,000 software engineers in product IT, compared to 2,500 employees in Corporate IT (IDG 2021). To this end, these suppliers are better prepared for the upcoming car IT / product IT than OEMs.

Theme 07: Accelerated outsourcing of commodities in traditional IT

Interviewees reported that outsourcing of commodities in traditional IT (also called enterprise IT, group IT or central IT) will continue to accelerate. Companies no longer want or can afford many thousands of employees for the operation of infrastructures such as data centres or networks in group IT. Various factors are prompting companies to hand over these functions to partners as part of strategic outsourcing projects, including assets and workforce. Some participants referred, for example, to the new strategic partnership between Daimler and the Indian IT service provider Infosys, which is to take over the operation of the fragmented IT infrastructure to a large extent, including workforce from the regions of Europe, the Americas and Asia Pacific. In the case of Daimler, the network architectures and the operating models of the more than 100 existing data centres worldwide are to be modernised and made scalable by Infosys. Responsibility for important applications remains within the company. Other interviewees opined that more companies will follow this trend. The companies do not want this to be understood as a classic outsourcing measure, but declare it as a strategic further development of IT. The focus would not be on the cost aspect, but on a coordinated method of freeing-up capacity for software engineering, technological innovations and higher flexibility. However, participants also argued that traditional IT is at the centre of cost-cutting and efficiency programmes. P05 and others declared traditional IT a stagnant topic.

The situation is different for tier-1 suppliers, as interviewees from this automotive sector argued. Traditionally, insourcing predominates for most suppliers. However, the participants agreed that the economic situation is triggering a trend towards commodity outsourcing here as well.

Theme 08: Accelerated value-added sourcing

Interviewees were of the opinion that the German automotive industry is not in a position to tackle digitalisation without partnerships and completely on its own. This would require scarcely affordable investments, which would also be missed in the development of other technologies, such as electromobility. More critically, it would be almost impossible to catch up with the specialised software and technology groups and their advanced developments. The findings revealed that the German automotive industry can only master the complex challenges of digitalisation through networks of strategic partnerships. In order to compete, automotive companies need to be aware of both the start-ups and the large US and China based software groups.

P06 and others confirmed that start-ups are important drivers of innovation and have to be considered as cooperation partners, as they have highly skilled professionals that make them influential players in the industry, to some extent. However, as the participants noted, the automotive industry is in a dilemma as it has to cooperate with companies that can potentially pose a threat to it, as future competitors. The participants estimated that the share of software in the growth of the automotive industry will increase to up to 80 % by the end of this decade. Therefore, it is not surprising for the participants that an increasing number of IT companies are interested in this highly profitable market, even if the aim or outcome of some developments is to date not yet foreseeable. Companies such as Google, Apple or Microsoft have focused on artificial intelligence and data algorithms in the self-driving car and have aligned their strategies accordingly. In addition, Asian chip manufacturers are upgrading to deliver intelligent solutions for the car of the future. Some participants argued that the IT companies have no plans to build their own vehicles so far and "only" equip vehicles of car manufacturers with their artificial intelligence. Other participants warned that this is no less alarming for the German automotive industry.

The interviewees also assumed that the existing partnerships with tier-1 suppliers, who have so far supplied the software embedded in the ECUs, will be further intensified, as these suppliers have many years of experience in product IT and vehicle assistance systems and also have resources that cannot be built up any time soon by the OEMs. The suppliers want to programme the middleware, the non-visible part of the car operating system, which ensures that all applications can interact with each other, and offer it to the vehicle manufacturers.

Overall, the interviewees felt that the industry must cooperate where necessary to exploit the capabilities of the technology groups and suppliers. Companies need to engage with a wide variety of partners from the software industry in a range of different forms of cooperation, such as strategic partnerships, alliances and the like, in order to co-develop. Strategic acquisitions or shareholdings in specialised software companies are also an option. The new alliances are also regarded as opportunities and interviewees pointed out that there are already numerous dependencies between the long-established automotive industry and challengers from the software technology sector. Without IIoT solutions from software companies, the automotive industry, for example, would not be able to network its factories in the sense of Industry 4.0 and thus produce its vehicles more efficiently. Without the technical capabilities of hyperscalers, the possibilities of cloud sourcing or the networking of vehicles as integral parts of the IIoT would be unthinkable. Car buyers demand that they can connect their smartphone as smoothly as possible with the digital offerings in the car. This only works if car manufacturers cooperate with the providers of smartphone operating systems. In addition, the platforms and ecosystems for offering mobility services require the interaction of many actors. Based on reports from interviewees and corporate documents, the following table (Table 11 provides examples of new partnerships for value-added sourcing, some of which have already been mentioned in the chapter findings.

Table 11: Examples of value-added sourcing in the German automotive industry

Volkswagen (2021b) has been working with Amazon AWS and Siemens to develop an industrial cloud that will connect all 122 of its plants to further invest in factory automation and to make use of a large amount of technical data. The industrial cloud is based on AWS technologies in the areas of IIoT, machine learning, data analytics and computing services. The solution is being developed as an open industry platform that other partners from industry, logistics and sales can use as well. This is intended to create a steadily growing global industrial ecosystem. In addition, Volkswagen entered into a long-term partnership with Microsoft Germany in 2020 to promote and jointly implement projects; for example, in the area of digital education and training. The aim is to facilitate access to digital technologies and thus increase participation in future opportunities.
Europe's largest automaker **Volkswagen** (Automobil Industrie, 2022a) and the world's largest automotive supplier **Bosch** announced a partnership to develop and launch highly automated driving functions in all VW vehicle classes, also making them available to other manufacturers. Both companies declared this as a paradigm shift in the cooperation between OEM and tier-1 supplier. The times in which OEMs purchase complete components from suppliers and integrate them into the vehicles by means of specifications and high-volume orders are coming to an end. This partnership is said to be the ultimate attempt to progress without direct involvement of US technology companies in car operating systems. To this end, Bosch is bundling 2,300 software engineers in a new organisation for faster development. With this new set-up, Bosch aims to become the leading supplier of application-independent vehicle software in the future.

Volkswagen has also announced a billion-dollar investment in Ford subsidiary Argo AI. Argo is to develop software and technology for autonomous driving (Volkswagen, 2021c) The Israeli software specialist for autonomous driving Mobileye (a subsidiary of chip giant Intel) has been riding along as a "silent companion" in **Volkswagen** and **BMW** vehicles for years, letting the cars' cameras map hundreds of thousands of kilometres of road all over the world as a basis for future driver assistance systems (CAM, 2021).
Daimler (2021b) reported on a joint venture with NVIDIA to build a software-defined vehicle architecture for automated driving for the Mercedes Benz brand. **Daimler Truck** strengthened its position in fully automated driving (SAE Level 4) through a partnership with Waymo in the U.S. and also acquired a majority stake in Torc Robotics. Another milestone is the cooperation with Luminar Technologies, a leading provider of lidar hardware and software technology.
Previously, **Daimler and BMW** had agreed to a partnership in 2019 to jointly develop the next generation of technology in the field of automated driving (Daimler, 2020). After an intensive review, both companies agreed in June 2020 to postpone this partnership for the time being (BMW, 2021). They concluded that, in view of the high cost of a common technological basis and against the background of the overall business and economic situation, the conditions for a successful implementation of the cooperation are currently not given. Both companies are now working independently on their current generations of highly automated driving systems.
BMW and Microsoft founded the OMP initiative in 2019 to build an open manufacturing platform, based on Azure cloud (Bosch, 2020). This alliance aims to make it easier for companies to collaborate with each other. Knowledge, data, new technologies, and everything that drives the development of innovations can thus be shared more easily. One day, this should result in an industry-independent and standardised production platform based on open-source software. **ZF Friedrichshafen** and **Bosch** have also joined this alliance. Other manufacturers and suppliers from different industries can also join the alliance and share their Industry 4.0 experiences, data models and solutions with other members.
Bosch has another strategic partnership with Microsoft on the industrial application of mixed reality. The term refers to the mixing of the real world with objects artificially created on a computer (Bosch, 2020).

BMW has entered into strategic collaborations with Amazon Web Services to move business and operations data from many countries to the AWS cloud. This also includes a number of central IT systems and databases. A central component of BMW's cloud data strategy is also an Amazon S3-based data lake. BMW's "Cloud Data Hub" is to become the hub for managing company-wide data solutions in the cloud. Employees from all areas of the company could implement and operate analytical and data-driven applications. For this purpose, various AWS services such as machine learning would also be integrated in order to query, process and enrich development, production, sales and vehicle performance data, even in orders of magnitude of several petabytes.
Continental (2021) and Amazon Web Services (AWS) will be working together in the future as part of a development cooperation. The aim of the long-term collaboration is to develop the Continental Automotive Edge Platform (CAEdge), a modular hardware and software platform. It connects the vehicle with the cloud and offers numerous options for the development, provision and maintenance of software-intensive system functions through a virtual workbench.

Source: The author

Theme 09: Cloud sourcing offers access to key information technologies

All interviewees highlighted the particular strengths of cloud computing and stated that a modern cloud architecture is the most important backbone for digitalisation and a prerequisite for modern IT applications and infrastructure in a company. Besides outsourcing, the even greater effect from the interviewees' perspective is that hyperscalers offer access to technologies and know-how that can drive innovation in shorter cycles than in the on-premises environment. While the compute, storage and networking capabilities of hyperscalers are in principle comparable at a high level, for companies it is also a matter of leveraging sophisticated key technologies of cloud providers, such as Amazon AWS, Microsoft Azure, Google and others. For example, the world's largest public cloud provider, Amazon AWS, offers around 200 services covering areas such as computing, storage, databases, the IIoT, machine learning or artificial intelligence.

Google advertises being a technological leader in artificial intelligence. In general, the interviewees consider the development of data lakes as a central component of cloud data strategies in order to evaluate company-wide data with machine learning technologies, business intelligence services or advanced methods for analytics and to implement data-driven applications. Only with cloud computing, artificial intelligence and IIoT as key technologies can huge amounts of data be analysed and made useful for business.

Theme 10: New challenges for integration of cloud, edge and on-premises

Interviewees indicated that the previous data processing out of the central data centre will be distributed in the future to the public cloud, to the edge as well as the remaining on-premises volumes, including private cloud. Effective digitalisation requires end-to-end integration of these computing platforms.

Edge computing points to digital production, which is characterised by having a huge number of smart endpoints in factories that operate autonomously with advanced sensor technology, computer vision and artificial intelligence, and that produce and share large amounts of data. In these automated factories, humans are only involved in exceptional cases to monitor the systems or when unforeseen decisions have to be made. Interviewees opined that even high-performance networks take too long to transfer data to a data centre or the cloud for analysis. They favour two characteristics for these technologies that seem contradictory at first glance: cloud-based data management on the one hand and reliable real-time capability with low latencies and high security on the other. For the latter, edge computing is considered highly important as local data processing, complementing the cloud when it comes to optimum coverage with the appropriate connectivity. The same applies to the digital car, which is considered an edge device in the IIoT.

Legacy systems remain a barrier to effective cloud sourcing. Almost all interviewees confirmed that the companies were suffering from their fragmented IT systems, which have grown over decades. New functions were added again and again until the legacy systems reached their limits. Often hundreds, sometimes even thousands of systems are interconnected via transport layers and interfaces. The digital legacy is based on decades-old IT architecture. In fact, legacy systems have become a burden as their lifespan increases. Interviewees argued that outdated IT infrastructures and legacy systems prevent the profitable automation of business processes and slow down digitalisation. Legacy systems no longer meet the latest technical standards, do not follow best practices and there are sometimes considerable security problems, which are caused either by technical deficits or by the fact that in many cases, manufacturer's support has long since expired and there is a corresponding lack of security updates. P18 observed that legacy systems are very expensive and the long-standing systems not only slow down a company's business processes, but also swallow up a high proportion of IT costs. Others confirmed that a full 60 % of a company's total IT costs can be spent on the maintenance of legacy systems. And this increases proportionally to the time a system is in use, as well as to the accumulating technical debts that place more and more demands on the system.

All the while, IT providers, hyperscalers and IT consultants are raising expectations that by moving legacy systems to the cloud, the whole "hodgepodge" of applications and data, all the previously fragmented IT systems, can be reunited again. In the cloud, the fragments would merge, would be converted into a new architecture and, for example, data from the most diverse corporate divisions that had previously been considered in isolation could be used for digital business models with artificial intelligence. In contrast, P06 and others claimed that legacy systems are not all prepared for cloud sourcing and a simple "lift and shift" to the cloud will produce hardly any cost or performance effects. Interviewees reminded that normally expensive standardisation and consolidation has to be started first before the migration of these applications to the cloud. P05, P10 and P18 became even more specific, recommending not to be misled by reports from companies claiming that moving to the cloud has enabled them to reduce operational costs and increase flexibility to respond faster to customer demands. In most cases, large enterprises are still bound and constrained by legacy and proprietary applications and infrastructure. In this context, interviewees warned against the widespread expectation that the cloud business pays off simply by moving existing applications and infrastructures to a hyperscaler, where costs are reduced and performance is increased. Companies realised that cloud computing often leads to additional costs when all aspects are taken into account.

In contrast, cloud sourcing decisions might be strategic in nature in some cases. With the technological opportunities of cloud sourcing, there is also an expectation among top management of being able to eliminate some traditional IT, including the whole issue of legacy systems. Even the simple "lift and shift" of legacy systems into the cloud can be strategically attractive if, for example, it frees up capacity or reduces the workforce, ridding companies of ballast and giving them greater overall flexibility in the digital transformation. Especially with regard to the high investment required for digital transformation, companies have the ambition to transform capital expenditures (CapEx) into operating costs (OpEx). In this way, they can secure more regular access to new technologies, even with limited financial flexibility. Companies can also improve their capital ratios and save on capital costs if they do not have to account for their data centres and other investments themselves in the balance sheet.

Interviewees agreed that the public cloud has become a commodity, yet continues to be the top trend for outsourcing. Admittedly, part of a multi-cloud scenario is also the private cloud, which is indispensable for many companies. Legal and regulatory requirements in particular force companies to manage sensitive data on-premises on their own servers.

Most interviewees perceive a risk of becoming dependent on one large cloud provider, hence the pursuit of multi-cloud strategies. While confirming that cloud sourcing offers more possibilities and flexibility in handling data, they also point out how complex upcoming IT landscapes will be. In particular, the interlinking of internal on-premises resources with various cloud services, but also the countless combinations of different services in one cloud are not likely to be so easy to de-coupled. As a result, new dependencies can arise.

Theme 11: IT sourcing can deliver sustained competitiveness in the current dynamic business environment of the German automotive industry

The German automotive industry has world-leading engineering capabilities for driving experiences. However, in the future, core competencies, knowledge and capabilities that have been found in the IT sector up to now, will be decisive. The interviewees confirmed that on the one hand the automotive industry has to develop strongly in the direction of software-defined industry, and on the other hand the tech players are moving in the direction of the automotive industry. Thus, both the automotive industry and the tech players are moving into new competitive territories. For the German automotive industry, it is a matter of securing know-how through a wide range of measures within IT sourcing. Acquiring the new technical knowledge and capabilities as quickly as possible has the greatest impact on the competitiveness of the industry and ensures digital independency. The interviewees claimed that IT sourcing is responsible for sourcing the digital knowledge and resources for moving faster and with more insight into a software-defined industry.

6.4 Transitioning to new IT Sourcing Strategies

Theme 12: The current IT sourcing model is mainly driven by cost optimisation and has reached its limits

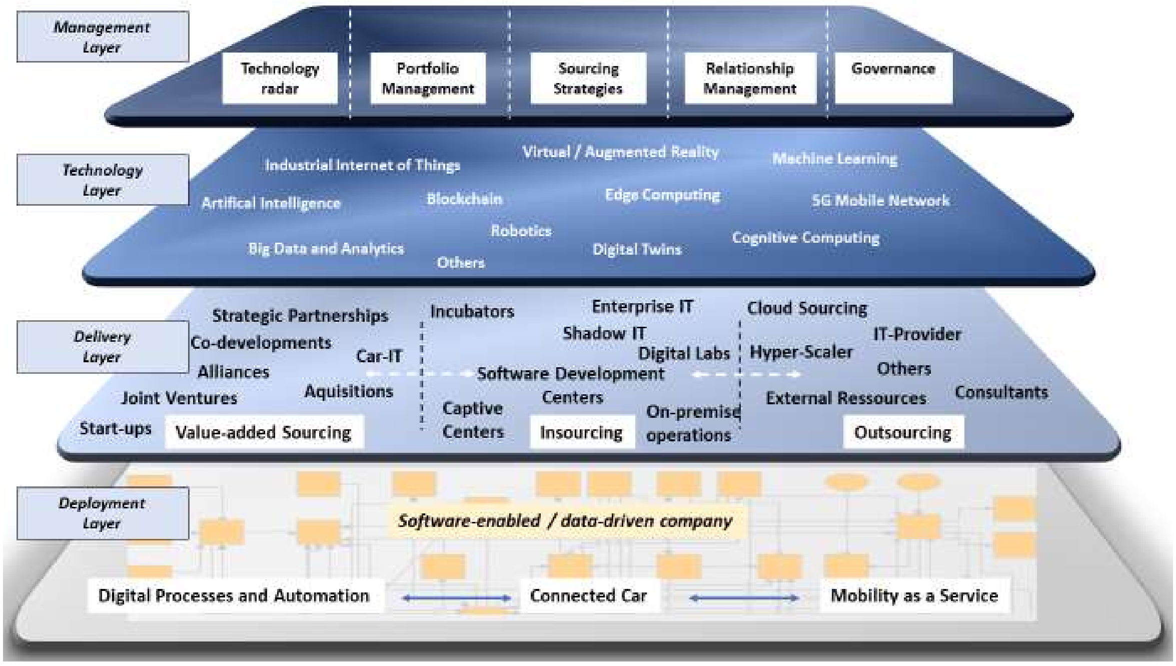
The interviews revealed that although IT has contributed significantly to increasing the efficiency of business processes over the last two decades, IT was not defined as a core competency in the companies and was largely outsourced, at least at the OEMs. The current IT sourcing model is predominantly motivated by budget perspectives. P09 and others argued that IT know-how has in the past been reduced to supplier management, and traditional IT organisations no longer even knew how to handle IT. Besides supplier management, the IT departments were essentially reduced to software implementation and operations. IT was not seen as an enabler but predominantly as a cost factor and the complexity of applications and infrastructures with constantly changing technologies remained a mystery to top management. Therefore, there was a strong temptation to outsource the complex IT. All this came along with a loss of know-how and high dependencies on a variety of IT providers. Interviewees stated that supplier management was essentially focused on commercial issues such as prices or service level agreements (SLAs). The large number of contracted IT providers led to a heterogeneous infrastructure and the technical evaluation of the delivered or developed solutions was hardly possible due to the loss of know-how. P10 and others confirmed that traditional IT organisations have lost control.

P04 and P10 stated that the previous IT sourcing model was mainly based on buying in full-time equivalents (FTEs) with a certain skillset and then using the “leased staff” to perform certain IT tasks. These traditional FTE-based commercial approaches were based on forms of contract, such as time-and-material or fixed prices. Output-based or transaction-based contracts were rarely used for the delivery of services. IT sourcing has not been accustomed to using new commercial contract models to measure the value of the work done, rather than the labour required to do the work and what can be achieved with their current labour pool. P15 concluded that the current IT sourcing model will soon be obsolete because IT sourcing management does not have the capabilities and skills to manage value-added partnerships.

Theme 13: Key elements of the future IT sourcing function

The interviewees addressed a number of reasons for why and how IT sourcing needs a strategic shift from the current sourcing model to a governed sourcing of digital technologies, knowledge and resources to fulfil the demands of digital transformation strategies. This can be drawn in a multi-layered diagram for IT sourcing, as shown in Figure 34, consisting of a governance layer, a technology layer as well as a delivery and deployment layer. Some interviewees described the sum of these layers and elements as an IT sourcing ecosystem that connects large networks of IT providers on a digital platform, where the many players generate value in various ways and where all actors interact according to established rules.

Figure 34: Multi-layered IT sourcing



Source: The author

The first layer represents the planning and control instruments to evaluate, guide, perform and monitor IT sourcing in the company in accordance with its digital transformation strategies. The interviewees considered governance to have the primary purpose of aligning the management processes in IT sourcing to ensure that the objectives of digital transformation are optimally achieved through sourcing decisions.

The second layer considers the variety of digital technologies for which the appropriate competencies and resources must be identified internally and externally. The third layer connects the company's own core competencies and resources with a variety of actors, such as partners, suppliers and an open community, integrates the multitude of actors in various ways and brings together the digital know-how of all parties involved. The fourth level addresses the three major fields of application for which the innovative solutions are being developed and operated.

P09 and P17 argued that IT sourcing management has to acquire competencies to maintain a technology radar that identifies which technologies are needed, what the maturity level of the technology is, where in the company it can be innovatively implemented and how it fits into the overall IT architecture of the company. Based on this, analysis is possible of how the range of digital technologies can be sourced, what is built internally and what is best delivered by which provider. P10 and P18 addressed the need for a corporate wide and consistent portfolio management, which has hitherto been completely neglected because, in principle, most of IT services were outsourced. Portfolio management thus takes on a new significance as more methodical questions, such as total cost of ownership (TCO), are asked about how the IT services should be provided. Interviewees referred to the two types of costs that companies have to consider when deciding on outsourcing: production costs and transition costs, which make up the overall costs of doing an activity. Production costs of IT services are operationalised through three components: hardware costs, software costs, and the costs of IT labour, and transaction costs are direct and indirect expenses for the negotiation, monitoring and enforcement of contracts between the client and the vendor. P10 stated that decisions and reviews in terms of TCO were rarely carried out. P03, P05, P08, and P18 insisted that IT sourcing is expected to balance between controlling run costs and risks while simultaneously building strategic technology partnerships and co-developments

The interviewees emphasised that value-added sourcing and cloud sourcing pose new challenges for supplier relationship management. Interviewees agreed that this requires a fundamental shift in the sourcing strategy, the delivery approaches and capabilities. P18 reminded that the previous "IT multi sourcing" is reaching a new relevance and a new level of complexity. In consequence, IT sourcing has to handle a tremendous amount of information of the lifetime of relationships and keep track of all the deliverables and commitments of hundreds and even thousands of IT providers, as well as from co-opetition relationships. Every supplier relationship poses a different sort of risk and requires a different level of governance. P18 and others observed that, with the changed strategies in IT sourcing, new demands are being placed on risk assessment to ensure that everything remains manageable. With value-added sourcing, strategic partnerships, co-developments and, above all, co-opetition relationships, the potential risk for the automotive industry increases.

Interviewees indicated that it is necessary to analyse exactly which external partner networks a company relies on to ensure it is still manageable for the company. The main concern of the companies is that the previous dependencies on providers do not turn into even greater dependencies in the future, especially with the hyperscalers and tech players. This raises questions about the contractual relationship that need to be answered. P18 argued that traditional contract models for customer and service providers are reaching their limits. Due to the market dominance of the hyperscalers and tech players on the one hand and the fact that the automotive companies rely on gap-closing partnerships on the other hand, contract negotiations reach a new dimension where the automotive companies have to decide exactly which role they will take in networks of value-added sourcing.

Additionally, data management is taking on a whole new significance, especially in the context of cloud computing. In a software-enabled automotive company, software development is no longer an exclusive tool for central IT organisations. Software engineers, data scientists, and AI experts, among others, will exist in every business function and everywhere in the company. Highly sophisticated applications from the cloud can be accessed from any place in the company and cloud consumption happens everywhere. P08 warned that uncontrolled cloud consumption can become a cost trap if everyone in the company can independently approach a hyperscaler under framework agreements, and favoured the central control of demand.

Interviewees such as P06, P09 and others referred to the hardly imaginable amount of data silos in the companies and that a semantics, a data vocabulary, must be created as a basis for the interaction of the many actors in the IT sourcing network. Companies need to know where their data is, what it represents, where it originates and have to be able to restore it quickly in an emergency or move data back and forth between different clouds and hyperscalers.

Theme 14: IT competency spreads throughout the entire company

Interviewees stated that staff recruitment will focus on thousands of software engineers, AI experts, business and process modelers, data scientists, as well as cloud and security experts. Qualified data experts are needed in all areas of the company to build and expand sustainable data expertise. As many areas of the data-driven enterprise are dominated by software and data analytics, the interviewees concluded that many employees may become a knowledge worker, who turns data and information into strategic assets of the company. In turn, it was emphasised that artificial intelligence, robotic process automation and the fast-learning algorithms lead to a higher automation of the workforce. Estimates vary as to what percentage of companies' workforces will be replaced by software, AI and robotic automation and to what extent this can be compensated for by new jobs. However, they are certain that automated factories and business processes will lead to a "next generation workforce", where "teams" will consist of humans and digital workers, but where human and technological intelligence will also become even more interchangeable.

As a result of increasing automation in IT, the interviewees expected that the previous model of personnel-intensive offshore delivery will continue to lose importance. This will be the case in the medium term, especially for standardisable and low value-added tasks in first-level support. In the long term, the use of AI technologies such as machine learning and voice assistants can probably also solve more complex service requests. P18 and others stated that this trend could already be observed, especially among the large, global IT service providers, which have a high level of automation in their global delivery centres and thus offer services with a relatively low-cost level. Relieving internal IT service staff of tedious and standardisable routine tasks is important in order to redistribute tasks within the IT organisation towards value-creating topics.

Most interviewees confirmed that the transformation into the "next-generation workforce" will free up capacity and demonstrated this with the example of moving entire data centres and infrastructures to the clouds provided by the hyperscalers. In the process, highly experienced and employees released from their traditional roles will be trained in different skill-sets to master the digital transformation. However, the interviewees also confirmed that freeing up capacity has its limits. Due to the age structure and other reasons, it is sometimes hard to imagine that all the employees who have been released will be able to meet the requirements arising from the new tasks within the framework of the digital transformation. These employees are good at operating data centres or other infrastructures and have the skill-set for previous supplier or project management, but many of the employees cannot be developed for the new topics in the context of digitalisation.

P15 claimed that a new integrated allocation strategy is needed for the next-generation workforce. In the current business model, human labour and digital workforce are delivered differently and divided in two separate organisations. Human labour is provided by HR through recruitment and digital labour, whereas digital intelligence and technology is provided by IT through IT sourcing. In future, the best workforce for the task at hand will have to be decided in each individual case. Sometimes it may be human labour, such as a data scientist or other expert, but often it will be digital labour in the form of robotic process automation, where workers learn to interact with robots. Interviewees stated that robotic process automation is the most highly adopted automation solution and the most mature technology solution. Subsequently it might be cognitive computing, with the simulation of human thought processes in a computerised model. Interviewees noted other examples of cognitive computing, such as computer vision, machine learning, natural language processing or voice recognition. In another case the allocation might be a high sophisticated software for artificial intelligence. Consequently, the question arises of who exactly will define and provide the workforce needed for a particular process in the future. P15 insisted that, fundamentally, the current dividing line between HR and IT must be removed and an integration of both functions must take place, in order to establish clear responsibility for the management of the next-generation workforce and respective allocation strategies.

The considerations regarding the “next generation workforce” underpin the fact that digital competency is no longer centralised in software development centres or IT organisations, but distributed throughout the entire company. In this context, the discussion about the future role of IT sourcing management resulted in a diverse set answers and opinions, which also depend on how the participants assess the future role of IT in general. P09 and P17 argued that traditional IT needs to get much closer to the business, regardless of IT sourcing. They generally questioned the organisation of a central IT, where IT is mostly disconnected from the real business and argued, in the context of digitalisation, for small, lean, business-oriented IT units. In line with this, P03 and P08 revealed that business wants to take back control of IT. Business functions are requiring more autonomy over their IT sourcing to leverage advances in technology and quicker time to market. Moreover, participants added that with the "X-as-a-Service" model, consumption-based services are becoming the dominant force in IT and will drive changes in the role IT plays in the enterprise. Therefore, it is no longer the sole domain of corporate IT organisations to design, build, test, run and maintain business applications.

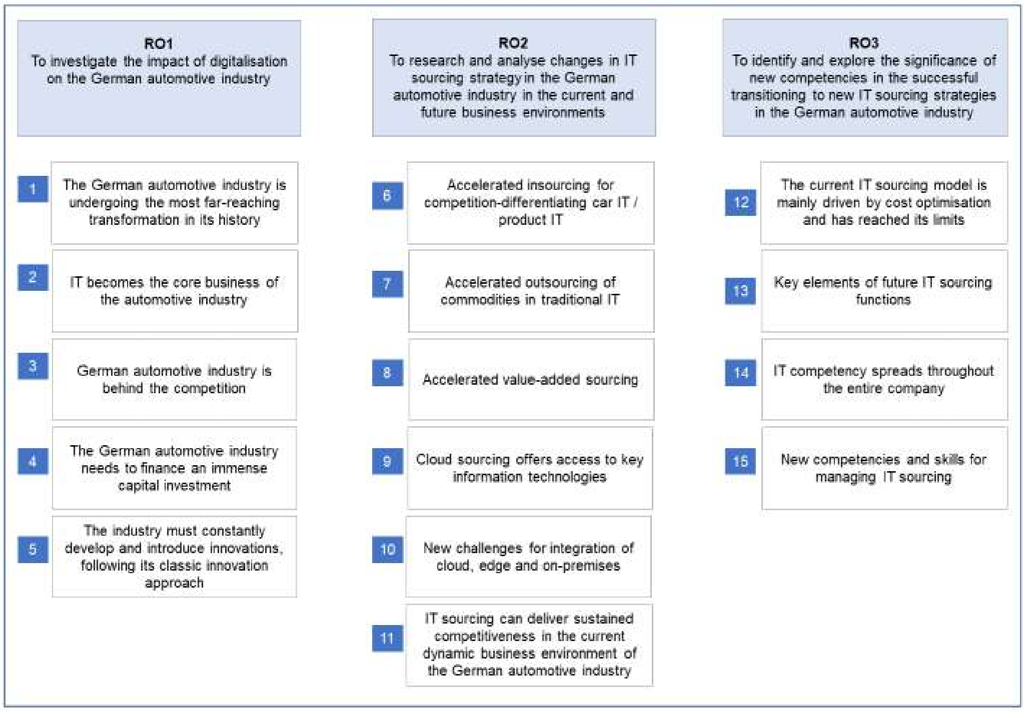
Theme 15: New competencies and skills for managing IT sourcing

In order to understand what new competencies and skills in IT sourcing are required, the interviewees once again marked the initial situation. Generally viewed, the management of IT sourcing must transform from a writer of small purchase orders to an orchestrator of the IT sourcing network. P17 noted that the main challenge is flexibility and providing a fast scaling "liquid workforce", both in one direction and the other. The interviewees noted that legacy application and infrastructure support contracts will have to coexist with new forms of contracts for outsourcing, cloud sourcing and value-added sourcing in the context of digitalisation, for the foreseeable future. The monolithic long-term contracts signed in the last decade may no longer fit the new requirements of scalability and may need to be reworked or replaced. Hence, a consolidation of the existing and fragmented supplier landscape is a first prerequisite for IT sourcing. Secondly, digital technologies are evolving at an incredible speed and extensive knowledge of the digital technologies is needed to maintain pace, to know what is possible, in particular what technology can be made available via sourcing or kept internally. In-depth knowledge of digital technologies is a mandatory prerequisite for negotiating and working on an eye level with the tech players and specialised niche providers. Thirdly, besides the awareness of digital technologies, governance structures and processes must be in place to hold providers accountable for contractual terms and compliance through constant tracking of deliverables and outcomes. Fourthly, P03, P05 and others stated that tracking the potential for risk, ensuring compliance and staying on top of the financial and contractual details for hundreds or even thousands of IT providers require high-level organisational skills. Fifth, P08 underlined the need to develop methodological skills to assess and review business cases. Finally, an important success factor is building strong, mutually-beneficial relationships with partners who do not see themselves as IT suppliers. Learnability and cooperation are the new guiding principles for innovation, which requires new competencies and skills to manage IT sourcing.

6.5 Summary: Drawing Conclusions from Emergent Themes

The analysis of the findings resulted in 15 emergent themes (Figure 35). Addressing RO1, five emergent themes demonstrated the impact of digitalisation on the German automotive industry, which are reflected in digital transformation strategies. With regard to RO2, analysis of the findings suggests six themes of relevance to a reshaping of IT sourcing strategies and priorities for the current and future business environment. As RO1 and RO2 - with their emergent themes - essentially reflected *what* changes are ahead for IT sourcing, RO3, in contrast, raised four emergent themes regarding critical competencies, skills and capabilities, indicating *how* a successful transition to the new IT sourcing strategies might to take place.

Figure 35: Emergent themes arising from data analysis and interpretation



Source: The author

The following conclusions, which will impact future management of IT sourcing in particular, and corporate IT in general in various forms, can be drawn from the emergent themes (Table 12).

Table 12: Conclusions drawn from the emergent themes

Concerning RO1, the impacts of digitalisation on the German automotive industry
(1) Electromobility, connectivity and highly automated/autonomous driving, as well as connecting production plants with IIoT technologies, require software-based innovations at an unprecedented speed. The car is increasingly becoming a permanently networked device of the internet. In the future, vehicles will be defined more and more by software. In the design and engineering process, expertise of software and vehicle hardware are combined, and a vehicle is no longer developed in terms of components but in terms of IT-systems. A new challenge is to master the new interface between software and hardware development, which have two widely different development methods and technology cycles.
(2) The cloud is the backbone of digitalisation. With the power of the hyperscalers, large cloud platforms can be built for connecting cars and new mobility services. Moreover, cloud-based industrial platforms are being built to exploit the opportunities of digital production and cross-industry networking of value chains. The rollout of digitalised production with IIoT technologies requires complex production clouds and powerful backend systems.
(3) There is increasing recognition that innovations are needed, in the shortest possible time, if the industry is to continue to play a leading role in the global automotive market. These developments require, first of all, software competencies the industry never developed over decades. Technology companies outside the industry have a competitive advantage in these areas, and have recognised earlier the business opportunities of connected cars and future mobility services. The German automotive industry underestimated the significance of software as a future key technology and core competency, and has entered this field late. Therefore, the German automotive industry has to catch up with financially strong software companies that are using their technical capabilities to enter the automotive business.
(4) Innovations require high investments, which will be financed from the current business based on the combustion engine for as long as possible, which itself will

require further investment in flexible factories to produce new model variants. Therefore, cost-cutting and efficiency programmes remain on the agenda of the industry.
Concerning RO2, the changes in IT sourcing strategies
(1) Within digitalisation, IT sourcing is becoming a strategic element. The German automotive industry depends on world-class IT resources and modern digital key technologies and services from software giants and hyperscalers outside the industry, and even from competitors. The industry runs the risk of being surpassed in a short time by digital newcomers, or reduced to being mere contract manufacturers. This presents the car companies with strategically difficult decisions: Should they attack the new competitors or partner with them. They can hardly win a technology race against these companies because their lead in software and artificial intelligence is too great. Interviewees concluded that there is no alternative, and the automotive companies need to find their role in new partnerships with partners outside the industry. These potential partners themselves are highly ambitious to enter the mobility industry of the future, so that the German automotive industry does not run the risk of being surpassed in a short time by digital newcomers or reduced to being mere contract manufacturers. (2) Speed, reactivity and flexibility in providing world-class IT resources are key. The automotive companies must undergo enormous technical, structural, organisational and cultural changes in order to become the architects of software-enabled business models. Rapidly building a flexible IT sourcing ecosystem with a variety of partners to fill competency gaps is becoming imperative. In addition to building up in-house IT resources in new software development centres within business functions, value-added sourcing will be key to catching up on backlogs in software development for connected cars and autonomous driving, as well as drawing on the expertise of tech players in areas such as artificial intelligence for digital drivers. Traditional make-or-buy decisions become make-or-buy-or-cooperate decisions. The findings point to three central motives for value-added sourcing: Firstly, gap closing alliances to bridge individual resource and competency gaps and to jointly realise competitive

advantages that cannot be achieved individually. Secondly, sharing the increasing fixed costs for the development of OEM car operating systems with a simultaneous acceleration in the speed of change, causing a corresponding rise of business risks. Thirdly, the companies, together with selected competitors or partners, strive to increase the probability that their own IT development path will become an industry standard, or will continue to be based on competitive industry standards. Additionally, competitors are forced to cooperate to achieve strategic results, a phenomenon known as "co-opetition", where firms simultaneously cooperate and compete.

(3) IT sourcing must make the provision of IT services and software solutions as efficient as possible. High priority should be given to the further outsourcing of commodities in traditional IT, combined with the elimination of unnecessary activities in order to focus resources more flexibly on the new demands. For the future, outsourcing is synonymous with cloud sourcing to use more cost-effective, flexible and scalable sourcing models. Cloud sourcing has been proven to meet high demands on a wide range of services in the three areas of IaaS, SaaS and PaaS. Converting CapEx to OpEx ("budget instead of headcount and investment") might be an additional goal to meet cost-cutting programmes with staff reductions. However, in the German automotive industry, cloud sourcing is still in its early stages and offers considerable potential.

(4) The consequences outlined above are also changing the current IT provider landscape, leading to the redirection of IT budgets to hyperscalers and new partners, thereby impacting the business of traditional IT providers.

Concerning RO3, the conclusions for the successful transitioning to new IT sourcing strategies
(1) IT sourcing management must adopt a new entrepreneurial mindset for value-added sourcing. The challenge is to structure and govern an ecosystem for IT sourcing with specialised actors taking over specific roles and activities. The management of relationships of a joint value proposition by many actors will be the key for success.

(2) Automotive companies are becoming software-enabled companies, where IT is run as a business (e.g. car operating systems). This will result in the reallocation of responsibilities for IT, a trend which in fact started before digitalisation. IT will become the core competency for certain business functions. The current organisational boundaries between IT and business are dissolving and business functions inevitably take ownership over some elements of IT.

(3) Consequently, the emergent themes require a new direction in organisational structures for the future management of IT sourcing in particular, and IT in general. A new collaboration arrangement between business functions and Corporate IT will be needed. This will be discussed in the next chapter.

Source: The author

7 A Blueprint for the Future Management of IT Sourcing

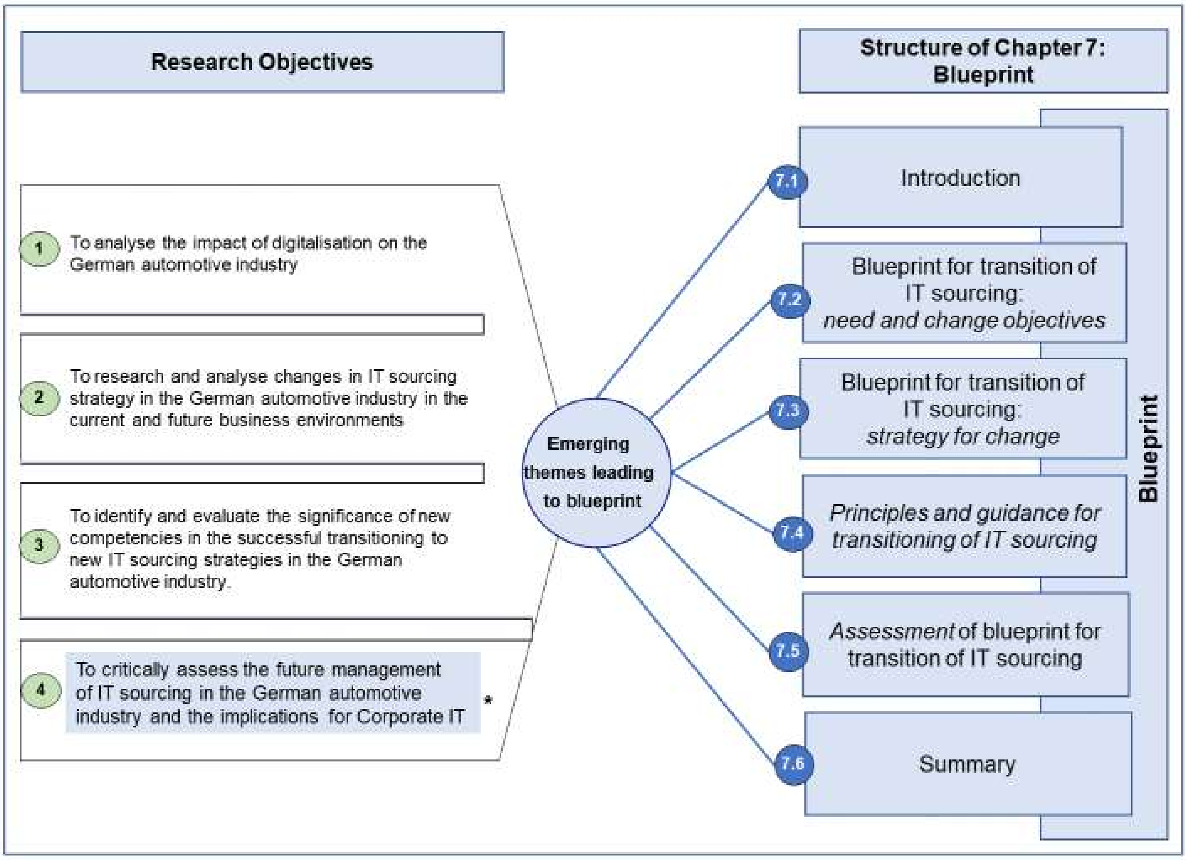
7.1 Introduction

The analysis of findings in chapter six was used to address the first three research objectives, and revealed 15 emergent themes. These themes have implications in various ways for the future management of IT sourcing. At present, IT sourcing is generally seen as a function of Corporate IT, but this may change as the interaction between business functions and Corporate IT is reviewed in the context of digitalisation, and ownership of IT responsibilities is re-assessed. This will ultimately determine who will be responsible for IT sourcing in the future. Of course, the debate about user ownership of IT has been going on since the 1980s, with end-user computing, hybrid project managers, agile project management, user-based systems administrators, process owners, multi-faceted agile teams, DevOps, and industry use cases all featuring in the discussion. However, the literature review, the case study findings and the data analysis indicate that the previous roles, competencies and responsibilities of Corporate IT, or an IT organisation led by a CIO, are changing with digitalisation. Therefore, to address RO4 this chapter discusses two different, but related, aspects of IT management. Firstly, the future management of IT sourcing in the German automotive industry as one of the main objectives of this study, and, secondly, resulting implications for Corporate IT.

The emergent themes substantiated the development of a blueprint for the future management of IT sourcing in the context of C.A.S.E. in the German automotive industry. The blueprint addresses two aspects: (1) The need for a group-wide IT sourcing ecosystem that places the business functions at the centre; (2) The resultant redistribution (that will take place to some extent) of traditional IT roles, competencies and responsibilities into the business functions.

The chapter is structured into six sections (Figure 36). After this introductory section, the following section focuses on the first part of the blueprint and summarises the need and change objectives. The following section then moves to the second part of the blueprint and outlines the strategy for change. This also illustrates the new allocation of responsibilities and tasks for Business IT and Corporate IT as well as mission critical skills. In order to support practitioners in the German automotive industry, section 7.4 provides principles and guidance for transitioning of IT sourcing. The practical relevance of the blueprint was assessed with participants of the in-depth interviews using an online survey, compromising six statements and a five-point Likert scale. The results are documented in section 7.5. Finally, a summary of the chapter is provided in section 7.6.

Figure 36: Structure of chapter 7



Source: The author

In this thesis, blueprint is understood as a general definition that has been used both to define "as-is" and "to-be." Nguyen (2013, p. 19) described blueprint as a "uniform, implementation-agnostic specification." The complex organisations of the German automotive industry are unable to transition from an existing collaboration model to a future one, in only one step. The changes must occur gradually and are dependent on company-specific factors, such as culture, leadership, relationship among the actors, and the like. Based on this, the blueprint contains a set of attributes and elements indicating the overall targets for the transition. This distinguishes blueprint from terms such as framework, which suggests clearly defined boundaries, and model as an exact, very specific and isomorphic image of reality (Dinkelbach, 1973). In contrast, the blueprint leaves individual design options with regard to the steps and speed for executing the transition. Depending on the specific situations in the companies, some aspects may be more relevant than others. After extensive practical experience on how companies have progressed during the transition, the blueprint may provide the basis for developing specific models with fixed process steps, management positions, job descriptions, number of employees, outcomes, rules, and the like.

7.2 Blueprint for the Transition of IT Sourcing: the Need for Change

Interview feedback suggests differing perspectives on the role and value of the IT function. On the one hand, IT is basically recognised as an innovation driver for the business. All processes of the automotive industry are underpinned by innovative and functioning IT systems, and their effective use has undoubtedly led to productivity increases and thus competitive advantages. IT organisations are seen as proactive enablers and optimisers of business models and processes. On the other hand, the industrialisation and standardisation of IT, further intensified in recent years by cloud sourcing, have contributed to pushing the internal IT organisation into the role of an internal IT service provider, which is predominantly measured by efficiency and cost optimisation and geared to frictionless operation, reliability, and stability. In these cases, "alignment" refers to the efficient and affordable realisation of requirements from business functions. Additionally, systematic decisions based on defined strategies regarding insourcing and outsourcing no longer took place, since a large part of the traditional IT was outsourced anyway. Therefore, an alignment, as described in the various scientific models, can in the context of digitalisation only be recognised to a certain extent.

"Plan-Build-Run" was hitherto the dominant process model, with the IT organisation performing three main functions. "Plan" is related to the definition and alignment of IT strategies in terms of applications and infrastructures. Within the other two areas, the IT solutions were developed ("Build") and operated ("Run"). Meanwhile, companies continued to reduce their internal IT value chain and outsourced large parts of it to external partners. Accordingly, IT organisations evolved towards a "Source-Make-Deliver" paradigm (Urbach & Ahlemann, 2016, p. 25). "Source" includes the supply of services, "Make" the orchestration of different components to an IT service and "Deliver" the provision of the IT services. The relationship between Corporate IT and traditional outsourcing partners was determined by individual cooperation with customised arrangements and pricing, as well as comparatively high flexibility in shaping the relationship. This form of IT industrialisation has generally led to the desired effects, but at the same time increased the risk that IT organisations may have acted separately from the business functions, resulting in a loss of know-how about digital technologies and the management of IT.

The business functions mostly own the largest part of the IT budgets. The budgets are allocated in annual planning cycles to IT projects and services which are contractually regulated in service level agreements between business functions and Corporate IT. This is the general *modus operandi* across the German automotive industry. With budget responsibility, the business owners control the applications to be developed and the services to be delivered, and thus also have a decisive influence on the technologies to be used and the IT providers to be selected, even though Corporate IT is the official task holder for developing IT sourcing strategies as well as overall supplier management. Due to the responsibility for the IT budget being in the business functions, the internal IT organisation is often run as a cost centre that is given a cost budget, or as a shared service centre with internal service charging. From a business point of view, this puts the internal IT organisation in competition with external service providers.

With the exception of infrastructure management and some governance functions, the Corporate IT organisation essentially mirrors the functional organisation of the business. Application management within Corporate IT is mostly structured into individual departments for engineering, logistics and production, marketing, sales and aftersales, as well as support functions such as finance, accounting and human resources. As a result, a myriad of functionally oriented IT systems has emerged, developed by multiple IT providers, leading to heterogeneous infrastructures and legacy systems, which represent a barrier to digitalisation. Despite all the expectations of Corporate IT to act cross-functionally and to be the enabler of an innovative process organisation, it has been unable to prevent this development. P09 gave examples of how one of the most important databases in the automotive industry, the parts list with the entire geometric product description (Bill of material: BoM), is still stored and maintained in several different locations in the company. Engineering has its engineering BoM, logistics and production turn it into the production BoM, sales and aftersales transfer it into a sales and marketing BoM, and finally cost calculation creates another BoM for specific purposes. All databases are inconsistent and require high multiple workloads.

Even former complex standard software solutions constitute a form of legacy. P15, for example, reported that the company concerned has five separate SAP ERP systems in operation, which can be regarded as a critical phenomenon reflecting the intransigence of the business as regards changing its business practices. Due to the reluctance of the business functions to leave the very individual processes that have been perfected over decades, the ERP systems have been highly customised and are now no longer upgradeable. According to the interviewees, the high customisation of standard packages has happened everywhere in this industry, which also explains the huge number of SAP consultants. In 2018, the company launched a costly migration of its five ERP systems to a single platform based on SAP S/4HANA, which includes a three-year development and a three-year rollout phase. The creation of a new data model as a global basis for analytics is one of the main objectives.

External sourcing consultants have been widely involved when new sourcing projects are started or sourcing engagements need to be realigned. Specifically, this involves support with tenders and provider selection, the choice of suitable cloud solutions, contract negotiations and the planning and implementation of hybrid sourcing models and transition processes. In addition, the consulting may encompass data protection and data security issues, IT architecture topics, the screening of suitable IT or cloud providers, and their management. Moreover, sourcing consultants support the definition of new role and process models for the cooperation between IT providers, the business functions and Corporate IT after the transition. In this context, they are also often tasked with re-organising IT or justifying "uncomfortable" decisions such as closing departments and laying off staff. To cope with multi-sourcing / multi-provider processes, where many individual services are contracted to many individual providers, the industry often relies on one or more general contractor to manage the legal issues and everyday control of the complex provider network, with its many interfaces.

Overall, interview evidence suggests that the collaboration between Business and Corporate IT has been suboptimal. Business functions has often acted independently of Corporate IT when developing or buying IT based solutions for process innovations. Significant IT roles, competencies and responsibilities have been located in the business. The specialised engineering and product IT or production IT have never been part of the traditional corporate

IT organisation. Hence, extensive so-called "shadow IT" organisations have emerged in the business areas. Thus, a considerable amount of IT expenditure is spent directly by the business functions and independently of Corporate IT. This is current practice in many companies and has long been on the increase, creating unclear or overlapping responsibilities for IT. In contrast, despite the loss of transparency and control of Corporate IT over " shadow IT" and the associated negative connotation of the term, "shadow IT" has also been a driver for user-driven innovations and process improvements.

Digitalisation has given this movement a further boost, with the emergence of a large number of new organisational units and roles, such as incubators, design labs, Chief Digital Officer (CDO), Chief Technology Officers (CTO), new business functions for Car-IT, innovation labs, and digital factories. All these initiatives aim to accelerate the development and adoption of digital innovations, working largely outside of the existing bureaucratic organisational structures of the groups, operating independently of, and not coordinated with, corporate IT strategies and policies. Even though Corporate IT still claims the overall control of policies and standards, the problems arising from the lack of coordination and separation of roles, competencies and responsibilities between the new digital units and Corporate IT remain unresolved.

In addition to the traditional IT providers in the automotive industry, new partner, contract and supplier relationships are emerging with specialised software companies for the development of car operating systems or the networking of factories with IIoT technologies. In particular, provider management is changing, with cloud services and the relationship being more often determined by the cloud provider.

Contrary to the current business-IT alignment and given the realities of digitalisation, a new approach to the management of IT is required. In digital business models, the main product is software. In the German automotive industry, however, these changes are reinforced by the transformation of the industry with the paradigm shift from hardware-driven to software-enabled companies with additional new digital business models, as initiated by C.A.S.E. This is expressed, for example, in car IT with the car-operating system or in purely software-based mobility services. Consistently, in business functions with digital business models based on innovative digital technologies, a strong focus on IT in general and IT sourcing is emerging.

With digitalisation many areas of a company are becoming an IT domain and IT is part of the core competency of the business functions. Business functions produce software as a product for C.A.S.E.-relevant innovations and are equipped with all the innovation, design and transformation capabilities to fulfil their mission. These functions have all the necessary IT competencies and skills at their disposal, and the development centres have access to innovative technologies, specialised IT resources and partner-networks anywhere in the world. In these organisations, the previous assignment of roles, competencies and responsibility between Business and Corporate IT is becoming obsolete or not fit-for-purpose.

Furthermore, cloud technologies with their as-a-service models are regarded as a driver for innovations as well as for more attractive options of IT outsourcing. With cloud sourcing, access to and use of highly sophisticated digital technologies and resources is becoming easier, more agile and more controllable. The ever-expanding possibilities of cloud computing are eroding the exclusivity of in-house IT services provided by Corporate IT. With immediate and easy access to marketable information technologies and innovative tools, the business functions are in a position to make its own sourcing arrangements and decisions and can purchase these services directly, bypassing Corporate IT. This is leading to a general trend towards an increasing emancipation and greater IT independence of the business functions, which probably applies not only to the automotive industry but also to other sectors of the economy.

Business functions are responsible for an end-to-end process which is oriented towards the fulfilment of a specific customer need and therefore extends from the customer's need to the provision of the product or service. A “customer” includes both internal and external customers. These functions not only understand how the business works and what the IT solution must look like from a business perspective, but also can deal with digital technologies and create innovative IT solutions. This has been proven in the past, for example, with engineering or production IT, which have been separated from Corporate IT, and this is even more valid with the new software development functions in the context of C.A.S.E.

In consequence, especially for the German automotive industry with its paradigm shift to software-enabled companies, the realignment of business and IT will therefore be a logical and necessary result that leads to a fusion of business functions and IT strategies towards a digital business strategy. This includes areas where digital technologies and software are directly and deeply involved in the value creation process, or where they are the core or an essential part of the product.

Rather than emphasising current organisational structures with the separation of business functions and IT, the blueprint allows for distributed leadership with managerial processes for IT value creation. Thus, the previous strong orientation of Corporate IT as a service provider is being left behind and IT sourcing management is being incorporated into the business functions, with stronger entrepreneurial responsibility. The change objectives are three-fold: (1) The blueprint aims to embed “shadow IT” as a core function of the business into a future IT sourcing ecosystem where necessary; (2) the blueprint takes C.A.S.E. into account and empowers business functions with all IT competencies they need for their value creation; (3) Corporate IT is empowered with the competencies and authority to orchestrate and govern an enterprise-wide IT sourcing ecosystem.

7.3 Blueprint for the Transition of IT Sourcing: Strategy for Change

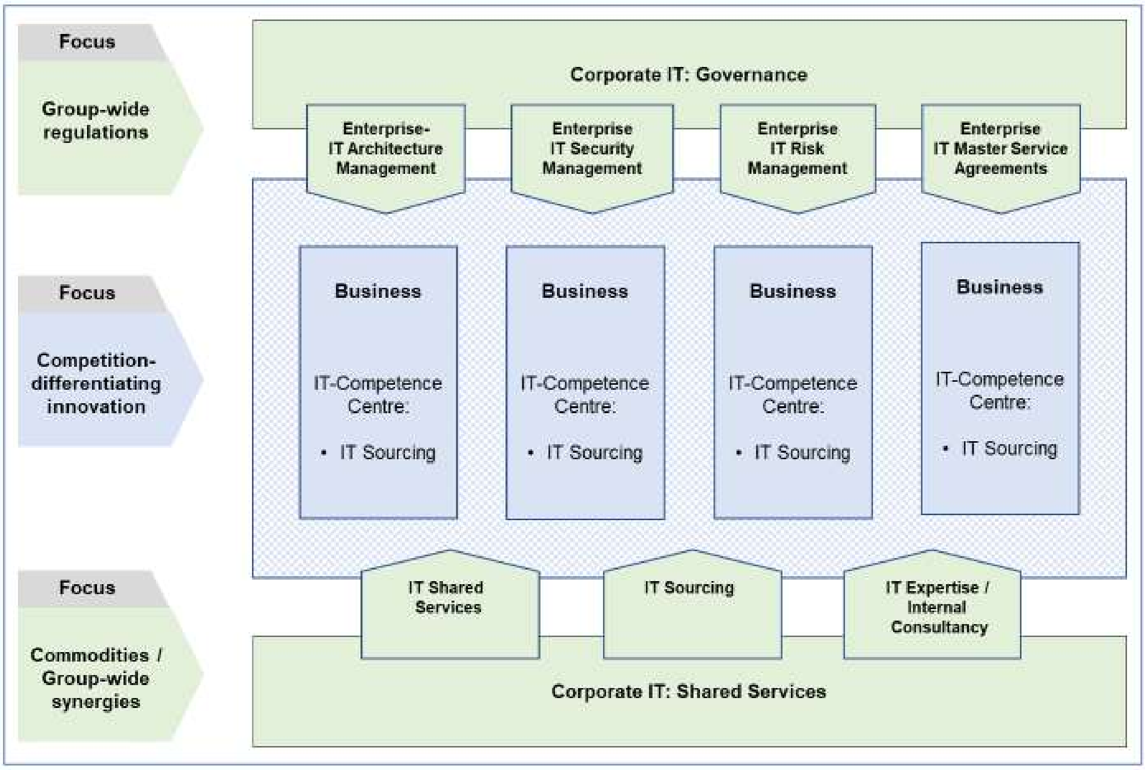
This research study supports the general perspectives put forward by some authors (Urbach & Ahlemann, 2016; Schröder & Müller, 2017) concerning the changing role of IT. In contrast to the the implied disappearance of Corporate IT, this study argues for a controlled shift of IT sourcing into the business functions to a certain extent, combined with a realignment of IT responsibilities and roles between Business and Corporate IT for sourcing related tasks.

Any changes in IT sourcing have implications for Corporate IT. The blueprint for future IT sourcing management involves mutual dependencies and relationships between the IT organisation and the business functions, which need careful management to ensure a balanced transformation process (i.e. as much decentralisation and flexibility as possible and as little governance as necessary). This differentiation is not sufficiently reflected in the general perspectives addressed in the literature. Moreover, they hardly reflect the findings of this case study on the new strategic importance of IT sourcing in the context of C.A.S.E.

The following paragraphs set out a blueprint for the transformation of IT sourcing in particular, and Corporate IT in general (Figure 37). This takes into account that shifting IT sourcing into the business functions is not suitable for the sourcing of all IT services or products. Sourcing of some IT services with high synergy effects will continue to be managed by Corporate IT.

Additionally, Corporate IT governance will be required to ensure that autonomous IT sourcing in the business functions is carried out according to agreed rules and procedures. The realignment is explained in more detail in the next subsections.

Figure 37: Blueprint for future management of IT sourcing



Source: The author

7.3.1 Business Line IT Sourcing

The redistribution of IT sourcing management is synonymous with greater autonomy of the business functions to develop digital products and services. The blueprint is based on establishing an IT competence centre in each business line / core process. All business lines will develop IT-specific competencies on digital technologies and innovations for digital business development. These principles will also lead to an appropriately empowered IT sourcing management embedded in a business's IT competence centre.

The focus of the business IT competence centre, including IT sourcing, is on digital innovations that are competition-differentiating. This gives the business lines a holistic responsibility for the creation of digital products and services. They have ownership of their business requirements as well as the IT technologies and projects necessary for their implementation in a domain-specific IT landscape. This holistic responsibility is most appropriate when the following criteria are met. Firstly, the business needs to act more flexibly to accelerate the development and adoption of digital innovations for shorter time to market. Secondly, a high level of domain-specific knowledge with little synergy to other areas is required. Thirdly, the business has to act with as little friction as possible. In this way, complex and costly coordination processes and lengthy development cycles can be avoided.

However, business embedded IT sourcing management requires the development of new capabilities, such as a profound domain knowledge, stronger provider networking as well as an attitude of taking responsibility. The domain knowledge consists of a deep understanding of the business with the corresponding orientation to new digital business models, the specific consequences of digital transformation, and the associated constraints. In addition, a deep understanding of the resulting innovation and project portfolio, with demands for digital technologies and skillsets from the next generation workforce, is required. In addition, IT sourcing requires a comprehensive understanding of the current and future planned core competencies of the business, in order to fill gaps with suitable sourcing strategies or to unburden the business from non-core tasks.

Strong leadership in IT sourcing is required to attract the appropriate partners among the powerful software companies and promising start-ups for gap-closing purposes. In addition, consideration needs to be given to the consequences for the workforce resulting from sourcing decisions, ensuring a manageable sourcing mix within the various technology environments as well as managing realistic expectations of sourcing decisions. Being close to the business allows more flexible and agile decision-making to quickly gain access to mission critical digital technologies. IT sourcing is forced to exploit all possible measures to reduce IT costs in order to support the financing of the digital investments of the business. Above all, IT sourcing is involved in the strategy development of the business with effects on sourcing and, conversely, top management of the business is involved earlier and more intensively in sourcing strategies, especially when it comes to strategic partnerships or if major impacts on employment are to be expected.

The greatest challenge compared to traditional IT sourcing resides in value-added sourcing, and the ability to manage multi-layered relationships with partners from the industrial automation and software technology sectors. This requires capabilities to negotiate contracts with previously unaccustomed partners to prevent vendor lock-in and maintain the independence of the automotive companies. IT sourcing will need to change from the client-contractor principle to the management of a growing number of new and non-industry competitors and market entrants. Due to the strategic importance of these collaborations, they will be made by the senior executives in the business and involve the efficient cooperation of many employees from both automotive companies and development partners, to develop joint solutions.

In consequence, the management of IT sourcing as an integrated instrument of the business is closely aligned with specific business processes or business functions. Empowered with specific business expertise and the corresponding knowledge base, IT sourcing management can respond directly and effectively to the innovation, technology, project and budget decisions of a business. This gives the business the elasticity to manage its value chains agilely with appropriate IT sourcing decisions. The business embedded management for IT sourcing thus contributes directly to the success of the business and assumes direct entrepreneurial responsibility for its involvement. The business is the digital innovator, implements the innovation projects with its experts, collaborates with the IT providers, and the business management decide which partner networks to work with. Executives in the business are also responsible for all implications that arise from IT sourcing decisions regarding employment and the future direction of the workforce. The management of IT sourcing develops an appreciation of the specific business requirements and becomes a valuable and accountable part of the business delivery process. As a result, by combining process knowledge and IT sourcing capabilities, the business is responsible for the development of appropriate sourcing strategies, the business case for sourcing decisions, the provider selection, the transition and handover of tasks to providers, provider relationship management, ongoing demand management and the monitoring of all IT services and service levels.

7.3.2 Corporate IT

Shared Services: IT services with a high synergy across business functions will continue to be provided by Corporate IT. For this purpose, Corporate IT maintains appropriately equipped Shared Service Centres, which offer the business functional commodity-IT services that are not competition-differentiating for the company, but are nevertheless necessary for business operations. Corporate IT can provide these services more effectively and cost-efficiently than if they were devolved in the business functions. These services may be provided internally or by external service providers, although the outsourced share is likely to be very high. These services include all standard software products, computer workstations, office workplaces with group-wide office software, networks, data centres or general service management functions such as incident management. Certain services may be managed entirely in-house for strategic or other reasons. It is also very likely that responsibility for most legacy systems will remain in Corporate IT until they are replaced or phased out.

Finally, the Shared Service Centres also offer selected IT expertise that can be used by business functions. Here, the Shared Service Centre acts as an internal sourcing consultant to provide support to the business on amongst other things, fundamental and recurring IT sourcing issues. In a wider context, the Centre provides a technology radar and a supplier radar service, as emphasised by interviewees such as P09 and P17. The technology radar acts like a "technology scouting" system and checks out what new technologies are on the horizon, identifies which technologies are needed, the maturity level of the technology, where in the business it can be innovatively implemented, and how it fits into the overall IT architecture of the business. This can provide an analysis of how the range of digital technologies can be sourced, what is built internally and what is best delivered by which provider. Additionally, it will be necessary to monitor whether large technology providers or companies from neighbouring industries develop business models that can influence the company's own product and service portfolio, as well as its own positioning in the market. The technology radar is also the basis for developing a technical qualification profile for IT sourcing management. In turn, the supplier radar functions like a "supplier scouting" service and has a global overview of mission critical IT resources, reliability and risk assessment of IT providers, for which competitors these providers currently work, and how these resources can be best utilised.

IT Governance: IT sourcing related governance functions are assigned to Corporate IT. Governance ensures that all IT-relevant sourcing processes follow a coherent approach and are handled consistently for reasons of compliance. This also includes the definition of decision-making authorisation and duties, control and reporting processes, as well as other basic rules for complying with legal requirements. Key areas of corporate IT governance include corporate IT architecture management, corporate security and risk management, as well as corporate master agreements with IT providers for the call-off of services. Corporate IT are authorised to govern and monitor company-wide IT sourcing activities and ensure conformity with the company-wide regulations. Corporate IT governance is thus the unifying element across the IT areas in the company.

The historically evolved IT infrastructure and application landscapes are a major challenge for IT management and often lead to a loss of transparency, increased risks and costs, distraction from core business topics and the inability to flexibly implement new digital business strategies. Corporate architecture management (also called enterprise architecture management: EAM) addresses this issue through standardisation initiatives and advanced architecture concepts. These problems have hardly been solved so far, so that the IT architectures of many companies are unsuitable for agile digitalisation projects. Corporate architecture management must ensure standardised transformable IT architectures that are modular, flexible, elastic, cost-effective and secure. Architectures must be service-oriented; moreover, elasticity and flexibility have to be guaranteed even with increasing security requirements. This function also includes the cloud architecture of the company (private, public, hybrid or multi-cloud).

A data-driven business requires that data streams in the business are made visible and that a company-wide data semantic model is developed and adhered to. Companies are less and less concerned with data analysis as a retrospective evaluation of day-to-day business. Instead, the focus is increasingly on forecasting future developments. Data is perceived as a business enabler that reveals trends, facilitates predictions and contributes to increasing efficiency and profits. Consequently, data-driven businesses are pushing ahead with digital transformation and are looking for solutions that enable fast and targeted insights based on comprehensive and wide-ranging cloud-based data sources, sometimes termed data lakes. The enterprise data model (EDM) plays a major part in designing these data lakes. Interviewees noted that companies are establishing the position of Chief Data Officer, who has responsibility for all corporate data and ensures that processes are shaped by embedding artificial intelligence systems. P03 and P08 stated that in the modern enterprise, data is key to drive deep learning and help computers "think intelligently" to make decisions that improve business performance. However, much of this data is handled in legacy systems and the challenge is to incorporate this data into the wider EDM and make appropriate connections between seemingly unrelated systems.

With increased networking, it is becoming a core competency of Corporate IT to ensure IT security, cybersecurity and data protection within the wider framework of corporate security and risk management. According to the participants, cyber-attacks increased dramatically during the pandemic. Hiring a workforce with requisite security skills and training the existing workforce to be resilient in the face of cyber-attacks continues to be a focus area of Corporate IT. The interviewees explained that the appointment of a Chief Information Security Officer (CISO) is being discussed in this context. The role aims to minimise security and data protection risks and ensure that policies and regulations are adhered to in order to prevent potential damage to businesses.

Cars will be much more connected in the future, based on 5G networks. In this context, very different cybersecurity risks arise that need to be addressed. Not only can in-house network infrastructure be attacked, as was the case with traditional IT, with highly automated and autonomous driving, vehicles are connected to different mobile networks regardless of location. Consequently, a different security strategy is required for these vehicles.

Additionally, the negotiation and management of master service agreements (MSAs) with IT providers for the call-off of services is part of Corporate IT governance. This is particularly significant in the case of cloud sourcing contracts with hyperscalers. An MSA combines contractual provisions that apply to a number of individual services; this can include contingents on the volume of service calls by Business IT and on general payment rates.

Corporate IT governance also has to actively navigate the transition process of shifting roles, competencies and responsibilities to the Business IT competence centres. Distributed IT sourcing management requires a new entrepreneurial role for being a value creator in the business. This applies all the more to the newly established Corporate IT, which in future will act more as an orchestrator of a group-wide IT sourcing ecosystem. One key challenge will be to design an alignment structure for corporate governance, which is particularly important since all partners involved in the ecosystem pursue their individual business function specific agendas. Entrepreneurial capabilities are required to establish a new self-image of Corporate IT, being less concerned with resource management but acting more as a guardian of company-wide governance functions. In this context, the statement of P18 *"own the outcome, not the overhead"* assumes a whole new significance.

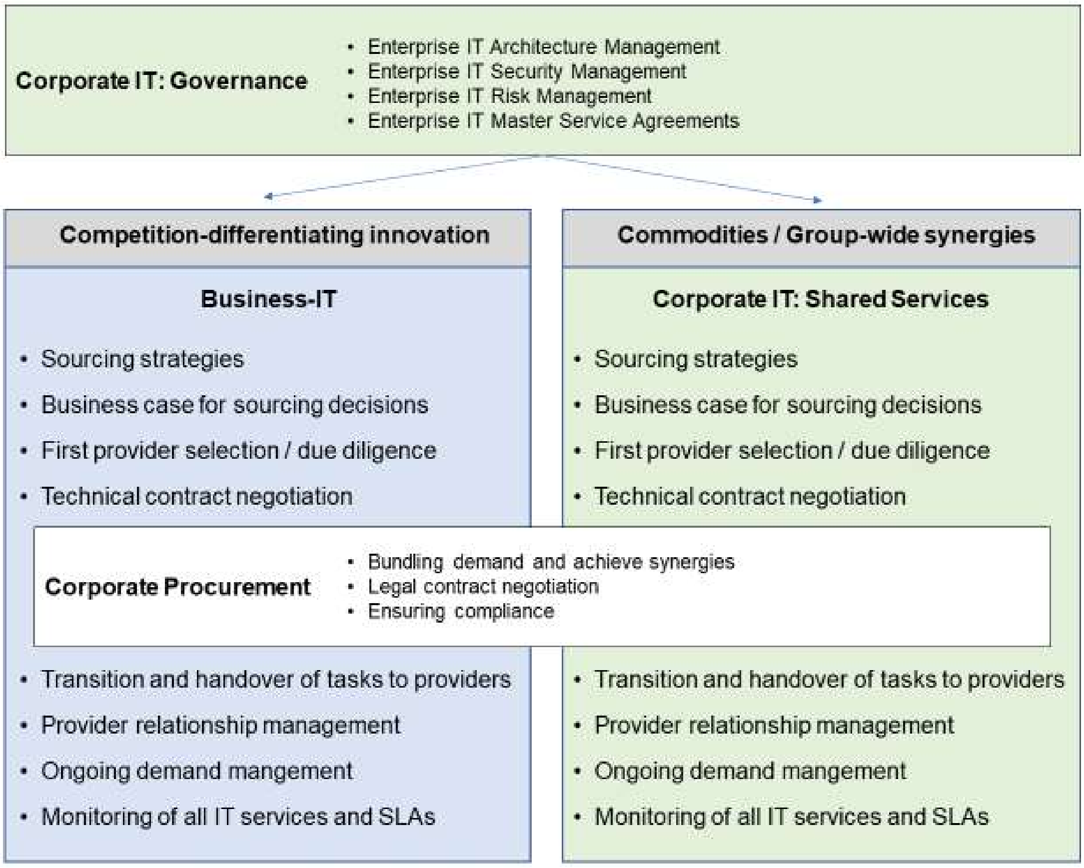
There is a risk that hard-won consolidations of IT applications and infrastructures will be threatened by the new autonomy of the business functions. Distribution of IT tasks makes it complicated to comply with or implement new corporate standards in the long term, meaning sub-optimisations combined with significantly higher costs for the entire business are a risk. Therefore, one of the most demanding challenges for Corporate IT governance is to find the right balance between the need for regulation on the one hand and necessary flexibility to enable the digital transformation on the other, as strong formal IT governance practices will moderate, or reduce, the flexibility and speed of digital transformation. Particular emphasis is placed on agreeing standards and structures for data integration with the business so that different technologies can communicate with each other and have common access to data bases.

7.3.3 New Allocation of Responsibilities and Tasks

Overall, the blueprint leads to a new allocation of responsibilities and tasks for future IT sourcing management (Figure 38). IT related governance functions are assigned to Corporate IT. Sourcing tasks that constitute the main stages in a sourcing process are performed by both entities: Business IT for mainly competition-differentiating innovations; and Corporate IT for shared services.

Although both entities have basically the same IT sourcing responsibilities and tasks, the respective focus is different. Business IT primarily arranges for all forms of gap-closing alliances. The partners involved are mainly the hyperscalers, with their cloud capabilities and their specialised services covering big data, data analysis, the IIoT, machine learning or artificial intelligence. Above all, this is about partnering with competing and experienced technology firms for automated / autonomous driving or networking of factories with IIoT solutions. These topics also require partnering with competitors or suppliers. Start-ups are also important drivers of innovation and must be considered as potential partners.

Figure 38: Reassignment of responsibilities and tasks



Source: The author

For shared services of Corporate IT, commodities and synergies are the influencing factors of IT sourcing strategies. A majority of the sourcing partners involved are the traditional IT providers who are engaged in the provision and maintenance of legacy systems, as well as most of the standard software packages, and the operation of infrastructures. One of the main tasks will be the consolidation of the existing supplier landscape in the business. Corporate IT also needs to be able to set up sourcing projects with the hyperscalers; for example, to source infrastructure via the cloud or to bring legacy systems into the cloud. However, the allocation of responsibilities in Business and Corporate IT should not be seen as either-or. Digital technologies are evolving at a fast pace and over time, meaning competition-differentiating technologies will become commoditised and will then be sourced by Corporate IT.

Corporate Procurement has a traditionally strong position in the German automotive industry and acts as an important stakeholder for IT sourcing. This initially includes the consolidation and bundling of requirements and activities to achieve synergies. The legal contractual terms (prices, penalties, etc.) are negotiated exclusively by Corporate Procurement. Tenders have to apply to corporate compliance. This describes the requirements for companies to behave in accordance with the law and honesty. These functions have to ensure the strict avoidance of violations of the law in the selection of suppliers, data protection regulations or money laundering activities. Additionally, compliance also aims to observe self-chosen guidelines and values to which an organisation voluntarily commits itself and which are usually derived from general ethical guidelines. Providers who do not comply with these ethical guidelines are not included in the tendering processes or the supplier relationships are terminated.

The various statements from the interviewees as well as the data analysis (Theme 15) illustrate that the required skills for the future management of IT sourcing vary significantly from the previous ones. The skills can be grouped into analytical skills, social-communicative skills, managerial skills, methodological skills, and entrepreneurial skills, for which Table 13 shows examples. Future IT sourcing requires a higher level of professionalism from the management involved. As part of the transition, Business and Corporate IT need to conduct an up-to-date assessment of which skills are available or need to be developed. Corporate IT has to ensure that these mission-critical skills are mastered by all parties involved as part of its governance and as the orchestrator of the IT sourcing ecosystem.

Table 13: Examples of skills for future management of IT sourcing

Skills	Examples
Analytical skills	• To analyse digital technology developments and how they go beyond traditional existing strengths of the business. • To seize opportunities from digital technologies that were previously considered unattainable. • To analyse competency and resource gaps in the business. • To analyse strategic sourcing options. • To analyse partners’ and suppliers’ capabilities. • To analyse how different digital technologies should be sourced.

	• To analyse the best-fit operating model. • To analyse the ecosystems and delivery models of hyperscalers.
Methodological skills	• To develop business cases for sourcing decisions. • To enable consistent and structured decision-making. • To review outsourcing decisions in terms of total cost of ownership. • To adapt and implement process models for IT sourcing.
Social-communicative skills	• To negotiate all different forms of contracts at eye level. • To build strong, mutually beneficial relationships. • To resolve competitive conflicts in collaborative partnerships. • To communicate all sourcing relevant information to stakeholders.
Managerial skills	• To set up project management for sourcing activities. • To manage collaborative partnerships in the ecosystem. • To monitor and review service delivery performance. • To perform regular contract assessments. • To take preventive or remedial actions in case of failing engagements • To avoid vendor lock-in.
Entrepreneurial skills	• To always focus on business value. • To manage expectations realistically. • To promote changes in business processes for adapting standard software packages. • To promote transformational IT sourcing management. • To actively drive the consolidation of the existing supplier landscape in the business. • To promote the digital independence of the business. • To take over personal responsibility for decision making.

Source: The author

Additionally, the findings highlighted that a new entrepreneurial mind set and stance in value-added sourcing is necessary to successfully shape the necessary digital transformation of a business. IT sourcing management has to develop a new attitude for the change from the client-contractor principle or the management of transactional relationships, to the management of transformational relationships, because the industry is highly dependent on the value contribution of partners. This also represents a new recognition and challenge for the German automotive industry, especially because large technology companies are less impressed by the market position and power of the industry and hold a high-power position as partners themselves. Examples of this are the hyperscalers or technology giants from the software sector, which might be "too big to care" about the opinions and development efforts of individual automotive companies.

7.4 Principles and Guidance for the Transitioning of IT Sourcing

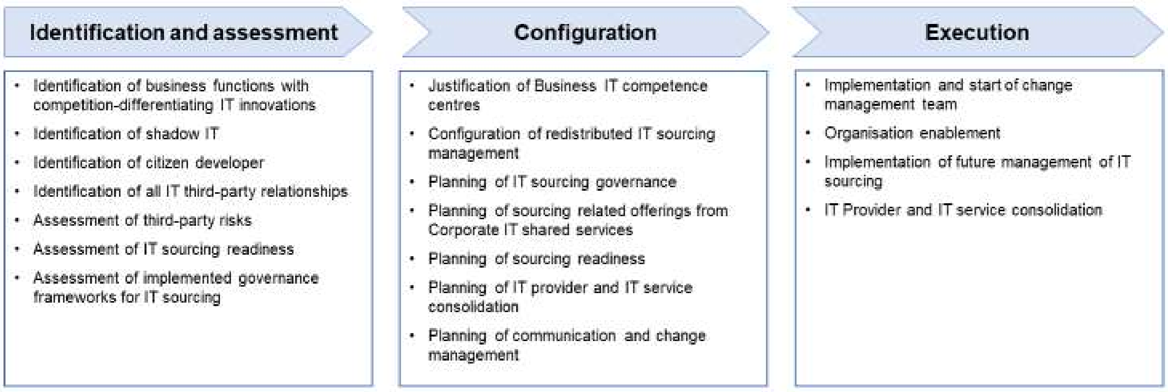
Each company in the German automotive industry has a different starting proposition in terms of its organisation, the stakeholders involved, corporate strategies and the like, which determines the speed at which it can execute the blueprint. Independent of this, the blueprint contains certain principles, which can provide guidance for practitioners charged with the transitioning of IT sourcing. A critical issue here is that the German automotive industry is transforming from a product-centric business model to accommodate software-enabled car companies and mobility service providers. This leads to new business domains, where information technology, software and the intelligent use of data will account for a large share of automotive value creation. This transition makes obsolete the previous "waterfall-based" business-IT alignment, among other things, which was a logical consequence of defining IT's relationship with the business as an internal provider. In this environment, an IT-business *integration* is more appropriate than a business-IT *alignment.*

As part of the blueprint, a three-step approach is suggested for the transitioning of IT sourcing: (1) identification and assessment (2) configuration and (3) execution. A guiding principle is that the CIO, as the orchestrator of the group-wide IT sourcing ecosystem, has to actively lead the change, regardless of which stakeholders in the business are involved.

The OEMs and tier-1 suppliers of the German automotive industry have complex structures with local plants, organisations and business functions all over the world, developed over decades and often created through mergers and acquisitions. As a result of digitalisation, new software units have emerged in recent years, shadow IT has spread further and citizen developers are now established in business functions (for definition of citizen developer see page 248). Organisations have individually piloted digital innovations for their processes, products, services and business models in many places in the business, combined with engagements with IT providers, as the findings revealed. On the one hand, the blueprint should give business functions within the widely distributed structures the necessary flexibility to implement digital innovations; on the other hand, consistent corporate IT governance is required for all IT-related sourcing processes to follow a coherent approach within the group. The right balance has to be found between these two opposing objectives, as governance often comes at the expense of flexibility. A mandatory prerequisite is therefore that the following objectives are at the forefront of a transitioning of IT sourcing: (a) maximum transparency of IT sourcing in the group through identification and assessment of the "as-is"; (b) as much flexibility for Business IT as possible and as much corporate governance as necessary for the configuration of IT sourcing "to-be", and (c) using the blueprint as an opportunity to get rid of ballast and transfer as few legacy issues as possible into the new organisational set-up for IT sourcing management in Business IT and Corporate IT.

The following Figure 39 highlights the main issues that need to be considered in a company-specific transition of IT sourcing, which are then further detailed in the next three sub-sections.

Figure 39: Three-step approach for the transitioning of IT sourcing



Source: The author

7.4.1 Transitioning of IT Sourcing: Identification and Assessment

In order to achieve a re-assignment of responsibilities and tasks for IT sourcing that is accepted and supported by all stakeholders, it is first necessary to determine which IT activities are competition-differentiating innovations or commodities. This determines which parts of IT sourcing should be located in Business IT or in the shared services of Corporate IT. In addition, the sourcing activities of the shadow IT activity distributed throughout the business should be made transparent and assessed. Existing governance frameworks in the groups need to be examined to determine to what extent they are being used. It is also important to assess the existing IT sourcing management skills and competencies across the business and to understand how the responsibilities and tasks are currently performed. A risk assessment of all provider relationships can be used to support a rationalisation for the provider landscape prior to switching responsibilities for sourcing management. Table 14 addresses the main activities to create transparency and assess "as-is."

Table 14: Transitioning of IT sourcing: identification and assessment

Main activities for transition	Action check-list: Identification and assessment
Identification of business functions for competition-differentiating IT innovations	• Identification of all business functions across the group that are claiming IT and software is a core competency for developing competition-differentiating IT innovations. • Assessment of strategic business objectives and mapping, with the claim of the business function for autonomous IT sourcing.
Identification of shadow IT	• Identification of all shadow IT distributed throughout the group including staff, skills, budgets and activities.
Identification of citizen developers	• Identification of all citizen developers distributed throughout the group, including skills, budgets and activities.
Identification of all third-party relationships	• Identification of all third-party relationships across the group. • Structured analysis of existing contracts, licences and service level agreements (SLAs).

	• Assessment of cloud consumptions throughout the group. • Assessment of IT provider status (competencies, cost, need in future, potential supplier's suitability, supplier's performance). • Identification of external IT sourcing consultants and additional needs.
Assessment of third-party risks	• Reputational risks, based on the impact to an organisation's reputation due to a failure or risk event caused by the services or products of a third party. • Operational risk, as the impact to an organisation's operations based on the supplier's ability to deliver services or products, manage its subcontractors and rely on its technology. • Business continuity and resiliency risk to manage collaborative partnerships in the ecosystem. • Information security and privacy risk, as the potential impact to an organisation in terms of its suppliers' requirements for availability and confidentiality of information and data privacy. • Strategic risk, as the geopolitical, regulatory, legal and economic risk of sourcing with a third party in a different location and with a different strategic direction. • Regulatory risk, as the impact to an organisation based on the third party's ability to comply with regulations. • Financial risk, as the risk associated with the supplier's financial stability and viability.
Assessment of IT sourcing readiness	• Review of existing sourcing processes and their use (tender processes, supplier selection, contract management, relationship management, performance management, effective monitoring processes and reporting). • Assessment of how the responsibilities and tasks for IT sourcing are currently performed. • Identification of the loss of knowledge for IT provider management as a result of traditional outsourcing in recent years.

	• Identification and assessment of existing management structures, functions and resources for IT sourcing throughout the group. • Assessment of existing qualifications and skills for IT sourcing management throughout the group. • Identification of required expertise for more complex supplier relationships, such as value-added sourcing, the cloud, and as-a-service-arrangements. • Assessment of internal resource needs and qualification for (re-)achieving sourcing readiness.
Assessment of implemented governance frameworks for IT sourcing	• Assessment of implemented frameworks for governance mechanisms and current performance (roles, responsibilities, accountabilities, executive committees, councils, policies and procedures, measurements, budgets, chargeback, decision-making authorisations and duties, control and reporting processes, as well as other rules for complying with legal requirements). • Assessment of implemented governance frameworks for protection of intellectual property, data privacy, and security compliance. • Assessment of implemented governance frameworks for enterprise architecture management (EAM) and current performance. • Assessment of implemented governance frameworks for enterprise data model (EDM) and current performance.

Source: The author

7.4.2 Transitioning of IT Sourcing: Configuration

Based on the identified and assessed "as-is", an awareness and a common understanding between all stakeholders about the need for action and the basic configuration of the IT sourcing ecosystem can be generated. Corporate IT as the orchestrator of the ecosystem provides the technological platform and defines the organisational rules for the collaboration of the different parties. In general, ecosystems are multi-sided collaboration models between different parties and vital components in the operations of technology firms or hyperscalers. They place great emphasis on innovation and are well known and used by start-ups to exchange ideas, knowledge, information or services. Familiarisation and coordinated engagement with existing ecosystems need to be progressed by both Business and Corporate IT.

The IT governance framework for IT sourcing highlights the “who” and “how” of the elements of the redistributed IT sourcing. The processes and associated procedures for the redistribution of capacities for IT sourcing management between Business IT and Corporate IT need to be established. In this context, the empowerment of distributed IT sourcing management must also be defined (taking account of the qualifications and skills listed in Table 13, for example). Role profiles in both Business and Corporate IT should be drawn up and agreed. In Shared Services within Corporate IT, the technology and supplier radars are set up as a service for Business IT. Key suppliers are briefed on planned internal restructuring and implications for business-to-business negotiations and contractual agreements.

Table 15 addresses the main activities to configurate the group-wide IT sourcing ecosystem and the entire organisational set-up for the redistribution of IT sourcing management and the re-assignment of responsibilities and tasks.

Table 15: Transitioning of IT sourcing: configuration

Main activities for transition	Action check-list: Configuration
Justification of Business IT competence centres	• Preparing and reaching a governing Board decision on the justification and scope of the Business IT competence centres within the group.
Configuration of redistributed IT sourcing management	• Planning the organisational set-up of the distributed IT sourcing management in the Business IT competence centres (resources, appropriate management structures). • Planning the organisational set-up of the remaining IT sourcing management in Corporate IT (shifting resources, to Business IT competence centres, remaining resources in Corporate IT).
Planning of IT sourcing governance	• Standardised design of distributed sourcing processes (tender processes, supplier selection, contract management,

	relationship management, performance management, effective monitoring processes and reporting, invoicing, contract termination). • Definition of standardised sourcing contract structures and templates for contracts and service level agreements, including standardised digital libraries. • Definition of criteria and processes for standardised provider assessment, audits, effective alert mechanisms, penalties, key supplier meetings and AI-based assessment of a huge number of contracts concerning key obligations and risk profiling information. • Definition of standardised methods and tools for continuous improvement and productivity (e.g. key performance indicator, TCO, balanced score card). • Definition of appropriate governance mechanisms for steering distributed IT sourcing management (e.g. roles, responsibilities, accountabilities, executive committees, councils, inter-departmental steering groups, decision-making processes, policies, budgets). • (Re-)design of enterprise architecture management (EAM). • (Re-)design of enterprise data model (EDM) including frameworks for AI-based data analytics. • Planning of enterprise IT master service agreements.
Planning of sourcing related offerings from Corporate IT Shared Cervices	• Design of technology radar for conducting research on state of emerging technologies. • Design of supplier radar for monitoring the outsourcing market (e.g. workforce, attractiveness and risks, tax benefits, availability of infrastructures, vendor capable of fitting into the client's culture and meets business needs best (Best Practice Supplier)).
Planning of sourcing readiness	• Planning of the qualification programme (required expertise and skills for the various sourcing arrangements as well as management capabilities). • Planning of the training programme for the new or revised IT sourcing processes.

	• Planning of individual training of methods (e.g. TCO, negotiation techniques, project management, problem solving, escalations).
Planning of IT provider and IT service consolidation	• Planning of projects for IT provider consolidation and finding an overall agreement with involved stakeholders (e.g. reduction of number of providers; group-wide consolidation and harmonisation of different contracts with the same strategic partners). • Finding an overall agreement with involved stakeholders about service cuts or re-negotiation of existing IT service contracts. • Planning of optimising IT services (e.g. volume reduction concerning licenses, servers; harmonising existing service level agreements; measures for cloud consumption). • Planning of standardising IT infrastructures. • Starting a phasing-out plan for outsourced legacy systems.
Planning of communication and change management	• Planning of IT provider briefing on planned restructuring and implications for business-to-business negotiations and contractual agreements. • Planning of internal communication on planned transition process of IT sourcing for stakeholders involved and employees affected. • Planning of change management activities throughout the transition programme (e.g. adapting new roles, handling resistance to change, shift management mindset from allocating resources to managing the results, correcting any misinformation that affects the transition, resolving escalated issues, sharing knowledge).
Approval of configuration for transition	• Preparing and reaching board approval for overall configuration of transition.

Source: The author

7.4.3 Transitioning of IT Sourcing: Execution

The pace of transition towards the blueprint depends on how rapidly the German automotive businesses can overcome traditional boundaries between IT and business. The more carefully the two previous steps are carried out, the smoother and more effective the implementation of the blueprint will be. Digitalisation and the new responsibilities for IT as a core competency make the previous business-IT alignment model redundant. New corporate structures will require more of an IT-business integration arrangement and ethic, in which all parties work to support shared objectives, and in which IT sourcing will play a critical role. New posts are appointed, and appropriate management structures and inter-departmental steering groups are put in place to ensure a smooth transition. Handover meetings with key suppliers are set up and enacted. Table 16 addresses the main activities to execute the transition.

Table 16: Transitioning of IT sourcing: execution

Main activities for transition	Action check-list: Execution
Instigate change management	• Implementing a change management team for transitioning of IT sourcing and getting started with the main tasks such as o Introducing the overall masterplan for guiding all activities along defined priorities and principles, including all dependencies to be managed and maintained throughout the transition; o ongoing communication of the transition programme and progress to all parties involved; o ongoing buy-in from all stakeholders involved; o ongoing management of escalations and problem solving.
Organisation enablement (Needs to finish first, because it enables the whole IT sourcing management of the group to work together)	• Training of all staff and management on the new or revised and standardised IT sourcing processes, which are mandatory for the entire group, as well as on the governance framework conditions. • Individual training of new methods (e.g. negotiation techniques, TCO).

	• Training of management capabilities for orchestrating IT sourcing ecosystems.
Implementation of future management of IT sourcing (according to blueprint)	• Implementation of new Business IT competence centres. • Transformation of previous shadow IT / citizen developers into business IT competence centres. • Reorganisation of Corporate IT. • Getting management and staff in place (if required, shifting resources from Corporate IT to Business IT competence centres).
IT provider and IT service consolidation	• Starting projects for simplifying the supplier landscape and reducing the number of IT providers to achieve economies of scale. • Starting projects for standardisation of IT infrastructures according to requirements of enterprise architecture management. • Starting projects for an enterprise data model and repositories (e.g. as required for AI-based data analysis). • Re-negotiation of existing IT service contracts. • Cleaning up redundant IT services. • Starting projects for volume reduction measures (e.g. licences, cloud consumption). • Replacing external IT sourcing consultants and strengthen internal competencies. • Monitoring of cost savings and quality improvements through consolidation activities.

Source: The author

7.5 Assessment of the Blueprint for the Transitioning of IT Sourcing

The practical relevance of the blueprint was assessed with participants of the in-depth interviews using an online survey, comprising six statements and a five-point Likert scale. The invitation letter also included a short interim report of the results from the interviews as well as a summary of the main elements of the blueprint. A total of 19 letters of invitation were sent out and a total of 17 responses were received (Table 17). All participants expressed their appreciation for the interim report and the majority of the participants considered the blueprint to represent a future direction for the management of IT.

Table 17: Results of second online survey

SA: Strongly agree; A: Agree; U: Undecided; D: Disagree; SD: Strongly disagree

Survey Statements	SA	A	U	D	SD
01. Digital technology development and application will become the core competency of the German automotive industry.	**13**	**4**			
02. IT and business strategies will merge and overlap and become part of a unified digital business strategy. Cloud computing will be a key component of this strategy.	**8**	**9**			
03. The strategic responsibility for IT will move, in part, into the business functions. Business managers will have budget responsibility for a range of IT applications and services. Business functions will develop their own digital technology expertise and be responsible for sourcing management and decision-making.	**5**	**9**		**3**	
04. A redistribution of many traditional IT roles, competencies and responsibilities into the business functions will take place. New roles will emerge, with more hybrid IT/business managers.	**6**	**9**	**1**	**1**	
05. The Corporate IT function will remain as the guardian of Company-wide IT governance functions, and as the orchestrator of a group-wide distributed IT sourcing ecosystem.	**8**	**7**	**2**		
06. New digital entrepreneurial skills and competencies will be needed in both the business functions and Corporate IT to manage this transition, in which Corporate IT will play a key role. IT competence centres will emerge in the business functions to take responsibility for IT sourcing and management.	**8**	**8**	**1**		

Source: The author

Participants were asked to provide a statement on how they viewed the blueprint for their company in general and, most importantly, to provide a brief comment as to where they disagreed with a statement.

Concerning statements three and five, some participants argued that there are tendencies in their companies to support the statements, but clear conclusions have not yet been reached. P03 and P12 reported that there is a reluctance to create new management positions and an interim solution seems reasonable, whereby the CIO is also the head of engineering IT. P16 pointed out that although software resources are consolidated in new organisational units, the organisation of interfaces to the backend systems remains undecided. Corporate IT has an enormous amount of experience, which it has steadily enriched over many years. "*This knowledge of business processes, software systems and IT architectures must continue to be used intensively*." P16 also stated, for example, that manufacturers are still running ancient product documentation systems programmed in Cobol on mainframes, rather than in flexible cloud environments. The more sensible approach would be to relieve Corporate IT of some of its burdensome operational activities, so that it can better support product IT with its resources and competencies.

P15 reaffirmed a strict governance function for Corporate IT but regarded the role of the traditional CIO as disruptive. In contrast to the blueprint, IT would have to take on more business functions, and P15 argued for a fusion of HR and IT as the future organisational entity responsible for managing human workforce, robotics and AI.

In the context of the governance function of Corporate IT, P06 and P14 underlined that the so-called "citizen developers" have an important role in the digital transformation. They used this term to refer to software development in business functions by experienced knowledge workers or AI analysis teams who, in contrast to professional software developers, do not have any special programming skills. Therefore, they are provided with standardised software development tools by Corporate IT that provide technical access to data sources and connect them to data lakes. Data scientists in the business functions examine this data for patterns, and business analysts interpret these patterns and identify promising use cases for AI. Citizen developers are part of the official IT infrastructure from the beginning and are therefore not considered "shadow IT", as they are equipped with pre-configured software components, integrated security mechanisms and controlled interfaces to the company data.

P14 and others pointed out that the so-called shadow IT can also be professionalised with the citizen development approach. Therefore, the developers in the business functions must first be equipped with further competencies and know-how, whereby IT should take on a central role in the development of guidelines and support. Corporate IT must support both citizen developers and shadow IT in the same way, with application platforms and advice on information security, data protection and development skills. Instead of the negatively connoted term “shadow IT”, the term "business managed applications" has come popular.

P06 in particular indicated that from the perspective of the company in question, the blueprint should be expanded even further, as the company is pursuing business strategies such as "lean headquarters" and, in this context, attaches even greater importance to citizen developers for application development in the future.

P08 also underlined the importance of the blueprint and, moreover, questioned the necessity for the business functions to develop new competencies and skills for value-added sourcing and partnering, as business functions have been following best-practices for many years. P08 indicated that the automotive industry has established a unique global network of alliances for research, development and manufacturing between OEMs and suppliers, partnerships with research institutions and leading technology partners, innovation partnerships in areas such as new materials and production processes, and the like. Business functions of all areas have had decades to perfect relationships and practices within these alliances. They have been remarkably successful, spurring innovation, cost reduction, and new efficiencies from their external partners. Business functions have created and leveraged an environment in which partners in complex networks are continually challenged to deliver better products and processes. In this context, it was explained that these experiences are less pronounced in Corporate IT and that the business functions are better prepared for the various forms of value-added sourcing. Even if they are not used to working with partners from the IT sector, the transfer of proven industrial concepts for managing all sorts of alliances and staying in long-term collaborative relationships is advantageous.

Interviewees such as P05 and P08 emphasised that Corporate IT is even better positioned in the new structures proposed by the blueprint than being confronted with the everlasting question of IT's value contribution. In the new structures, “*this can be presented much more directly,* *simply and clearly*." P08 suggested "*we are talking about being product aligned, to overcome the traditional boundary between business and IT*."

In addition to confirming the elements of the blueprint, P13 and P19 referred to the contention that Car-IT divides the German car manufacturers. There are strong doubts in the industry as to whether the independent development of the car operating system by some OEMs is really feasible and economically viable. Meanwhile, software giants such as Alphabet (with its subsidiaries Google and Waymo) are pushing further into the software of car operating systems. It is only a matter of time before Google and others occupy even more domains in the car. Therefore, some parts of the German automotive industry are striving for a German open-source ecosystem for the software-defined vehicle, constituting a German alliance against the technology giants.

Participants of tier-1 suppliers also assume that OEMs are all still in a very early phase of the development of a car operating system, and are by no means in a position to completely develop a classic operating system on their own. Alternatively, in-house software development for the car operating systems again may only account for 20 % of the total, with the rest coming from partners. The newly announced partnership between Volkswagen and Bosch (section 6.3, Theme 08, Table 11) underlines this assumption.

7.6 Summary

Based on the case study evidence, IT sourcing is currently still designed for a stable business environment rather than for a dynamic transformation, and the general collaboration between the business and the IT function has been suboptimal and not "fit for purpose." This chapter addressed RO4 and discussed aspects of the future management of IT sourcing and resulting implications for Corporate IT. The objective was to determine the principles upon which a redesign of IT sourcing with redistributed responsibilities and modified qualification profiles should be based.

The need for change concerned why and how an entire industry must now adapt its IT sourcing strategies to enable the business functions for digital innovation. An important focus will be on value-added sourcing. The industry must re-orient itself in an increasingly complex competitive landscape that includes new, formerly non-industry players, start-ups, and global IT companies.

Value-added sourcing with newly-formed partnerships and strategic alliances will play a key role in maintaining competitive capabilities. Traditional organisations for IT sourcing management in particular, and Corporate IT in general, are no longer applicable in the German automotive industry.

The strategies for change were manifested in a blueprint that proposes a general redistribution of traditional IT roles and especially a re-assignment of responsibilities and tasks for IT sourcing. Within this blueprint, IT sourcing tasks and responsibilities for competition-differentiating innovations are shifted to IT competence centres based in business functions, where IT is run as a business. IT governance functions remain with Corporate IT, but with a new remit and scope, expanded responsibility and authority across the group. Corporate IT also retains responsibility for IT sourcing for shared services.

New skills and competencies for IT sourcing management centre on an enhanced knowledge base and stronger provider networking. Deep understanding of digital technologies and experience and knowledge of business processes are required for decision-making. With the cloud as the backbone for digitalisation, the IT sourcing management has to carefully balance the benefits from cloud computing against the challenges of various cloud technologies, security concepts, performance and control, and managing multiple or hybrid clouds. The orchestration of value-added sourcing with distributed activities within ecosystems which are focused on the development of joint solutions for highly complex problems, such as automated / autonomous driving, requires a new entrepreneurial mindset for IT sourcing management.

8 Conclusions

8.1 Introduction

The aim of this study was to research evolving IT sourcing strategies in the German automotive industry and provide practitioners with guidance for managing transition. From a methodological point of view, the thesis approached this research based on the constructivist perspective with its associated interpretative research methodology. This is closely linked to a mainly qualitative research and inductive approach. The thesis centred on a single-case study of the German automotive industry as a whole to achieve a holistic view of the industry, which is one of the major contributors to the German economy. The industry has always been characterised by a high international division of labour and such businesses are viewed as “inverted firms”, where a high proportion of value creation comes from outside the firm (Van Alstyne & Parker, 2021).

Due to megatrends such as electrification and digitalisation, the industry is undergoing the greatest transformation in its existence. The future success of the industry depends heavily on its level of digital innovation, for which IT sourcing is becoming a strategic function to provide missing capabilities and resources. This sector of the German economy is highly heterogeneous and complex, and provided a unique opportunity to focus on the contextual domain of this study. Therefore, this industry is a paramount example for studying evolving IT sourcing strategies. However, IT sourcing is a multi-layered phenomenon with complex questions that encompass many aspects.

The explorative study was designed to combine the analysis of existing literature, a series of in-depth interviews with industry experts as the main means of data collection and two supporting online surveys. Thematic analysis was chosen as most appropriate to capture the complexities of meaning within a rich textual data set. The data collection from CIOs, CDOs and other experts provided an up-to-date and realistic insight into the transformational power of C.A.S.E. and how the impacts of decarbonisation and digitalisation place new and competing demands on IT sourcing. The current situation, challenges, goals, threats and problems were reported very openly. The mix of OEMs and tier-1 suppliers, supplemented by industry-knowledgeable sourcing consultants, provided an analysis which differs from the previous scientific literature on this sector. This also applies to the overall assessment of Corporate IT organisations and IT roles. To the best of the author's knowledge and belief, this study is the first to research and analyse the influence of digitalisation on IT sourcing within an entire major German industry sector.

This final chapter summarises and concludes the outcomes of the present research project, which is considered to add significant and valuable knowledge to the discipline in which the research was conducted. After this introductory section, the following section addresses the research questions defined in chapter two. The following section then assesses the contribution to knowledge of this research, followed by a section focussing on the contribution to practice. Then, the limitations of this research are articulated and perspectives for further research are given. Lastly, this chapter closes with final comments and reflections.

8.2 Answering the Research Questions

The study started with four research objectives as a general direction for the literature review and data collection. Several gaps in the literature were revealed, which led to three additional research questions and finally to the development of a conceptual framework. Table 7 in chapter three displayed the main lines of interactions from the conceptual framework and how this corresponds with the ROs and RQs. Chapter six and seven have already presented how the research objectives were met. In this section, the research questions are answered in turn, complementing the findings and discussion relating to the research objectives.

- **RQ1**: To what extent has digitalisation influenced the German automotive industry's strategy regarding IT sourcing?

Digitalisation influences the German automotive industry’s strategy regarding IT sourcing in various ways and leads to several ways of new thinking and potential benefits for future IT sourcing in particular, and corporate IT in general, creating a new awareness on IT as a future core competency.

In the literature, IT sourcing has so far mostly been considered in the context of business-critical resources for process innovations (mainstream business systems). With digitalisation, IT has become the core of digital products and business models, with corresponding platforms and ecosystems. Now, however, it is appropriate to consider IT sourcing in a new light that encompasses the three technology fields: corporate (traditional enterprise IT), product IT (including connected cars / car IT) and cloud-based platforms and ecosystems for mobility services.

Although the claim of IT as an enabler has often been formulated in the literature and in practice, IT has also often been classified as an internal service provider. IT costs were generally in focus and IT was always being confronted with the ever-present question of IT's value contribution. With digitalisation, IT in general is becoming the centre of process and product innovations that will determine the future competitiveness of the industry. IT sourcing is now regarded as a strategic function to provide the business with the mission critical talent and resources to master digital technologies.

Cloud computing has become the backbone of digitalisation from a threefold perspective. For future IT outsourcing decisions, cloud sourcing will be the first choice. In this context, some participants referred to their so-called “cloud first” or “cloud only” IT outsourcing strategies. Cloud computing is also about acquiring fast and scalable access to key modern digital technologies and services, such as AI or Big Data, from specialised software providers or hyperscalers. Additionally, cloud computing is the enabler for connected vehicles, IIoT and data exchange with backend systems.

Digitalisation is forcing businesses to finally modernise IT systems, infrastructures and enterprise data models. The previously dominant alignment model of "IT follows business" has led to a complex landscape of functionally oriented systems that now, as legacy systems, represent a barrier to digitalisation. Businesses are recognising the urgent need to shut down legacy systems with inconsistent and redundant data structures and create new data models that serve as a global basis for analytics and associated functions. A new determination to adapt business processes to cloud-based digital technologies or standard software packages is required instead of costly customising.

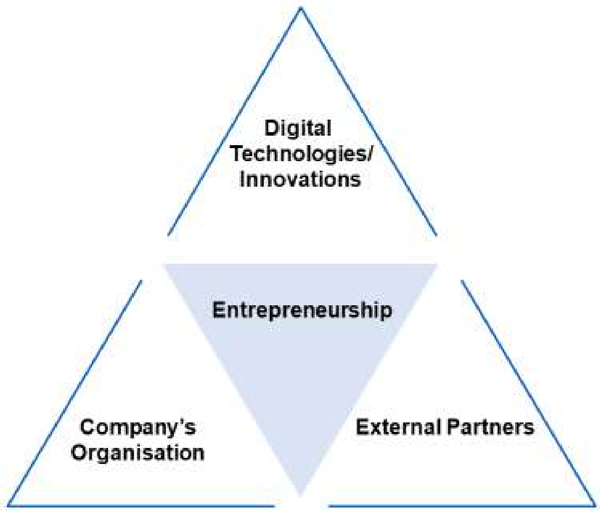
Most importantly, IT sourcing has so far followed the prevailing industry rationale for leveraging the existing sourcing power of the automotive companies. The IT sourcing model was mainly based on the buying of Full-time Equivalents (FTEs) for specific projects or activities, the sourcing of transaction-based services or the buying of licence-based software in hierarchical purchasing and supplier relationships, with the “dictating” of fixed prices. Contracts were renewed year after year and due to the long-standing “know-how monopoly” of the IT providers, there was largely a vendor lock-in. With digitalisation and especially with the further levels of autonomous driving as well as the IIoT projects, IT sourcing will need to undergo a paradigm shift to value-added sourcing. Interviewees referred in this context, for example, to the partnership between Mercedes and Nvidia for the development of the MB-OS. Nvidia is considered best in class in terms of the computing power of its chips and AI applications and is worth five times as much as Mercedes on the stock market (Automobil Industrie, 2022b). The automotive companies are being forced to enter into long-term "partnerships of fate" with technology groups that are far ahead of them in terms of software, networking, artificial intelligence and autonomous driving. These technology groups are imposing their terms on car companies, demanding revenue-sharing that has not existed with traditional IT providers and draining profits from automotive manufacturers. Consequently, IT sourcing is assuming a completely new significance.

- **RQ2**: What are the new entrepreneurial competencies for the successful transitioning to new IT sourcing strategies in the German automotive industry?

The interpretation of the findings and data analysis indicate that the new entrepreneurial competencies of IT sourcing management in the German automotive industry result from the need to develop and deploy digital technologies / innovations, changes in the company's organisation and capabilities, and the requirements of dealing effectively with a new set of external partners (Figure 40). Entrepreneurial competencies therefore refer to taking into account and weighing up these three factors in every decision and action, which demands a profound knowledge base, attracting stakeholders, networking and orchestrating of ecosystems, as well as assertiveness and accountability. Other social competencies are also necessary but not further detailed here.

An extensive knowledge base is required to exploit the opportunities of digital technologies for innovations before others do so. This involves assessments and judgements concerning the maturity level of digital technologies and compatibility between expectations of digital technologies and their real potential. Compatibility can also refer to fit or non-fit with corporate strategies, organisational processes, existing IT infrastructure and systems landscape. There must be appropriate interfaces between new and existing technology and new technology must be adaptable. In most cases, the benefits of technology-based innovations can only be realised through changes in organisational structures or processes, which requires entrepreneurial competencies to create the necessary awareness in the large organisations.

Figure 40: Determining influences that will shape entrepreneurial competencies



Source: The author

An extensive knowledge base is also required to identify the type and need of capabilities to successfully benefit from digital technologies. However, the findings distinguish between capability and capacity issues. The motivation to work with external technology partners differs between the lifecycle stages of technologies / innovations (Fernandes et al., 2022). With digitalisation, the German automotive industry is at the beginning of an innovation lifecycle. This essentially requires value-added sourcing for missing internal *capabilities*. This is different from outsourcing in the later stages of the innovation life cycle for missing internal *capacities*. In the latter case, the business knows exactly what it wants and contracts with the best-known IT provider (Van Alstyne & Parker, 2021). In the first case, the future benefits of emerging technologies are uncertain and the business lacks expertise, due to the complexity and pace of technological change.

Particularly in the German automotive industry, with its complex organisational and decision-making structures, attracting internal stakeholders is an indispensable entrepreneurial competency. Opportunities arise when organisations or people creatively imagine the future and then pursue their goals based on their forward-looking expectations (Jones & Ratten, 2021). However, entrepreneurship embedded in large organisations implies generating interest among stakeholders and mobilising them to support new IT sourcing arrangements. Certain sourcing activities, such as partnering with technology groups, public cloud sourcing with hyperscalers or outsourcing of entire IT infrastructures, can only be realised if various stakeholders lend their support. However, given the uncertainty associated with such projects, it can be risky for stakeholders to lend their support - a perception that is heightened by the fact that a project has not yet received the support of other stakeholders. Therefore, mobilising key stakeholders with appropriate influence on other decision-makers is critical to success.

Networking and orchestrating ecosystems, for joint value creation in international sourcing arrangements for missing internal capabilities, will be the most challenging entrepreneurial competency given the future involvement of new technology groups. Partnership-like relationships require a high level of trust and significant knowledge and information exchange. Without a trusted relationship, partners remain reluctant to exchange knowledge or strategic information. Cooperation among competitors might prove difficult. In general, ecosystems are characterised by a joint value proposition that can only be realised if all actors are aligned and adhere to the planned structure and activities (Jacobides et al., 2018; Lingens et al., 2021). This is particularly crucial, since all partners pursue their individual agenda, which requires in particular intercultural competencies for joint decision-making. However, competencies for managing relationships are also required in the traditional outsourcing of commodities to hyperscalers, for example, and also in the context of a consolidation of the existing provider landscape, as this will provoke strong reactions from traditional providers for economic reasons.

Assertiveness will be no less important for the future IT sourcing management. The findings revealed that IT still finds itself in a paradoxical situation and often has to justify IT costs that IT itself is barely able to influence. From one perspective, IT expenses for the operation of legacy systems are rising, together with new transformation projects through digitalisation, cloud computing and their associated operating costs, as well as compliance, data protection and information security requirements. By contrast, the factors influencing IT costs are mostly beyond IT's control, as interviewees reported. These results, above all, illustrate the organisational complexity of automotive companies and the degree of standardisation and harmonisation of processes, as evidenced, for example, by the high proportion of customising and individualisation of standard software packages. Therefore, IT sourcing is required to execute IT sourcing strategies more consistently and to intervene more intensively in business decisions that run counter to them.

Finally, the perception of new entrepreneurial competencies also leads to greater accountability than IT has had in general as the predominant internal service provider.

- **RQ3**: What blueprint can be developed to aid practitioners in the German automotive industry in the re-assessment of IT sourcing?

The literature review and findings revealed that decades of discussion on the value of IT have led to a wide variety of perceptions of IT and the optimum responsibilities for Corporate IT (including IT sourcing). The perceptions range from cost factor to internal service provider to enabler and strategic corporate function. In terms of organisational structure, most CIOs report to the Executive Board member Finance and Controlling or Human Resources, in some cases to the Executive Board member Procurement and in exceptional cases to the Group CEO (e.g. IDG, 2022). There are doubts as to whether a Board member for Finance and Controlling, HR or Procurement can adequately represent the technological complexity of IT on the group Board. In parallel, and even more so with digitalisation, IT tasks are performed directly in the business. With the new significance of IT in the product, new IT organisations have emerged outside corporate IT that are part of R&D or production alongside newly assigned Board members for C.A.S.E.

In the last two decades, the IT organisation itself has adopted a number of different models and approaches, such as plan-build-run or source-make-deliver, with the aim of providing highly efficient IT services to businesses. Regardless of the organisational weaknesses mentioned above, it is recognised that Corporate IT has an enormous amount of experience that it has continuously enriched over many years. This knowledge about business processes, software systems and IT architectures must continue to be used intensively. However, during this study, evidence has arisen that existing IT organisation models no longer cover the demands of digitalisation in the German automotive industry, with its highly dynamic digital transformation from a hardware-centric to a software- or service-centric industry, where IT is becoming the core competency of the business. This research revealed that the trend towards software-defined products, manufactured in smart factories and marketed together with new mobility services, is leading to a fusion of business functions and IT in the German automotive industry. There was recognition that the boundaries between business functions and IT need to be removed or redesigned. Therefore, as outlined and justified in chapter seven, a blueprint has been developed that constructively combines the existing strengths of Corporate IT on the one hand, and new C.A.S.E.-driven demands on the other.

8.3 Contribution to Knowledge

A wide range of well-documented research results exist for all the individual contextual factors evidenced in the conceptual framework (Figure 22). However, research has not yet adequately examined the extent of the digital transformation in the German automotive industry or the resultant new options for IT sourcing strategies. This research study extends the existing academic literature by providing a structured analysis of the interplay of factors influencing future IT sourcing as well as the resulting organisational consequences for the future management of IT sourcing.

This research makes a contribution to knowledge in five main areas:

- Impact of digitalisation on the German automotive industry.
- Alignment between business models and IT strategies.
- Adjustments of IT sourcing strategies in the German automotive industry.
- Proposed blueprint for transitioning of IT sourcing management.
- Entrepreneurial competencies for future IT sourcing management.

The following table details the contribution to knowledge in the five areas and explains how this relates to the existing literature in the research area, as addressed in the literature review.

Table 18: Contribution to knowledge in five main areas

The first main contribution to knowledge relates to the ***impact of digitalisation on the German automotive industry***	
Existing academic literature	Extensions of existing academic literature
Authors, such as Gebayew et al. (2018), Koch et al. (2017), Mertens and Wiener (2018), Riedl et al. (2017), Stelzer (2017), and Winkelhake (2017) argued that digitalisation and digital technologies should not be treated as completely new phenomena. They considered digitalisation as: • the innovative use of information systems; • information technology with increasingly powerful, highly flexible and efficient hardware and software, which enable previously unknown solutions; • identical with "information technology" and generally used as a synonym for the speed of change and the adoption of powerful information technologies; • not a new issue for Information Management.	The findings of this study are predominantly in agreement with views in the existing academic literature. The German automotive industry views digitalisation as a continuation of the previous IT enabled transformation. • Most of the businesses claimed that digital technologies are evolutionary in nature and the industry has invested in state-of-the-art information technologies for years. • Technology-driven transformation has been at the centre of activity for decades. • The industry has always used innovative methods in both technology and in the organization in general, precisely to remain competitive or to avoid disruption.
In the literature, digitalisation is frequently referred to as digital disruption, the use of disruptive technologies, disruptive innovation, or disruptive business models. The term "disruptive" has become very prominent and has also provoked an ongoing and controversial discussion in the field of management studies.	The findings of this study evidenced a contrasting perspective in the German automotive industry and provided insights that reviews of "disruptive digital technologies" are absolutely context-dependent. • As with all other technologies, they only become disruptive if companies do not have the skills and financial resources to turn

• Many publications emphasise, for example, that digital disturbances could "shake the core of every industry" or trigger "big bang" situations that could threaten entire sectors (e.g. Skog et. al., 2018, p. 431). • In contrast, Christensen et al. (2018) complained that the core concept of "disruptive innovation" has been alarmingly misunderstood. In particular, any risk that is partly technological is incorrectly labelled as "disruptive technology."	them into innovations in time, do not react with the necessary speed, underestimate newly emerging competitors or do not consider cultural barriers within the company. The findings evidenced the challenges facing the German automotive industry in achieving digital transformation from the previous business model with combustion engines to electric mobility and digitalisation, especially in terms of automated driving and mobility services. • Participants emphasised that the main challenge for the German automotive industry is how to shape the digital transformation process rather than the novelty of digital technologies. • The industry's key topic for the future are innovations on highly automated / autonomous electrified driving with a digital technology focus on cloud computing for car connectivity and IIoT, big data and artificial intelligence, meaning that IT is becoming a core competency. • However, the industry only recognised the new market expectations a few years ago, or did not want to recognise them due to high investment in the existing business model, or it simply underestimated new competitors. • To catch up, the industry is now forced to close existing gaps in capabilities through many forms of alliance with competitors from the software sector or with tier-1 suppliers.

Kraus et al. (2022) complained that previous research to date has been limited to certain specialised areas, such as business and management, and that "articles do not provide any information about the context in which their respective research was carried out" (p. 13). Therefore, they called for wider perspectives regarding the study of digital transformation.	In contrast, this study broadened the debate by analysing the impact of digitalisation on transformation strategies, going beyond the consideration of individual firms and considering an entire industrial sector in Germany, which has a significant impact on the economy of the home country.

The second significant contribution to knowledge relates to the ***alignment between business model and IT strategies***	
Existing academic literature	Extensions of existing academic literature
Both for the debate of what constitutes a business model as well as for alignment, previous studies mainly emphasised the role of well-documented and proven alignment models. However, the models are controversial not only in theory but also in practice. • Henderson and Venkatraman (1993, 1999) developed the Strategic Alignment Model. The classic alignment models were developed according to this logic of "IT follows business." • Bharadwaj et al. (2013) questioned traditional IT strategy conceptions most fundamentally and posited a fusion of business strategy and IT strategy into a digital business strategy. • Teubner and Stockhinger (2020) were concerned because the fusion perspective rejects the idea of a conceptual distinction between corporate business strategy and IT strategies. They	The findings of this study are predominantly in agreement with views in the existing academic literature. The concept of business-IT alignment is still valid, but the nature of alignment has changed within the digital transformation of the German automotive industry. • This study extended the debate by revealing that the German automotive industry comprises large international groups with multi-faceted business models, differentiated by brands, markets or ways of approaching the customer. This would imply multi-track alignment processes between business and IT and resulting IT sourcing strategies, which has been missing in the previous literature. • Additionally, this study provided clear evidence that in some cases, up to 75% of the IT budget has been outsourced. Due to the

suggested consideration of digital business strategy as an intersection of both strategies. • Kotusev (2020) referred to the “hard side” of business and IT alignment and concluded that how business and IT alignment practically operates in organisations has never been studied. • Turner (2021) reasoned that the companies studied in the literature perform only one main business model.	associated loss of know-how and control as well as vendor lock-in, there was no longer an alignment process and the outsourcing volume contracts were simply updated on an annual basis. • However, in traditional business models a business-IT alignment process is certainly still necessary, whatever its design is. Moreover, the study provided indications that traditional business-IT alignment is not suitable for digital business models in which business and IT merge. • The findings revealed that the previous classic "waterfall principle" with the maxim that IT follows the business, has been abandoned. • This applies above all to the technology environments, in which IT has become an essential component of automotive products and mobility services and is deeply integrated into the value creation process of the automotive industry. • In these cases, a digital business strategy with a merged IT strategy should be pursued on the basis that IT strategy is no longer subordinate to business strategy. • Among other implications, this important insight ultimately led to the blueprint for managing transition with a redistribution of responsibilities for IT sourcing.

<table>
<tr><th colspan="2">The third main contribution to knowledge relates to the adjustments of IT sourcing strategies in the German automotive industry</th></tr>
<tr><th>Existing academic literature</th><th>Extensions of existing academic literature</th></tr>
<tr><td>IT sourcing has been the focus of many studies, mostly with considerations of individual and isolated elements on outsourcing and insourcing, such as:

• cloud sourcing (e.g. Boes et al., 2019);
• decision making processes in outsourcing (e.g. Rueckel et al., 2020);
• multi sourcing (Könning et al., 2018);
• conflicts between flexibility and long-lasting contracts with providers (e.g. Gerster & Dremel, 2019);
• switching suppliers (e.g. Olzmann & Wynn (2012);
• outsourcing contracts and legal issues (e.g. Söbbing et al., 2015);
• process model for optimising IT outsourcing (e.g. Brautsch & Wynn, 2013);
• knowledge transfer and re-integration (e.g. Nujen et al., 2015);
• characteristics of make, buy or alley (e.g. Wiegard (2020),

which have obviously been sufficiently studied.</td><td>In contrast and for the first time, this study provided an extended perspective by evaluating all basic sourcing models holistically under the influence of digitalisation in an entire industry sector.

• The findings of this study proved that C.A.S.E. and digitalisation are changing the three-decade ratio between IT-insourcing and outsourcing in the German automotive industry.
• Based on the participants' estimates of current and future budget allocations, the change in IT sourcing between 2021 and 2026 has been projected and published (Felser, 2021).
• This will determine shifts and new priorities in IT sourcing for the next five years.

Additionally, the study revealed cloud sourcing as the backbone of digitisation, but also outlined the challenges, new dependencies and risks in working with hyperscalers.

• The findings revealed that modern cloud concepts today go far beyond the mere hosting of IT applications. Rather, they form the strategic starting point in the companies' business strategies for readjusting to the digital transformation of the economy.</td></tr>
</table>

	• In practice, they not only provide the necessary dynamically scalable IT infrastructure, but also act as a new guiding concept for the design of new business models and value creation systems. • Despite the promises of hyperscalers and the expectations of top management for cloud sourcing, the study shows that a large part (legacy systems) of existing IT applications are not effectively cloud-enabled.
Recent systematic literature reviews of academic literature revealed various rationales for IT backsourcing, such as contract problems, internal organisational changes and external environmental changes (e.g. Von Bary & Westner, 2018; Felser & Wynn, 2020). • However, little is known about the real extent of IT backsourcing. • The existing literature bases its conclusions on some individual examples of high-profile / large-scale events that have received press attention.	In contrast, and unlike insourcing and outsourcing, the findings of this study showed basically no evidence of IT backsourcing due to digitalisation.
Previous research in the domain of IT sourcing has largely focused on the support for business processes (mainstream business systems) by Corporate IT and has not given particular consideration to the consequences of the digital transformation for the German automotive industry.	This study extended previous research and considers IT sourcing also in product IT (including connected cars / car IT) and cloud-based platforms and ecosystems for mobility services in the German industry sector as a whole.

Previous studies argued that a significant causality between the topics of digitalisation and IT sourcing does not seem to exist (Kahl et al., 2017).	In contrast, the findings of this study proved that C.A.S.E. and digitalisation are changing the three-decade ratio between IT-insourcing and outsourcing in the German automotive industry.
Previous research has not given sufficient consideration to value-added sourcing, which has hardly been applied to IT so far.	The study revealed that an important focus will be on value-added sourcing which will play a key role in maintaining competitive capabilities. • Therefore, this research study attempted to shed more light on related new relationships with IT partners and long-standing critical dependencies within the industry. • The findings evidenced that the automotive companies are being forced to enter into long-term partnerships with technology groups that are far ahead of them in terms of software, networking, artificial intelligence and autonomous driving. • In this regard, this study made two basic conclusions: o In the current decade, the classic IT outsourcing models in the German automotive industry will mainly refer to business models with combustion engines. The motivation relates to the sourcing of cost-optimised IT *capacities*. o For the new business models with highly automated / autonomous electrified vehicles, the motivation is to source *capabilities* within the framework of value-added sourcing, which requires new entrepreneurial sourcing ecosystems.

<table>
<tr><th colspan="2">The fourth main contribution to knowledge was made in the form of a proposed blueprint for transitioning of IT sourcing management</th></tr>
<tr><th>Existing academic literature</th><th>Extensions of existing academic literature</th></tr>
<tr><td>In the existing literature, various authors theoretically and at a high level of abstraction have questioned the continued existence of Corporate IT or a CIO organisation, such as:

• using various hypotheses and scenarios (Schröder & Müller, 2017; Urbach & Ahlemann, 2016);
• discussing the role of the CIO (e.g. Liebe 2020);
• raising the question: who actually leads IT in a digitised company? (Alt et al., 2020);
• discussing behavioural and managerial type shifts in new sourcing relationships (Crowley et al., 2017).

However, existing studies did not provide sufficient and entirely clear information of how fundamental IT tasks for IT governance, for example, are to be carried out responsibly at group level, and how this is to be practically distinguished from IT tasks in the business.</td><td>In contrast, the blueprint based on the findings of this study and defined in chapter seven emphasises a specific new form with clearly defined specifications for a new cooperation between Business and Corporate IT and the subsequent re-positioning of IT responsibilities between Business and Corporate IT.

The blueprint differs greatly from the abstract discussion in the existing literature regarding the future of corporate IT organisations. The blueprint:

• empowers business functions with all IT competencies they need for their value creation through implementing Business IT Centres;
• empowers Corporate IT with the competencies and authority for enterprise-wide IT governance, besides Corporate shared services to realise group-wide synergies;
• consolidates a fragmented IT (corporate IT, product IT, car IT, production IT, shadow IT and the like) and embeds it in a group-wide set of rules for IT sourcing;
• constructively combines the existing strengths of Corporate IT on the one hand, and new C.A.S.E.-driven demands on the other.</td></tr>
</table>

The fifth main contribution to knowledge refers to ***entrepreneurship***	
Existing academic literature	Extensions of existing academic literature
Entrepreneurship has gained a growing interest in the academic literature, notably in the context of digitalisation. The terms, concepts, characteristics and values of digital entrepreneurship vary widely and concern a range of issues, as authors address this topic from different methodologies and perspectives, including: • a focus mainly on issues relating to the technology itself rather than those relating to the capabilities and capacities of enterprises, as well as the strategies for implementing digital technologies (e.g. Anim-Yeboah et al., 2020; Kane, 2019); • transformational entrepreneurship as an alternative type of entrepreneurial activity in larger organisations, among others, to create a vision for exploiting new growth opportunities in a competitive environment (e.g. Maas et al., 2019; Jones & Maas, 2019); • utilising knowledge by enabling different entities to collaborate on projects in entrepreneurial ecosystems (Jones & Ratten, 2021); • missing theories regarding entrepreneurial ecosystems (Ratten, 2022); • phenomenon of "forced co-opetition" (Hannewald, 2021).	This study was more concerned with corporate entrepreneurship, which takes place in established large corporations to transform complex corporate operations into new business models, as represented by OEMs and tier-1 suppliers of the German automotive industry. In the context of this study, digital entrepreneurship emerged as a significant new competency in making IT sourcing decisions. • The major implication of digitalisation for entrepreneurship in the large and cumbersome organisations of the German automotive industry is, first of all, the creation of a transformational culture that is supportive of innovation throughout the ecosystem of the businesses. • Entrepreneurial purposes depend on the successful transfer of knowledge provided by knowledge communities, especially in knowledge intensive industries. • Knowledge acquisition improves the capacity of a business's organisational learning to create internal capabilities. • In contrast to the previous more static management of sourcing engagements, entrepreneurship-driven IT sourcing is essential for the orchestration of value-added sourcing within complex

	sourcing ecosystems and a wide variety of partners from different industries.
	
	Additionally, this study revealed indications concerning the barely researched phenomenon of "forced co-opetition" which differs fundamentally from traditional supplier management in IT multi-sourcing arrangements.
	
	• As the examples identified by the findings demonstrate, this has two dimensions in the current situation of IT sourcing in the German automotive industry: vertical and horizontal forced co-opetition.
	  o Vertical relational competencies relate to forced partnerships entered into between automotive companies and software companies, where the latter can become serious competitors.
	  o Horizontal relational competencies relate to managing the relationships between competing IT providers, as enforced by automotive companies in their IT sourcing ecosystems.

Existing studies lack sufficient information on the skills of company-internal entrepreneurs to successfully manage future IT sourcing under the specific conditions of the German automotive industry. • The literature mainly discusses the role of Chief Digital Officer to bundle the responsibilities for digital transformation (e.g. Skog et al., 2017)	This study extended existing literature and illustrates, based on the findings, that the required entrepreneurial and managerial skills for the future management of IT sourcing vary significantly from those required hitherto. • The interviews revealed that IT managers in general need to develop the capability to clearly assess and address the business value proposition of IT, i.e., to think and act like an entrepreneur.

	• According to the interviews, this ability is at present not widely evidenced in IT managers. The findings of this study also evidenced that most businesses have created the role of Chief Digital Officer (CDO) and suggested that the CDO is probably acting across business functions and processes and his/her task is to develop a holistic digital transformation strategy in the large and highly fragmented companies of the German automotive industry.

Source: The author

8.4 Contribution to Practice

This study also provides implications for organisational business practices in the field of IT. In the literature review and in the results of this study, a different assessment of the value of IT became apparent. The role of the IT organisation was also assessed differently. Digitalisation has changed the view of the value-creating utilisation of IT. Consequently, decision-makers in the businesses now need to clarify how this function will be organised effectively.

The proposed blueprint and associated action check-list will support practitioners in the German automotive industry to ascertain (1) why the transformational power of C.A.S.E., in combination with the new digital technologies, necessitates an adaptation of their IT sourcing management and related functions of Corporate IT; (2) how the successful transition to future sourcing strategies and management functions can be organised; (3) on which principles a redesign of IT sourcing and related functions of Corporate IT should be based. The blueprint is a symbiosis of different elements for which there cannot be any "either-or-decisions” and is intended to create innovative and collaborative partnerships between IT and business.

With digitalisation, group-wide IT governance has gained further importance, for which Corporate IT is responsible, and which must be authorised and enforced. In order to exploit all available synergies between business functions, Corporate IT will continue to act as an internal service provider, although it must clearly demonstrate its value proposition. The citizen development approach is of great importance for business processes and supports the autonomy aspirations of the business regarding IT. This approach can also reduce dependence on external resources. In addition, the same approach can be used to professionalise what has until now been seen as “shadow IT”, as IT competence centres located within business functions. The many new business functions, with IT as a core competency for product and service, are becoming an integral part of the IT ecosystem in the businesses.

The elements highlighted in this study can provide practitioners with guidelines to focus on necessary organisational changes in IT. Ultimately, the blueprint can create the awareness that the traditional barriers between business and IT have to be removed, and business and IT have to merge to a certain extent. Rather than emphasising current organisational structures with the separation of business and IT, the model allows for distributed leadership with managerial process for IT value creation. The previous orientation of the central IT function as a service provider is being replaced by a clearer role for Corporate IT as the provider of shared services and IT governance. Practitioners might use the blueprint to further refine it and derive a business-specific organisational concept and transition plan that takes account of the individual circumstances of each business.

Given the complexity of future IT sourcing, practitioners might better understand and consider long-term implications when orchestrating complex IT sourcing ecosystems: Value-added sourcing is a resource-consuming strategy which requires high commitments from both automotive company and partner; it involves high investments in setting up the activity; it requires a high level of trust, communication and information sharing, and it shifts potential innovation power to partners.

8.5 Limitations and Further Research

The primary research phase of this study was conducted over a twenty-eight-month period spanning the years 2020, 2021 and the beginning of 2022, and results provide but a "snapshot" of the situation for IT sourcing strategies in a certain context, and conditions can, and will, change over time. Interpretation of findings needs to take account of many influencing entrepreneurial factors in a complex environment. The megatrends are themselves highly dynamic, and digital technologies have rapid innovation cycles. Due to technological step-changes, the principle of exponential growth in the performance of information technologies continues to exist. Quantum computing or blockchain, for example, are other new fields of technology that continue to impact the processes of businesses. On the product side, the discussion about emission standards continues. This will once again accelerate the transition to electromobility and bring about an earlier end of the combustion engine, with all the implications discussed above.

At present, however, it is hard to estimate the extent to which the OEMs will position themselves in this new business field in the next few years, and become involved with upgrading their own IT competencies and in-house developments. Follow-up studies to explore emerging IT sourcing strategies in this area and to examine how the German automotive industry can stand its ground in the "gap closing alliances" with the tech players would be of value.

Questions have been raised as to whether it is a tactical misstep for each automaker to develop its own software platform and car operating system. Following the smartphone effect, it could be that in a few years there will only be two or three standardised car operating systems worldwide. Google parent Alphabet has long since begun to transfer an operating system - Android Automotive - into vehicles. Google's offer is tempting for carmakers because manufacturers may save billions on developing their own car operating system. It is only a matter of time before Google and others occupy even more domains in the car. Follow-up studies could investigate which will succeed in the end: a narrow range of standard car operating systems or OEM-specific ones.

There is still a lack of knowledge and transparency concerning IT budgets as there are very few figures on the IT budget in the literature, and it can be assumed that these figures only refer to corporate IT. The amount of IT expenditure in the business functions (extensive shadow IT) and the cost types under which they are posted remain unknown. Therefore, in-depth quantitative case studies with an OEM and a tier-1 supplier would be of value to get a realistic understanding of the IT costs in the businesses, with corresponding conclusions on IT outsourcing costs.

The blueprint is understood to be a starting point for the transition into the new form of collaboration between Business and Corporate IT. Further studies are recommended to refine the blueprint into a model that builds on extensive practical experience on how businesses progress during the transition. Another field for additional research would be a benchmark with Tesla in terms of IT organisations. In the findings, it was repeatedly claimed that Tesla has a different development philosophy and firstly develops the software for the car, i.e., the central computer in the car, and then builds a car around it. This makes Tesla the automotive prototype in which the company core consists of IT. The business produces digital products, everything else is secondary.

In this study, the researcher is acting as an insider with a value-bound emic position. The researcher is a professional from outside the German automotive industry. She is free to think and act, has no opinions shaped by years of experience in the German automotive industry and does not have any pre-existing ideas concerning IT sourcing. However, the research methodology in this research is based on a qualitative approach and the researcher depends on the experience of the participants involved and their perspectives on a specific phenomenon, which can lead to responses biased in one direction.

The researcher does not claim that the findings are generalisable to other sectors of the German economy. The limited number of interview participants represent OEMs and tier-1 suppliers. However, it is reasonable to assume that conclusions are applicable to traditional automotive industries in other countries. The findings may also be useful to understand evolving IT sourcing strategies in other industry sectors.

8.6 Final Comments and Reflections

Reflecting on my exciting research journey so far, and critically thinking about the most important crossroads during the journey, as well as new insights in terms of ideas, beliefs, viewpoints, dealing with complex situations and other personal aspects, lead to a variety of thrilling impressions for which I would like to write an in-depth chapter in this thesis. Unfortunately, this is impossible due to the limited word count. Therefore, I have to single out a few issues that are particularly significant for me.

The most important prerequisite for this study was to get personal access to 19 top IT managers in the German automotive industry, who spent a lot of time on the first survey, the interviews and the second survey, with follow-up communication and information. Assuming that participants are constantly being asked for information, interviews and answers to surveys from other parties, this suggests that the topic of this study has been of interest. On a personal level, it was fascinating to see how many individuals unknown to me were willing to participate and invest a lot of time after being contacted directly.

Because of the Covid pandemic, interviews could not take place at the interviewees' location but were conducted as videoconferences and lasted between one and one and a half hours. What was initially regrettable turned out to be an advantage in retrospect, as the participants were mostly in their home offices and therefore not so time-constrained.

From all the reading of methodological issues, I was aware that interviewees adapt their answers to what they think is the level of knowledge of the interviewer (Jönsson, 2010), which can also be interpreted in this way: asking questions presupposes knowledge. Therefore, a considerable amount of time was spent on a literature study of IT sourcing and the context-relevant themes.

In addition to almost 350 academic journals and additional reports from the Automobile Association and Automobile Research Centres, the annual business and sustainability reports of the companies concerned were also reviewed prior to the first survey as well as to each interview, in order to have a precise understanding of the company in question. In total, the data collection delivered a vast and exciting amount of material.

The rich data set was manually analysed and coded, despite the fact that authors such as Dudovskiy (2018) considered manual coding to be labour-intensive, time-consuming and outdated. My worry was that any form of software for computer-assisted qualitative data analysis creates a distance between me and the findings, my "treasure trove." To me, it was extremely important to dive deep into this data treasure to avoid losing any context. Therefore, the densely written matrix (chapter six) with more than 850 labels was printed out and laid out on the floor, taking up an area of 4 x 4 metres, which became my working space for the next six weeks to analyse and identify emergent themes.

After the creation of the blueprint (chapter seven), the interview participants were contacted again with a survey invitation letter designed to obtain feedback from practitioners on the blueprint. To motivate them in this task, this letter also included an interim report of the results from the interviews as well as a summary of the main elements of the blueprint. 17 participants answered the survey and expressed their appreciation for the interim report. They also came back to me with feedback on individual survey statements; I also found it impressive that they had taken time again.

Overall, the research journey has never been straightforward. At times it was difficult and required wrestling with new ways of thinking. The journey started with the narrow topic of IT backsourcing, then expanded to the present area of interest. A case study of the German automotive industry as a whole was initially not intended, and the need to conduct two surveys also only emerged in the course of the investigation. The original objective of developing an organisational model for transitioning IT sourcing was discarded as impractical. Instead, a blueprint seemed much more appropriate, but required a revision of the literature review as well as the conceptual framework due to the topics included, such as Corporate IT. This is a limited range of the necessary re-orientations.

One of my greatest difficulties in chapter five was to leave out very interesting topics from the rich data material and to present only the absolutely relevant information. The data collection provided very valuable information on current topics such as sustainability, future powertrains, autonomous driving, new customer expectations of mobility services, fast-growing competitors in China, global supply chains and the like, which had to be excluded. This became a painful process.

To where my research journey will go now will require some reflection. Certainly, the German automotive industry is on the edge of the most far-reaching transformation in its history (BMW, 2020). The industry is also on a journey. This study could only provide a small insight into how the traditional business model of the industry and related IT topics will change in the current decade, and how the transformation will challenge the current structure of the automotive landscape. The new focus on software-enablement will lead to a stepwise shift away from combustion engines towards alternative powertrains and electrified cars, and thus to a restructuring of the product portfolio and global value chains. Notwithstanding this shift, the basic principles of car production remain untouched and customers continue to demand modern vehicles. IT outsourcing in its various forms will continue to be an important practice. However, automotive companies are likely to find themselves in a new position within global value chains. The industry will be threatened by the international IT providers' ability to finance and innovate. The analysis of the results has shown that currently, no reliable perspective of the automotive market can be given for the next 10 to 15 years. The industry will be impacted by many different players in the coming years and will develop very dynamically in a direction yet to be determined.

To sum up, the automotive industry is a fascinating area for further research. Quite possibly, my research journey may not end here, but only start with this thesis as a new chapter in my life.

9 References

Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of Management, 43*(1), pp. 39-58. doi: 10.1177/0149206316678451

Ahlemann, F., & Urbach, N. (2016). Zehn kontroverse Thesen zur IT-Organisation der Zukunft [In English: Ten controversial hypotheses on the IT organisation of the future]. *Computerwoche, 38-39*, pp. 30-33. Retrieved July 05, 2021, from https://eref.uni-bayreuth.de/id/eprint/35071

Aliyu, A. A., Bello, M. U., Kasim, R., & Martin, D. (2014). Positivist and non-positivist paradigm in social science research: Conflicting paradigms or perfect partners. *Journal of Management & Sustainability, 4*(3), pp. 79-95. doi:10.5539/jms.v4n3p79

Alt, R., Leimeister, J. M., Priemuth, T., Sachse, S., Urbach, N., & Wunderlich, N. (2020). Software-Defined Business. *62*(6), pp. 609-621. doi:10.1007/s12599-020-00669-6

Alvesson, M., & Sköldberg, K. (2017). *Reflexive methodology: New vistas for qualitative research* (3rd ed.). Los Angeles: Sage.

Anderson, C. (2010). Presenting and evaluating qualitative research. *American Journal of Pharmaceutical Education, 74*(8), pp. 1-7. doi:10.5688/aj7408141

Anim-Yeboah, S., Boateng, R., Kolog, E. A., Owusu, A., & Bedi, I. (2020). Digital Entrepreneurship in Business Enterprises: A Systematic Review. In M. Hattingh, M. Matthee, H. Smuts, I. Pappas, Y. K. Dwivedi, & M. Mäntymäki (Ed.), *Responsible Design, Implementation and Use of Information and Communication Technology* (pp. 192-203). Cham, Switzerland: Springer. doi:10.1007/978-3-030-44999-5

Antonizzi, J., & Smuts, H. (2020). The Characteristics of Digital Entrepreneurship and Digital Transformation: A Systematic Literature Review. In M. Hattingh, M. Matthee, H. Smuts, I. Pappas, Y. K. Dwivedi, & M. Mäntymäki (Ed.), *Responsible Design, Implementation and Use of Information and Communication Technology* (pp. 239-251). Springer. doi:10.1007/978-3-030-44999-5

Antwi, S. K., & Hamza, K. (2015). Qualitative and quantitative research paradigms in business research: A philosophical reflection. *European Journal of Business and Management, 7*(3), pp. 217-225.

Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., . . . Zaharia, M. (2010). A view of cloud computing. In *Communications of the ACM* (Vol. 53, pp. 50-58). doi:10.1145/1721654.1721672

Automobil Industrie. (2022a). *Automated Driving*. Retrieved February 03, 2022, from https://www.automobil-industrie.vogel.de/bosch-kooperiert-mit-vw-softwaretochter-a-1090312/

Automobil Industrie. (2022b). *Das verdient Nvidia an Mercedes [In English: This is what Nvidia earns from Mercedes]*. Retrieved February 18, 2022, from Automatisiertes Fahren: https://www.automobil-industrie.vogel.de/das-verdient-nvidia-an-mercedes-a-1096933/?cmp=nl-99&uuid=7bf939a83e94e7e9b26cede0b16a1815

Bansal, P., & Corley, K. (2011). The coming of age for qualitative research: Embracing the diversity of qualitative methods. *The Academy of Management Journal, 54*(2), pp. 233-237. doi:10.5465/amj.2011.60262792

Barthélemy, J., & Geyer, D. (2005). An empirical investigation of IT outsourcing versus quasi-outsourcing in France and Germany. *Information & Management, 42*(4), pp. 533-542. doi: 10.1016/j.im.2004.02.005

Basl, J. (2018). Companies on the way to industry 4.0 and their readiness. *Journal of Systems Integration, 9*(3), pp. 3-6. doi:10.20470/jsi.v9i3.351

Bauer, W., Riedel, O., & Herrmann, F. (2020). *Beschäftigung 2030 - Auswirkungen von Elektromobilität und Digitalisierung auf die Qualität und Quantität der Beschäftigung bei Volkswagen [In English: Employment 2030 - Impact of electromobility and digitalisation on the quality and quantity of employme]*. Retrieved October 18, 2021, from http://publica.fraunhofer.de/dokumente/ N-615480.html

Baun, C., Kunze, M., Nimis, J., & Thai, S. (2010). Cloud computing–Web-basierte dynamische IT-Services [Cloud computing web-based dynamic IT services]. In O. Günther, W. Karl, R. Lienhart, K. Zeppenfeld, O. Günther, W. Karl, R. Lienhart, & K. Zeppenfeld (Eds.), *Informatik im Fokus.* Heidelberg: Springer. doi:10.1007/978-3-642-01594-6

Becker, J., Poeppelbuss, J., Venker, D., & Schwarze, L. (2011). Industrialisierung von IT-dienstleistungen: Anwendung industrieller konzepte und deren auswirkungen aus sicht von IT-dienstleistern. In A. Bernstein, & G. Schwabe (Eds.), *Proceedings of the 10th International Conference on Wirtschaftsinformatik* (Vol. 1, pp. 345-354). Zürich, Switzerland. doi:10.5167/uzh-60505

Behenna, A., Matzke, P., Kark, K., & Smith, A. (2014). *What The European CEO Needs From The CIO In 2014*. Retrieved July 14, 2021, from https://www.techcentral.ie/technology-now-the-differentiator-report-european-ceos/

Bell, E., Bryman, A., & Harley, B. (2018). *Business research methods* (5th ed.). New York: Oxford University Press.

Bell, J. (2014). *Doing Your Research Project: A guide for first-time researchers in education, health and social science* (5th ed.). Berkshire (UK): McGraw-Hill Education.

Berger, E. S., Von Briel, F., Davidsson, P., & Kuckertz, A. (2019). Digital or not – The future of entrepreneurship and innovation: Introduction to the special issue. *Journal of Business Research, 125*, pp. 436-442. doi:10.1016/j.jbusres.2019.12.020

Berghaus, S., & Back, A. (2016). Gestaltungsbereiche der Digitalen Transformation von Unternehmen: Entwicklung eines Reifegradmodells [In English: Design areas of the digital transformation of companies: Development of a maturity model]. *Die Unternehmung, 70*(2), pp. 98-123. doi:10.5771/0042-059X-2016-2-98

Bergmann, P. (2019). Die IT-Abteilung in der klassischen Form ist ein Auslaufmodell [In English: The IT department in its traditional form is a discontinued model]. *HMD Praxis der Wirtschaftsinformatik, 56*(2), pp. 370-384. doi:10.1365/s40702-019-00508-7

Berlin, C. (2021). Top 100 Automotive Supplier Global Ranking 2021. *Automobil Produktion, 2021*(04), 4-9.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. (2013). Digital business strategy: toward a next generation of insights. *MIS Quarterly, 37*(2), pp. 471-482.

Blaikie, N., & Priest, J. (2017). *Social research: Paradigms in action.* Cambridge: Polity Press.

Blaikie, N., & Priest, J. (2019). *Designing social research: The logic of anticipation* (3rd ed.). Cambridge: Polity Press.

BMW. (2020). *Sustainable Value Report 2019*. Retrieved August 13, 2020, from https://www.bmwgroup.com/content/dam/grpw/websites/bmwgroup_com/responsibility/downloads/en/2020/2020-BMW-Group-SVR-2019-Englisch.pdf

BMW. (2021). *BMW-Group-Annual Report and Sustainability-Report-2020-EN.* Retrieved April 15, 2021, from https://report.bmwgroup.com/downloads/

Boes, A., & Ziegler, A. (2021). *Umbruch in der Automobilindustrie: Analysen der Strategien von Schlüsselunternehmen an der Schwelle zur Informationsökonomie [In English: Upheaval in the Automotive Industry: Analyses of the Strategies of Key Companies on the Threshold of the Information.* ISF München. doi:10.36194/IDGUZDA_Forschungsbericht_Auto

Boes, A., Kämpf, T., Langes, B., & Ziegler, A. (2019). Die Cloud als Leitidee des digitalen Umbruchs [In English: The cloud as the guiding idea of the digital transformation]. In V. Stich, J. H. Schumann, D. Beverungen, G. Gudergan, & P. Jussen (Eds.), *Digitale Dienstleistungsinnovationen* (pp. 259-280). Springer Vieweg, Berlin, Heidelberg. doi:10.1007/978-3-662-59517-6

Böhmann, T., & Krcmar, H. (2014). Modularisierung-Grundlagen-und-Anwendung-bei-IT-Dienstleistungen [In English: Modularization-basics-and-application-in IT-services]. In *Konzepte für das Service Engineering* (pp. 45-83). Physica-Verlag HD. doi:10.1007/3-7908-1595-0_4

Bonnet, D., & Westerman, G. (2021). The New Elements of Digital Transformation. *MIT Sloan Management Review, 62*(2), pp. 82-89. Retrieved October 04, 2021, from https://www-proquest-com.glos.idm.oclc.org/docview/2471816389/592163BF0984B17PQ/1?accountid=27114

Bosch. (2020). *Greater collaboration in Industry 4.0: The Open Manufacturing Platform.* Retrieved April 16, 2021, from https://www.bosch.com/stories/open-manufacturing-platform/

Bosler, M., Burr, W., & Ihring, L. (2018). Vernetzte Fahrzeuge – empirische Analyse digitaler Geschäftsmodelle für Connected-Car-Services [In English: Connected cars - empirical analysis of digital business models for connected car services]. *HMD Praxis der Wirtschaftsinformatik, 55*(2), pp. 329-348. doi:10.1365/s40702-018-0396-8

Bosler, M., Jud, C., & Herzwurm, G. (2017). Connected-Car-Services: eine Klassifikation der Plattformen für das vernetzte Automobil [In English: Connected car services: a classification of platforms for the connected car]. *HMD Praxis der Wirtschaftsinformatik, 54*(6), pp. 1005-1020. doi:10.1365/s40702-017-0336-z

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), pp. 77-101. doi:10.1191/1478088706qp063oa

Brautsch, C., & Wynn, M. (2013). A New Process Model for Optimising IT Outsourcing Operations in the German Automotive Industry. In *SERVICE COMPUTATION 2013 : The Fifth International Conferences on Advanced Service Computing* (pp. 65-70).

Brennen, J. S., & Kreiss, D. (2016). Digitalization. *The International Encyclopedia of Communication Theory and Philosophy*, pp. 1-11. doi:10.1002/9781118766804.wbiect111

Brenner, W., Györy, A., Pirouz, M., & Uebernickel, F. (2011). *Bewusster Einsatz von Schatten-IT: Sicherheit & Innovationsförderung [In English: Deliberate use of shadow IT: security & promoting innovation].* Universität St. Gallen, Institut für Wirtschaftsinformatik. Retrieved January 14, 2022, from https://www.alexandria.unisg.ch/publications/214464

Briner, R. B., & Walshe, N. D. (2014). From passively received wisdom to actively constructed knowledge: Teaching systematic review skills as a foundation of evidence-based managemen. *Academy of Management Learning & Education, 13*(3), pp. 415-432. doi:10.5465/amle.2013.0222

Brown, N., & Brown, I. (2019). From digital business strategy to digital transformation-How: A systematic literature review. In *Proceedings of the South African Institute of Computer Scientists and Information Technologists 2019* (pp. 1-8). doi:10.1145/3351108.3351122

Buchta, D., Eul, & Schulte-Croonenberg, H. (2009). *Strategisches IT-Management [Strategic IT Management]* (3rd ed.). Wiesbaden: Gabler.

Bundesministerium für Wirtschaft und Klimaschutz. (2019). *Automobile Wertschöpfung 2030/2050 [In English: Automotive value creation 2030/2050]*. Retrieved October 19, 2021, from https://www.bmwi.de/Redaktion/DE/Publikationen/Studien/automobile-wertschoepfung-2030-2050.pdf?__blob=publicationFile&v=16

Bundesministerium für Wirtschaft und Klimaschutz. (2021a). *Eckdaten der deutschen Automobilindustrie [In English: Key data on the German automotive industry]*. Retrieved August 10, 2021, from https://www.bmwi.de/Redaktion/DE/Textsammlungen/Branchenfokus/Industrie/branchenfokus-automobilindustrie.html

Bundesministerium für Wirtschaft und Klimaschutz. (2021b). *Business Model Canvas Template*. Retrieved October 02, 2021, from https://www.existenzgruender.de/SharedDocs/Downloads/DE/Checklisten-Uebersichten/Businessplan/16_Business-modell-Canvas.pdf?__blob=publicationFile

Burke, M. E. (2007). Making choices: research paradigms and information management: Practical applications of philosophy in IM research. *Library Review, 56*(6), pp. 476-484. doi:10.1108/00242530710760373

Burrell, G., & Morgan, G. (1979). *Sociological Paradigms and Organisational Analysis. Elements of the Sociology of Corporate Life.* London: Heinemann.

Butler, N. P. (2012). *Stay, switch or back: Evaluating the IT sourcing cycle [Doctoral dissertation, Sheffield Hallam University, UK].* Published by ProQuest 10694296.

Butler, N., Slack, F., & Walton, J. (2011). IS/IT backsourcing-a case of outsourcing in reverse? *In 2011 44th Hawaii International Conference on System Sciences (pp. 1-10). IEEE.* doi:10.1109/HICSS.2011.261

Cacilo, A., & Haag, M. (2018). *Beschäftigungswirkungen der Fahrzeugdigitalisierung: Wirkungen der Digitalisierung und Fahrzeugautomatisierung auf Wertschöpfung und Beschäftigung [In English: Employment effects of vehicle digitalisation: Effects of* *digitalisation and vehicle automation]* (Vol. 406). Düsseldorf: Hans-Böckler-Stiftung. Retrieved July 01, 2019, from http://hdl.handle.net/10419/194158

Caputo, A., Pizzi, S., Pellegrini, M. M., & Dabić,, M. (2021). Digitalization and business models: Where are we going? A science map of the field. *Journal of Business Research, 123*, pp. 489-501. doi:10.1016/j.jbusres.2020.09.053

Carr, N. (2003). *IT doesn't matter.* Harvard Business Press. Retrieved August 18, 2020, from https://www.classes.cs.uchicago.edu/archive/2014/fall/51210-1/required.reading/ITDoesntMatter.pdf

Carr, N. (2004). *Does IT matter? Information technology and the corrosion of competitive advantage.* Boston, MA: Harvard Business School.

Casadesus-Masanell, R., & Ricart, J. E. (2010). From strategy to business models and onto tactics. *Long Range Planning, 43*(2-3), pp. 195-215. doi:10.1016/j.lrp.2010.01.004

Cassell, C., Bishop, V., Symon, G., Johnson, P., & Buehring, A. (2009). Learning to be a qualitative management researcher. *Management Learning, 40*(5), 513-533. doi:10.1177/1350507609340811

Center of Automotive Management. (2020a). *CCI 2020 - Connected Car Innovation Study*. Retrieved February 25, 2021, from https://cci.car-it.com/wp-content/uploads/2020/11/Studie_CCI_2020-v1.1oV.pdf

Center of Automotive Management. (2020b). *Mobility Services Report (MSR) 2020 Entwicklungstrends der Mobilitätsdienstleistungen von Automobilherstellern und Mobility Providern [In English: Mobility Services Report (MSR) 2020 Development Trends of Mobility Services of Automobile Manufacturers and]*. Retrieved February 25, 2021, from https://mobility-services-report.com/

Center of Automotive Management. (2020c). *Analyse: Marktkapitalisierung der globalen Autohersteller und „Big-Data"-Player in 2020 [In English: Analysis: Market capitalisation of global car manufacturers and "big data" players in 2020]*. Retrieved October 06, 2021, from https://ecomento.de/2020/01/21/marktkapitalisierung-globale-autohersteller-big-data-player-cam/

Center of Automotive Management. (2021). *Connected Car Innovation Study Studie_CCI_2021*. Retrieved February 20, 2022, from https://connected-car-innovation.de/wp-content/uploads/2021/08/Studie_CCI_2021_v1.06.pdf

Châlons, C., & Dufft, N. (2016). Die Rolle der IT als enabler für Digitalisierung [In English: The role of IT as an enabler for digitalisation]. In F. Abolhassan, *Was treibt die Digitalisierung?* (pp. 27-37). Wiesbaden: Springer Gabler. doi:10.1007/978-3-658-10640-9_2

Chan, Y. E., & Reich, B. H. (2007). IT Alignment: What we have learned. *Journal of Information Technology, 22*(4), 297-315. doi:10.1057/palgrave.jit.2000109

Chanias, S., & Hess, T. (2016). Understanding Digital Transformation Strategy formation: Insights from Europe's Automotive Industry. In *Pacific Asia Conference on Information Systems 296.*

Chesbrough, H. (2003). *Open Innovation: the New Imperative for Creating and Profiting from Technology.* Boston, MA: Harvard Business Press.

Chesbrough, H. (2017). The future of open innovation: The future of open innovation is more extensive, more collaborative, and more engaged with a wider variety of participants. *Research-Technology Management, 60*(1), pp. 35-38. doi:10.1080/08956308.2017.1255054

Chesbrough, H., & Bogers, M. (2014). Explicating Open Innovation: Clarifying an Emerging Paradigm for Understanding Innovation. In H. Chesbrough, W. Vanhaverbeke, & J. West (Eds.), *New Frontiers in Open Innovation* (pp. 3-28). Oxford: Oxford University Press.

Christensen, C. M. (1997). *The innovator's dilemma.* Boston, MA: Harvard Business School Press.

Christensen, C. M., McDonald, R., Altman, E. J., & Palmer, J. E. (2018). Disruptive innovation: An intellectual history and directions for future research. *Journal of Management Studies, 55*(7), pp. 1043-1078. doi:10.1111/joms.12349

CIO. (2004). *IT-Töchter im Sonderangebot [In English: IT subsidiaries on discount sale]*. Retrieved June 15, 2020, from https://www.cio.de/a/it-toechter-im-sonderangebot,803596

CIO. (2018). *T-Systems verliert Großauftrag von Thyssenkrupp [In English: T-Systems loses major contract from Thyssenkrupp]*. Retrieved August 08, 2020, from https://www.cio.de/a/t-systems-verliert-grossauftrag-von-thyssenkrupp,3575220

CIO. (2019). *Jedes zweite Unternehmen setzt auf einen CDO [In English: Every second company relies on a CDO]*. Retrieved August 16, 2021, from https://www.cio.de/a/jedes-zweite-unternehmen-setzt-auf-einen-cdo,3598272

Cohen, L., Manion, L., & Morrison, K. (2017). *Research methods in education* (8th ed.). London: Routledge.

Coltman, T., Tallon, P., Sharma, R., & Queiroz, M. (2015). Strategic IT alignment: twenty-five years on. *Journal of Information Technology, 30*, pp. 91-100. doi:10.1057/jit.2014.35

Computerwoche. (2003). *Dreimal Outsourcing rückwärts [In Englisch: Three times outsourcing backwards]*. Retrieved August 08, 2020, from https://www.computerwoche.de/a/dreimal-outsourcing-rueckwaerts,536968

Computerwoche. (2013). *Daimler holt ausgelagerte SAP zurück [In English: Daimler brings back outsourced SAP]*. Retrieved August 08, 2020, from https://www.computerwoche.de/a/daimler-holt-ausgelagerte-sap-zurueck,2540028

Computerwoche. (2017). *Chief Digital Officer CDO - Diese Unternehmen haben einen CDO In English: These companies have a CDO]*. Retrieved July 17, 2021, from https://www.computerwoche.de/a/diese-unternehmen-haben-einen-cdo,3331281

Connell, A. F., & Nord, W. R. (1996). The bloodless coup: The infiltration of organization science by uncertainty and values. *The Journal of Applied Behavioral Science, 32*(4), pp. 407-427. doi:10.1177/0021886396324005

Continental. (2021). *Continental and Amazon Web Services Create Platform for Automotive Software.* Retrieved April 15, 2021, from https://www.continental.com/en/press/press-releases/20210415-continental-and-amazon-web-services-251210

Coppola, R., & Morisio, M. (2016). Connected car: technologies, issues, future trends. *ACM Computing Surveys, 49*(3), pp. 1-36. doi:10.1145/2971482

Cresswell, J. W. (2007). *Qualitative research design: Choosing among five approaches.* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Sage Publications.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). California: Sage.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Thousand Oaks: Sage Publications.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process.* London: Sage.

Crowley, C., & Veling, L. (2018). *Sourcing and Supplier Management-A digital perspective.* Retrieved July 21, 2020, from Innovation Value Institute, IVI: http://mural.maynoothuniversity.ie/9182/1/IVI_IT-CMF_SSM_PositionPaper_Spring2018Release.pdf

Crowley, C., Carcary, M., Doherty, E., & Conway, G. (2017). Rethinking IT sourcing and supplier management for the digital age. In *11th European Conference of Information System Management ECISM 2017* (pp. 64-72).

Czernich, N., Falck, O., Erer, M., Keveloh, K., & Muineacháin, S. O. (2021). *Transformation in der Automobilindustrie–welche Kompetenzen sind gefragt? [InEnglish: Transformation in the automotive industry-what skills are needed?]*. Retrieved October 18, 221, from https://www.ifo.de/DocDL/sd-2021-12-digital-czernich-etal-kompetenzen-autoindustrie.pdf

Daimler. (2020). *Daimler Interim Report Q2, 2020.* Retrieved August 12, 2020, from https://www.daimler.com/investors/reports-news/interim-reports/2020/q2/

Daimler. (2021a). *Mercedes-Benz Strategy Update: electric drive*. Retrieved August 10, 2021, from https://www.daimler.com/dokumente/konzern/sonstiges/daimler-mercedes-benz-strategy-update-electric-drive.pdf

Daimler. (2021b). *Daimler-Annual-Report-2020-incl-combined-management-report-daimler-ag.* Retrieved February 19, 2021, from https://www.daimler.com/documents/investors/reports/annual-report/daimler/daimler-ir-annual-report-2020-incl-combined-management-report-daimler-ag.pdf

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly, 13*(3), pp. 319-340. doi:10.2307/249008

Denzin, N. K., & Lincoln, Y. S. (2018). *The Sage handbook of qualitative research* (5th ed.). London: Sage.

DePietro, R., Wiarda, E., & Fleischer, M. (1990). The context for change: Organization, technology and environment. In L. G. Tornatzky, & M. Fleischer (Eds.), *The processes of technological innovation* (pp. 151-175). Lexington, MA: Lexington Books.

Dhar, S. (2012). From outsourcing to Cloud computing: evolution of IT services. *Management Research Review, 35*(8), pp. 664 - 675. doi:10.1108/01409171211247677

Dibbern, J., Goles, T., Hirschheim, R., & Jayatila, B. (2004). Information systems outsourcing: a survey and analysis of the literature. *ACM SIGMIS: The DATABASE for Advances in Information Systems, 35*(4), pp. 6-102. doi:10.1145/1035233.1035236

Dinkelbach, W. (1973). Modell—ein isomorphes Abbild der Wirklichkeit [In English: Model - an isomorphic image of reality]. *Modell-und computer-gestützte Unternehmungsplanung*, pp. 151-162. doi:10.1007/978-3-322-89256-0_8

Dremel, C., Wulf, J., Herterich, M. M., Waizmann, J. C., & Brenner, W. (2017). How AUDI AG Established Big Data Analytics in Its Digital Transformation. *MIS Quarterly Executive, 16*(2), pp. 81-100.

Dudovskiy, J. (2018). *The Ultimate Guide to Writing a Dissertation in Business Studies: A Step-by-Step Assistance.* Retrieved December 11, 2019, from research-methodology.net

Easterby-Smith, M., Thorpe, R., & Jackson, P. R. (2015). *Management and Business Research* (5th ed.). London: Sage.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal, 50*(1), pp. 25-32. doi:10.5465/amj.2007.24160888

El Sawy, O. A., Kraemmergaard, P., Amsinck, H., & Vinther, A. L. (2020). How Lego built the Foundations and Enterprise Capabilities for Digital Leadership. In R. D. Galliers, D. E. Leidner, & B. Simeonova (Eds.), *Strategic Information Management: Theory and Practice* (5th ed., pp. 174-201). New York: Routledge.

Elia, G., Margherita, A., & Passiante, G. (2020). Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process. *Technological Forecasting and Social Change, 150*. doi:10.1016/j.techfore.2019.119791

Enkel, E., Bell, J., & Hogenkamp, H. (2011). Open innovation maturity framework. *International Journal of Innovation Management, 15*(06), pp. 1161-1189. doi:10.1142/S1363919611003696

Eriksson, P., & Kovalainen, A. (2015). *Qualitative methods in business research: A practical guide to social research* (2nd ed.). London, UK: Sage Publications Ltd. doi:10.4135/9780857028044.d8

European Commission. (2021). *European Chips Act*. Retrieved October 18, 2021, from HTTPS://EC.EUROPA.EU/COMMISSION/COMMISSIONERS/2019-2024/BRETON/BLOG/HOW-EUROPEAN-CHIPS-ACT-WILL-PUT-EUROPE-BACK-TECH-RACE_EN

Expertenkommission Forschung und Innovation. (2022). *Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2022 [In English: Report on Research, Innovation and Technological Performance in Germany]*. Retrieved March 10, 2022, from https://www.e-fi.de/fileadmin/Assets/Gutachten/2022/EFI_Gutachten_2022.pdf

Fang, Y., Henfridsson, O., & Jarvenpaa, S. L. (2018). Editorial on Generating Business and Social Value from Digital Entrepreneurship and Innovation. *Journal of Strategic Information Systems, 27*(4), pp. 275-277. doi:10.1016/j.jsis.2018.11.001

Farr, L., & Lind, M. (2019). Motivating Language and Intent to Stay in a Backsourced Information Technology Environment. *Journal of Global Information Management (JGIM), 27*(3), pp. 1-18. doi:10.4018/JGIM.2019070101

Felser, K. (2021). The Impact of Digital Technologies on IT Sourcing Strategies in the German Automotive Industry. In M. G. Wynn (Ed.), *Handbook of Research on Digital Transformation, Industry Use Cases, and the Impact of Disruptive Technologies* (pp. 383-408). doi:10.4018/978-1-7998-7712-7.ch020

Felser, K., & Wynn, M. G. (2020a). Digitalization and IT Backsourcing: Towards a Transformational Model for the German Automobile Industry. In *IARIA eKNOW 2020: The Twelfth International Conference on Information, Process, and Knowledge Management* (pp. 7-16). Valencia, Spain.

Felser, K., & Wynn, M. G. (2020b). Digitalization and Evolving IT Sourcing Strategies in the German Automotive Industry. *International Journal on Advances in Intelligent Systems, 13*(3/4), pp. 212-225.

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5*(1), pp. 80-92. doi:10.1177/160940690600500107

Fernandes, K. J., Milewski, S., Chaudhuri, A., & Yiong, Y. (2022). Contextualising the role of external partnerships to innovate the core and enabling processes of an organisation: A resource and knowledge-based view. *Journal of Business Research, 144*, pp. 146-162. doi:10.1016/j.jbusres.2022.01.091

Fink, A. (2019). *Conducting research literature reviews: From the internet to paper* (5th ed.). Los Angeles: Sage Publications.

Finlay, L. (2008). Reflecting on reflective practice. *Practice-based Professional Learning Centre: The Open University, 52*.

Fischer, H. P. (1997). *Die Kultur der schwarzen Zahlen - Das Fieldbook der Unternehmenstransformation bei Mercedes-Benz [In English: The Culture of Black Figures - The Fieldbook of Corporate Transformation at Mercedes-Benz].* (H. P. Fischer, Ed.) Stuttgart: Klett-Cotta.

Flick, U. (2009). *Introduction to Qualitative Research* (4th ed.). Sage Publications.

Floerecke, S. (2019). *Cloud-Computing-Ökosystem–Entwicklung eines Ökosystemmodells und Identifikation von erfolgswirksamen Geschäftsmodellcharakteristika [Doctoral Dissertation].* Falkultät für Wirtschaftswissenschaften, Universiät Passau.

Flyvbjerg, B. (2006). Five Misunderstandings about Case-Study Research. *Qualitative Inquiry, 12*(2), pp. 219-245. doi:10.1177/1077800405284363

Frank, A. G., Dalenogare, L. S., & Ayala, N. F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics, 210*, pp. 15-26. doi:10.1016/j.ijpe.2019.01.004

Friedmann, K. (2005). *Zwischen Mutter und Tochter [In English: Between mother and daughter]*. Retrieved June 15, 2020, from Computerwoche: https://www.computerwoche.de/a/zwischen-mutter-und-tochter,552945

Gabriel, R., Gersch, M., & Weber, P. (2009). Leistungstiefenentscheidung und IT-Sourcing - Veränderte Herausforderungen des Strategischen Informationsmanagements [In English: Service depth decision and IT sourcing]. In F. Keuper, B. Wagner, & H. D. Wysuwa, *Managed Services - IT Sourcing der nächsten Generation* (pp. 36-50). Gabler. doi:10.1007/978-3-8349-8290-2_2

Galliers, R. D. (2011). Further developments in information systems strategizing: unpacking the concept. In R. D. Galliers, & W. Currie (Eds.), *The Oxford Handbook of Information Systems: Critical Perspectives and New Directions* (pp. 329-345). Oxford: Oxford University Press.

Gambal, M. J., Asatiani, A., & Kotlarsky, J. (n.d.). trategic innovation through outsourcing – A theoretical review. *The Journal of Strategic Information Systems, 31*(2). doi:10.1016/j.jsis.2022.101718

Gartner. (2021). *Hype Cycle for Emerging Technologies 2021*. Retrieved September 20, 2021, from https://www.gartner.com/en/documents/4004623-hype-cycle-for-emerging-technologies-2021

Gebayew, C., Hardini, I. R., Panjaitan, G. H., & Kurniawan, N. (2018). A systematic literature review on digital transformation. In *2018 International Conference on Information Technology Systems and Innovation (ICITSI)* (pp. 260-265). doi:10.1109/ICITSI.2018.8695912

Gerster, D., & Dremel, C. (2019). Agile Contracts: Learnings from an autonomous driving sourcing project. In *Twenty-Seventh European Conference on Information Systems (ECIS2019).* Stockholm-Uppsala, Sweden.

Gerth, T., & Peppard, J. (2020). *Taking the Reins as CIO: A Blueprint for Leadership Transitions.* Springer Nature. doi:10.1007/978-3-030-31953-3

Gevestor. (2021). *Ranking der Top 10 Autohersteller der Welt [In English: Ranking of the world's top 10 car manufacturers]*. Retrieved August 12, 2021, from https://www.gevestor.de/finanzwissen/oekonomie/rankings/die-top-10-der-autohersteller-deutsche-konzerne-auf-dem-vormarsch-712706.html

Gibbs, G. R. (2018). *Analyzing qualitative data* (6th ed.). Sage.

Gioia, D. A., & Pitre, E. (1990). Multiparadigm perspectives on theory building. *Academy of Management Review, 15*(4), pp. 584-602. doi:10.5465/amr.1990.4310758

Glaser, B. G., Strauss, A. L., & Paul, A. T. (2005). *Grounded theory: strategien qualitativer forschung [In English: Grounded Theory: Strategies of Qualitative Research]* (2nd ed.). Bern: Huber.

Goles, T., & Hirschheim, R. (2000). The paradigm is dead, the paradigm is dead… long live the paradigm: the legacy of Burrell and Morgan. *Omega: The International Journal of Management Science, 28*(3), pp. 249-268. doi:10.1016/S0305-0483(99)00042-0

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal, 17, Winter Special Issue*, pp. 109-122. doi:10.1002/smj.4250171110

Gray, D. E. (2019). *Doing Research in the Business World* (2nd ed.). SAGE Publications Limited.

Grimm, A., Doll, C., Hacker, F., & Minnich, L. (2020). *Nachhaltige Automobilwirtschaft: Strategien für eine erfolgreiche Transformation [In English: Sustainable automotive industry: Strategies for a successful transformation], Working Paper Sustainability and Innovation, No. S19/2020.* Karlsruhe: Fraunhofer ISI. Retrieved February 15, 2021, from http://hdl.handle.net/10419/226383

Grix, J. (2018). *The foundations of research* (3rd ed.). Red Globe Press Macmillan International Higher Education, UK.

Grundhoff, S. (2022). BMWs Number One. *Automobil Produktion, 2022*(01), 30-31.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of Qualitative Research, 2*(105), pp. 163-194.

Guest, G., Namey, E. E., & Mitchell, M. L. (2013). Collecting qualitative data: A field manual for applied research. In *Qualitative Research: Defining and Designing* (pp. 1-40). Sage. doi:10.4135/9781506374680.n1

Guidehouse Insights . (2021). *Leaderboard Automated Driving Systems*. Retrieved March 06, 2022, from https://guidehouseinsights.com/reports/guidehouse-insights-leaderboard-automated-driving-systems

Haffke, I., Kalgovas, B., & Benlian, A. (2017). Options for Transforming the IT Function Using Bimodal IT. *MIS Quarterly Executive, 16*(2), pp. 101-120.

Hammerschmidt, C. (2022). IT Infrastrukturen müssen in Zukunft umweltfreundlicher werden [In English: IT infrastructures must become more environmentally friendly in the future]. *Automotive IT, 2022*(01), pp. 32-33.

Hanafizadeh, P., & Zareravasan, A. (2020). A Systematic Literature Review on IT Outsourcing Decision and Future Research Directions. *Journal of Global Information Management (JGIM), 28*(2), pp. 1-42. doi:10.4018/JGIM.2020040108

Hannewald, M., von Deimling, C., & Eßig, M. (2021). Supplier Performance Measurement for Embedded Software Projects in Automotive Industry: Developing a conceptual research framework. In *Conference: IPSERA Online Conference 2021 "Purchasing Innovation and Crisis Management".*

Hart, C. (2018). *Doing a Literature Review, Releasing the Research Imagination* (2nd ed.). Sage.

Harvey Nash, & KPMG. (2018). *CIO Survey 2018: The Ttransformational CIO.* Retrieved August 08, 2020, from Harvey Nash /KPMG CIO Survey 2018: https://assets.kpmg/content/dam/kpmg/xx/pdf/2018/06/harvey-nash-kpmg-cio-survey-2018.pdf

Harvey Nash, & KPMG. (2019). *CIO Survey 2019: A changing perspective.* Retrieved August 08, 2020, from Harvey Nash /KPMG CIO Survey 2019: https://assets.website-files.com/5da4969031ca1b26ebe008f7/5e96e895d119289d384f2c89_2019-HarveyNashKPMGCIOSurvey.pdf

Henderson, J. C., & Venkatraman, H. (1993, 1999). Strategic alignment: Leveraging information technology for transforming organizations. *IBM Systems Journal, 38*(2), pp. 472-484.

Hess , T. (2016). *Digitalisierung [in English: Digitalization]*. Retrieved January 2020, from http://www.enzyklopaedie-der-wirtschaftsinformatik.de/lexikon/technologien-methoden/Informatik--Grundlagen/digitalisierung

Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2020). Options for Formulating a Digital Transformation Strategy. In R. D. Galliers, D. E. Leidner, & B. Simeonova (Eds.), *Strategic Information Management: Theroy and Practice* (Vol. 5th, pp. 151-173). New York: Routledge.

Hirschheim, R., & Lacity, M. (1997). Information Systems Outsoucing and Insourcing: Lessons and Experiences. In *Pacific Asia Conference on Information Systems (PACIS)* (Vol. 3, pp. 19-28).

Hohnhaus, W., & Kreutter, P. (2003). IT-Outsourcing: Ausgestöpselt [In English: IT Outsourcing: Unplugged]. *FINANCE, November*, pp. 40-44.

Holden, M. T., & Lynch, P. (2004). Choosing the Appropriate Methodology: Understanding Research Philosophy. *The Marketing Review, 4*(4), pp. 397-409. doi:10.1362/1469347042772428

Holland, H. (2018). *Dialogmarketing und Kundenbindung mit Connected Cars: Wie Automobilherstellern mit Daten und Vernetzung die optimale Customer Experience gelingt [In English: Dialogue marketing and customer loyalty with connected cars: How car manufacturers use data and]* . Mainz: Springer Verlag. doi:10.1007/978-3-658-22929-0

Hussain, M. A., Elyas, T., & Nasseef, O. A. (2013). Research paradigms: A slippery slope for fresh researchers. *Life Science Journal, 10*(4), pp. 2374-2381.

IDG. (2021). *Jahrbuch 2021 Prognosen zur Zukunft der IT [In English: Yearbook 2021: Forecasts regarding the future of IT].* München: IDG Business Media GmbH.

IDG. (2022). *Jahrbuch 2022 Prognosen zur Zukunft der IT [In English: Yearbook 2022: Forecasts regarding the future of IT].* München: IDG Business Media GmbH.

Ilmudeen, A., Bao, Y., & Alharbi, I. M. (2019). How How does business-IT strategic alignment dimension impact on organizational performance measures: conjecture and empirical analysis. *Journal of Enterprise Information Management, 32*(3), pp. 457-476. doi:10.1108/JEIM-09-2018-0197

Ismail, M. H., Khater, M., & Zaki, M. (2017). Digital business transformation and strategy: What do we know so far? *Cambridge Service Alliance, 10*, pp. 1-35. doi:10.13140/RG.2.2.36492.62086

ISO. (2014). *Information Technology and Cloud Computing overview and vocabulary*. Retrieved April 20, 2020, from http://www.iso.org/iso/catalogue_detail?csnumber=60544

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal, 9*(8), pp. 2255-2276. doi:10.1002/smj.2904

Jannsen, N., Dudenhöffer, F., Canzler, W., Knie, A., Schneidewind, U., Koska, T., . . . Mattes, B. (2019). Autoindustrie—auf dem richtigen Weg? [In English: Automotive Industry - On the right way?)]. *Wirtschaftsdienst, 99*(7), pp. 451-469. doi:10.1007/s10273-019-2475-z

Jaroschinsky, A., & Opitz, C. (2018). *Strategische Sanierung von Automobilzulieferern [In English: Strategic restructuring of automotive suppliers].* Wiesbaden: Springer Fachmedien. doi:10.1007/978-3-658-22840-8

Johansson, B., Hallén, O., Persson, A., & Tarland, R. (2017). Sourcing Trends Predictions–An Analysis of Regions and Strategies. *Procedia Computer Science, 121*, pp. 716-723. doi:10.1016/j.procs.2017.11.093

Jöhnk, J., Röglinger, M., Thimmel, M., & Urbach, N. (2017). How to implement agile IT setups: A taxonomy of design options. In *25th European Conference on Information Systems (ECIS)* (pp. 1521-1535). Guimarães, Portugal.

Johnson, P., Buehring, A., Cassell, C., & Symon, G. (2006). Evaluating qualitative management research: Towards a contingent criteriology. *International Journal of Management Reviews, 8*(3), pp. 131-156. doi:10.1111/j.1468-2370.2006.00124.x

Johnson, R. B., & Onwuegbuzie , A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), pp. 14-26. doi:10.3102/0013189X033007014

Jonathan, G. M., Rusu, L., & Perjons. (2020). Business-it alignment in the era of digital transformation: Quo vadis? In *Hawaii International Conference on System Sciences (HICSS)* (pp. 5563-5572). Maui, Hawaii, USA. doi:10.24251/HICSS.2020.685

Jones, P., & Maas, G. (2019). Conclusions on Transformational Entrepreneurship. In G. Maas, & P. Jones, *Transformational Entrepreneurship Practices: Global Case Studies* (pp. 105-113). Palgrave Macmillan. doi:10.1007/978-3-030-11524-1_7

Jones, P., & Ratten, V. (2021). Knowledge spillovers and entrepreneurial ecosystems. *Knowledge Management Research & Practice, 19*(1), pp. 1-7. doi:10.1080/14778238.2020.1801363

Jönsson, S. (2010). Interventionism-an approach for the future? *Qualitative Research in Accounting & Management, 7*(1), pp. 124-134. doi:10.1108/11766091011034307

Kagermann, H., & Wahlster, W. (2021). Zehn Jahre Industrie 4.0 [In English: Ten years of Industry 4.0]. *Frankfurter Allgemeine Zeitung, 74*, p. 18.

Kagermann, H., Helbig, J., Hellinger, A., & Wahlster, W. (2013). *Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Securing the future of German manufacturing industry; final report of the Industrie 4.0 Working Group.* Deutsche Akademie der Technikwissenschaften.

Kahl, S., Urbach, N., Gschwendtner, M., & Zimmer, A. (2017). IT-Outsourcing im Zeitalter der Digitalisierung [in English: IT outsourcing in the age of digitalization].

Wirtschaftsinformatik & Management, 9(6), pp. 48-55. doi:10.1007/s35764-017-0132-0

Kahre, C., Hoffmann, D., & Ahlemann, F. (2017). Beyond business-IT alignment-digital business strategies as a paradigmatic shift: a review and research agenda. In *Proceedings of the 50th Hawaii International Conference on System Sciences* (pp. 4706-4715).

Kane, G. (2019). The technology fallacy: people are the real key to digital transformation. *Research-Technology Management, 62*(6), pp. 44-49. doi:10.1080/08956308.2019.1661079

Karpovsky, A., & Galliers, R. D. (2015). Aligning in Practice: From Current Cases to a new Agenda. *Journal of Information technology, 30*(2), pp. 136-160. doi:10.1057/jit.2014.34

Kawamoto, C. T., & Spers, R. G. (2019). A systematic review of the debate and the researchers of disruptive innovation. *Journal of Technology Management & Innovation, 14*(1), pp. 73-82. doi:10.4067/S0718-27242019000100073

Keen, P., & Williams, R. (2013). Value architectures for digital business: beyond the business model. *MIS Quarterly, 37*(2), pp. 643-647.

Kim, W. C., & Mauborgne, R. (2019). Nondisruptive creation: Rethinking innovation and growth. *MIT Sloan Management Review, 60*(3), pp. 46-55.

Koch, P., Ahlemann, F., & Urbach, N. (2016). Die innovative IT-Organisation in der digitalen Transformation Transformation [in English: The innovative IT organization in digital transformation]. *Managementorientiertes IT-Controlling und IT-Governance*, pp. 177-196. doi:10.1007/978-3-658-07990-1_11

Könning, M., Westner, M., & Strahringer, S. (2018). Multisourcing on the Rise: Results from an Analysis of more than 1,000 IT Outsourcing Deals in the ASG Region. In *Proceedings of the Multikonferenz Wirtschaftsinformatik* (pp. 1813-1824). Lüneburg , Germany.

Kopper, A., Strahringer, S., & Westner, M. (2018). Kontrollierte Nutzung von Schatten-IT [In English: Controlled use of Shadow-IT]. In M. Knoll, & S. Strahringer (Eds.), *IT-GRC-management–governance, risk und compliance: basics and applications* (pp. 129-150). Wiesbaden: Springer-Verlag. doi:10.1007/978-3-658-20059-6

Kotusev, S. (2020). The hard side of business and IT alignment. *IT Professional, 22*(1), pp. 47-55. doi:10.1109/MITP.2019.2912136

Kraus, S., Durst, S., Ferreira, J. J., Veiga, P., Kailer, N., & Weinmann, A. (2022). Digital transformation in business and management research: An overview of the current status quo. *International Journal of Information Management, 63*. doi:10.1016/j.ijinfomgt.2021.102466

Krcmar, H. (1992). Outsourcing: Mode ohne Grenzen [Outsourcing: fashion without limits]. *Information Management, 7*(4), p. 64.

Krcmar, H. (2015). *"Informationsmanagement [in English: Information Management]"* (6th ed.). München: Springer Verlag.

Kreutter, P., & Stadtmann, G. (2009). The Captives' End: Lebenszyklusmuster in der Entwicklung der deutschen IT-Outsourcing-Industrie [In English: The Captives' End: Life Cycle Patterns in the Development of the German IT Outsourcing Industry]. *Research Notes, 30*. Retrieved March 18, 2019, from http://hdl.handle.net/10419/40634

Kuhn, T. (1962). *The structure of scientific revolutions.* Chicago: University Press.

Kurbel, K., & Nowakowski, K. (2012). *Globale Transformation der Software-und Services-Branche: wo bleiben die deutschen Unternehmen? [In English: Global transformation of the software and services industry].* Discussion Paper, No. 316, European University Viadrina, Department of Business Administration and Economics, Frankfurt (Oder).

Lacity, M. C., & Hirschheim, R. (1993). The information systems outsourcing bandwagon. *MIT Sloan Management Review, 35*(1), p. 74.

Lacity, M. C., & Willcocks, L. (2000). *Global information technology outsourcing: In search of business advantage.* New York, USA: John Wiley & Sons, Inc.

Lee, N., & Lings, I. (2008). *Doing business research: a guide to theory and practice.* London: SAGE Publications Ltd.

Leimbach, T. (2010). *Die Geschichte der Softwarebranche in Deutschland [In English: The history of the software industry in Germany] [Doctoral dissertation, Ludwig Maximilians Universität München].* Universitätsbibliothek München.

Leimeister, S., Böhm, M., Riedl, C., & Krcmar, H. (2010). The business perspective of cloud computing: actors, roles and value networks. In *European Conference on Information Systems. ECIS 2010* (Vol. 56).

Lempp, M., & Siegfried, P. (2022). *Automotive Disruption and the Urban Mobility Revolution - Rethinking the Business Model 2030.* Springer Nature Switzerland. doi:10.1007/978-3-030-90036-6

Liebe, P. (2020). The different Roles of the Chief Information Officer (CIO) – A systematic Literature Review. In *Seminar IT-Managment in the Digital Age.* FH Wedel, Germany. Retrieved August 13, 2021, from https://www.fh-wedel.de/fileadmin/Mitarbeiter/Records/Liebe_2020_-_The_different_Roles_of_the_Chief_Information_Officer__CIO__-_A_systematic_Literature_Review.pdf

Linden, E., & Wittmer, A. (2018). *Zukunft Mobilität-Gigatrend Digitalisierung [In English: Future Mobility - Gigatrend Digitalisation].* CFAC-HSG Universität St. Gallen. Retrieved October 16, 2021, from https://www.alexandria.unisg.ch/publications/253291

Lingens, B., Miehé, L., & Gassmann, O. (2021). The ecosystem blueprint: How firms shape the design of an ecosystem according to the surrounding conditions. *Long Range Planning, 54*(2). doi:10.1016/j.lrp.2020.102043

Lipsky, S. (2011). *Cloud Computing: Eine Abgrenzung zum IT-Outsourcing und Systematisierung möglicher Sourcingoptionen [Cloud computing: A differentiation from IT outsourcing and systematization of possible sourcing options].* Arbeitspapiere des Instituts für Genossenschaftswesen der Westfälischen Wilhelms-Universität Münster, No. 119, IfG, Münster.

Loh, L., & Venkatraman, N. (1992). Diffusion of information technology outsourcing: influence sources and the Kodak effect. *Information Systems Research, 3*(4), pp. 334-358. doi:10.1287/isre.3.4.334

Luftman, J. (2004). Assessing business-IT allignment maturity. In J. Luftman, *Communications of Association for Information Systems* (pp. 99-128). IGI Global. doi:10.4018/978-1-59140-140-7.ch004

Maas, G., Jones, P., & Lockyer, J. (2019). The Journey to Transformational Entrepreneurship. In G. Maas, & P. Jones, *Transformational Entrepreneurship Practices: Global Case Studies* (pp. 1-14). Palgrave Macmillan. doi:10.1007/978-3-030-11524-1_1

Magalhães , R. (2016). Bringing the organizational dimension to IS management: re-thinking IS strategic alignment. In *Atas da Conferência da Associação Portuguesa de Sistemas de Informação* (Vol. 1). doi:10.18803/capsi.v1.%25p

Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. *Business & Information Systems Engineering, 57(5), 339-343.* doi:10.1007/s12599-015-0401-5

Maxwell, J. A. (2005). *Conceptual framework: What do you think is going on.* Retrieved October 17, 2019, from http://www.sagepub.com/upm-data/5056_Maxwell_Chapter_3.pdf

McFarlan, F. W., & Nolan, R. L. (2003). Why IT does matter. Retrieved September 26, 2020, from https://hbswk.hbs.edu/item/why-it-does-matter

McLaughlin, H. (2012). *Understanding Social Work Research* (2nd ed.). London: Sage Publications Ltd. doi:10.4135/9781473913844.n3

Mell, P., & Grance, T. (2011). *The NIST definition of cloud computing.* NIST: National Institute of Standards and Commerce, US Department of Commerce.

Merriam, S. B. (1998). *Case Study Research in Education: A qualitative Approach.* San Francisco: Jossey-Bass.

Mertens, P., & Wiener, M. (2018). Riding the Digitalization Wave: Toward a Sustainable Nomenclature in Wirtschaftsinformatik. *Business & Information Systems Engineering, 60(4), 367-372*. doi:10.1007/s12599-018-0545-1

Miles, M. B., Huberman, A. M., & Saldana, J. (2018). *Qualitative data analysis: A Methods Sourcebook* (4th ed.). Thousand Oaks, CA: Sage.

Miller, R. A., & Collier, E. W. (2010). Redefining entrepreneurship: A virtues and values perspective. *Journal of Leadership, Accountability and Ethics, 8*(2), pp. 80-89.

Mkansi, M., & Acheampong, E. A. (2012). Research philosophy debates and classifications: students' dilemma. *Electronic Journal of Business Research Methods, 10*(2), pp. 132-140.

Modiba, M. M., & Kekwaletswe, R. M. (2020). Resource Dependency Framework for Digital Transformation in South African Financial Service Providers. *International Journal of Computer Trends and Technology, 68*(4), pp. 107-125.

Muhic, M. (2019). *Transition to Cloud Sourcing-Innovation and Competitive Advantage [Doctoral dissertation, Lund University].* Department of Design Sciences, Faculty of Engineering, Lund University. Retrieved from https://lup.lub.lu.se/search/publication/883176a8-bddc-4d6d-9995-1f44c49641e9

Muhic, M., & Johansson, B. (2014). Cloud Sourcing–Next Generation Outsourcing? *Procedia Technology, 16*, pp. 553-561. doi:10.1016/j.protcy.2014.10.003

Müller , H. (2021). Die Automobilindustrie im Transformationsprozess: auf dem Weg zu „Zero Emission“ und „Vision Zero“ [In English: The automotive industry in the transformation process: on the way to "zero emissions" and "vision zero]. In W. Siebenpfeiffer (Ed.), *Mobilität der Zukunft* (pp. 271-278). Berlin: ATZ/MTZ-Fachbuch. Springer. doi:10.1007/978-3-662-61352-8_17

Myers, M. D., & Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and Organization, 17*(1), pp. 2-26. doi:10.1016/j.infoandorg.2006.11.001

Nambisan, S., & Baron , R. A. (2019). On the costs of digital entrepreneurship: Role conflict, stress, and venture performance in digital platform-based ecosystems. *Journal of Business Research, 125*, pp. 520-532. doi:10.1016/j.jbusres.2019.06.037

Nguyen, D. K. (2013). *Blueprint model and language for engineering cloud applications (UMI No. 12-5928387) [Doctoral dissertation, Tilburg University].* Tilburg School of Economics and Management (TiSEM), Tilburg University.

Nissen, V., & Termer, F. (2014). Business–IT-Alignment–Ergebnisse einer Befragung von IT-Führungskräften in Deutschland [In English: Business - IT Alignment - Results of a Survey of IT Executives in Germany]. *HMD Praxis der Wirtschaftsinformatik, 51*(5), pp. 549-560. doi:10.1365/s40702-014-0060-x

Nobbay, A. B. (2021). Innovation Through Social Media: A Case Study From the Oil and Gas Industry. In M. G. Wynn (Ed.), *Handbook of Research on Digital Transformation, Industry Use Cases, and the Impact of Disruptive Technologies* (pp. 182-204). IGI Global. doi:10.4018/978-1-7998-7712-7.ch011

Nujen, B., Halse, L., & Solli-Saether, H. (2015). Backsourcing and knowledge re-integration: a case study. In *IFIP International Conference on Advances in Production Management Systems (APMS)* (pp. 191-198). Tokyo, Japan: Springer, Cham. doi:10.1007/978-3-319-22759-7_22

Olayinka, O., & Wynn, M. G. (2021). Digital Transformation in the Nigerian Small Business Sector. In M. G. Wynn (Ed.), *Handbook of Research on Digital Transformation, Industry Use Cases, and the Impact of Disruptive Technologies* (pp. 359-382). IGI Global. doi:10.4018/978-1-7998-7712-7.ch019

Olzmann, M., & Wynn, M. G. (2012). How to switch IT service providers: recommendations for a successful transition. *International Journal on Advances in Intelligent Systems, 5*(1 & 2), pp. 209-219.

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers.* John Wiley & Sons.

Oswald, G., Setzke, D. S., Riasanow, T., & Krcmar, H. (2018). Technologietrends in der digitalen Transformation [In English: Technology trends in the digital transformation]. In G. Oswald, & H. Krcmar, *Digitale Transformation, Informationsmanagement und digitale Transformation* (pp. 11-34). Wiesbaden: Springer Gabler. doi:10.1007/978-3-658-22624-4_3

Oxford English Dictionary. (2016). *Digitization and Digitalization*. Retrieved August 13, 2021, from https://www.oed.com/

Paunov, C., & Planes-Satorra, S. (2019). How are digital technologies changing innovation?: Evidence from agriculture, the automotive industry and retail. *OECD Science, Technology and Industry Policy Papers, 74*. doi:10.1787/23074957

Pedersen, C., & Dalum, B. (2004). Incremental versus radical change-the case of the digital north Denmark Program. In *10th International Schumpeter Society Conference.* Bocconi University, Milano, Italy.

Peppard, J. (2018). Rethinking the concept of the IS organization. *Information Systems Journal, 28*(1), pp. 76-103. doi:10.1111/isj.12122

Peppard, J. (2020). Rethinking the Concept of the IS Organization. In R. D. Galliers, D. E. Leidner, & B. Simeonova (Eds.), *Strategic Information Management: Theory and Practice* (5th ed., pp. 309-335). New York: Routledge.

Popadiuk, S., & Choo, C. W. (2006). Innovation and knowledge creation: How are these concepts related? *International Journal of Information Management, 26*(4), pp. 302-312. doi:10.1016/j.ijinfomgt.2006.03.011

Porter, M. E. (1985). Technology and Competitive Strategy. In M. E. Porter, *Competitive advantage: Creating and sustaining superior performance* (pp. 60-78). The Free Press, a Division of Macmillian, Inc.

Porter, M. E. (2001). Strategy and the Internet. *Harvard Business Review, 79*(3), pp. 63-78.

Puls, T., & Fritsch, M. (2020). *Eine Branche unter Druck: Die Bedeutung der Autoindustrie für Deutschland [In English: An industry under pressure: The importance of the car industry for Germany], IW-Report, No. 43/2020.* Köln.

Qu, W. G., Oh, W., & Pinsonneault, A. (2010). The strategic value of IT insourcing: an IT-enabled business process perspective. *The Journal of Strategic Information Systems, 19*(2), pp. 96-108. doi:10.1016/j.jsis.2010.05.002

Ratten, V. (2022). Toward a Theory of Strategic Entrepreneurial Ecosystems and Business Model Innovation. In V. Ratten, *Strategic Entrepreneurial Ecosystems and Business Model Innovation.* Emerald Group Publishing.

Recker, J., & Von Briel, F. (2019). The future of digital entrepreneurship research: existing and emerging opportunities. In *Fortieth International Conference on Information Systems, 2019* (pp. 1-9). Munich.

Reinheimer, S., & Robra-Bissantz, S. (2017). Business-IT-Alignment–Kernaufgabe der Wirtschaftsinformatik [In English: Business IT Alignment Core Task of Business Informatics]. In S. Reinheimer, & S. Robra-Bissantz (Eds.), *Business-IT-Alignment* (pp. 7-29). Wiesbaden: Springer Vieweg. doi:10.1007/978-3-658-13760-1_2

Remenyi, D., Williams, B., Money, A., & Swartz, E. (1998). *Doing research in business and management: an introduction to process and method.* Sage.

Riasanow, T., Galic, G., & Böhm, M. (2017). Digital transformation in the automotive industry: Towards a generic value network. In *Proceedings of the 25th European Conference on Information Systems (ECIS), Guimarães, Portugal* (pp. 3191-3201).

Riedl, R., Benlian, A., Hess, T., Stelzer, D., & Sikora, H. (2017). On the relationship between information management and digitalization. *Business & Information Systems Engineering, 59*(6), pp. 475-482. doi:10.1007/s12599-017-0498-9

Robson, C., & McCartan, K. (2016). *Real World Research: A Resource for Social Research Methods in Applied Settings* (4th ed.). John Wiley & Sons.

Roos, M., & Siegmann, M. (2020). *Technologie-Roadmap für das autonome Autofahren: Eine wettbewerbsorientierte Technik- und Marktstudie für Deutschland [In English: Technology roadmap for autonomous driving: A competitive technology and market study].* Working Paper Forschungsförderung, No. 188. Düsseldorf: Hans-Böckler-Stiftung.

Roth, A. (2016). Industrie 4.0 – Hype oder Revolution? [in English: Industry 4.0 - Hype or Revolution?]. In A. Roth, *Einführung und Umsetzung von Industrie 4.0.* Berlin, Heidelberg: Springer Gabler. doi:10.1007/978-3-662-48505-7_1

Roth, G., & DiBella, A. (2015). *Systemic Change Management: The Five Capabilities for Improving Enterprises.* New York: Palgrave Macmillan. doi:10.1057/9781137412027

Rueckel, D., Krumay, B., & Schwarzgruber, S. (2020). Outsourcing in the Age of Digital Transformation. In *Americas Conference on Information Systems AMCIS 2020 Proceedings* (Vol. 24). Retrieved July 16, 2020, from https://aisel.aisnet.org/amcis2020/strategic_uses_it/strategic_uses_it/24

Sandberg, B. (2016). *Wissenschaftliches Arbeiten von Abbildung bis Zitat: Lehr-und Übungsbuch für Bachelor, Master und Promotion [In English: Scientific work from illustration to citation: textbook and exercise book for Bachelor's, Master's and doctoral studies]* (3rd ed.). Oldenbourg: De Gruyter. doi:10.1515/9783110514810

Sandelowski, M. (1998). Writing a good read: Strategies for re-presenting qualitative data. *Research in Nursing & Health, 21*(4), pp. 375-382. doi:10.1002/(SICI)1098-240X(199808)21:4<375::AID-NUR9>3.0.CO;2-C

Saunders, M., Lewis, P., & Thornhill, A. (2019). *Understanding research philosophies and approaches* (8th ed.). Harlow, UK: Pearson Education Limited.

Scherer, S., Reck, F., & Fliaster, A. (2019). Anbau, Umbau, Neubau? – Digitale Transformationsstrategien im Mobilitätssektor [In English: Extension, conversion, new construction? - Digital transformation strategies in the mobility sector]. In S. Meinhardt, & A. Pflaum (Eds.), *Digitale Geschäftsmodelle* (2nd ed., pp. 57-71). Wiesbaden: HMD. doi:10.1007/978-3-658-26316-4_4

Schneider, S., & Sunyaev, A. (2016). Determinant factors of cloud-sourcing decisions: reflecting on the IT outsourcing literature in the era of cloud computing. *Journal of Information Technology, 31*(1), pp. 1-31. doi:10.1057/jit.2014.25

Schön, D. (1983). *The reflective practitioner - how professionals think in action.* New York: Basic Books.

Schröder, H., & Müller, A. (2017). *IT-Organisation in der digitalen Transformation [In English: IT organisation in the digital transformation].* Wiesbaden: Springer Fachmedien. doi:10.1007/978-3-658-18645-6

Schultz, M., & Hatch, M. J. (1996). Living with multiple paradigms the case of paradigm interplay in organizational culture studies. *Academy of Management Review, 21*(2), pp. 529-557. doi:10.5465/amr.1996.9605060221

Schumpeter, J. A. (1972). *Kapitalismus, Sozialismus und Demokratie [Capitalism, Socialism and Democracy].* München: Francke.

Schwarz, J. (2018). *Der Einfluss der strategischen Rolle der IT auf die IT-Strategieentwicklung [In English: The influence of the strategic role of IT on IT strategy development].* SKILL 2018-Studierendenkonferenz Informatik, Gesellschaft für Informatik , Bonn.

Scotland, J. (2012). Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching, 5*(9), pp. 9-16. doi:10.5539/elt.v5n9p9

Seale, C. (1999). Quality in qualitative research. *Qualitative Inquiry, 5*(4), pp. 465-478.

Seiberth, G. (2015). *Wie verändern digitale Plattformen die Automobilwirtschaft [In English: How are digital platforms changing the automotive industry].* Accenture. Retrieved September 15, 2021, from http://plattform-maerkte.de/wp-content/uploads/2015/10/Gabriel-Seiberth-Accenture.pdf

Seiberth, G., & Gründinger, W. (2018). *Data-driven business models in connected cars, mobility services & beyond.* Retrieved April 19, 2020, from BVDW Research No.

01/18: https://www.bvdw.org/themen/smart-world/connected-mobility/data-driven-business-models/

Shen, K. N., Lindsay, V., & Xu, Y. (2018). Digital entrepreneurship. *Information Systems Journal, 28*(6), pp. 1125-1128. doi:10.1111/isj.12219

Shepherd, C., & Challenger, R. (2013). Revisiting paradigm (s) in management research: A rhetorical analysis of the paradigm wars. *International Journal of Management Reviews, 15*(2), pp. 225-244. doi:10.1111/ijmr.12004

Simonazzi, A., Sanginés, J. C., & Russo, M. (2020). *The Future of the Automotive Industry: Dangerous Challenges or New Life for a Saturated Market?* Working Paper No. 141. New York: Institut for new economic thinking. doi:10.36687/inetwp141

Singh, A., & Hess, T. (2020). How Chief Digital Officers promote the Digital Transformation of their Companies. In R. D. Galliers, D. E. Leidner, & B. Simeonova (Eds.), *Strategic Information Management: Theory and Practice* (5th ed., pp. 202-220). New York: Routledge.

Singh, A., Barthel, P., & Hess, T. (2017). Der CDO als Komplement zum CIO [In English: The CDO as a complement to the CIO]. *Wirtschaftsinformatik & Management, 9*(1), pp. 38-47. doi:10.1007/s35764-017-0004-7

Skog, D. A., Wimelius, H., & Sandberg, J. (2018). Digital disruption. *Business & Information Systems Engineering, 60*(5), pp. 431-437. doi:10.1007/s12599-018-0550-4

Skuridin, A. (2021). Chatbot Implementation in a Steel Company in Russia: Towards a Model for Successful Chatbot Projects. In M. G. Wynn (Ed.), *Handbook of Research on Digital Transformation, Industry Use Cases, and the Impact of Disruptive Technologies* (pp. 268-290). IGI Global. doi:10.4018/978-1-7998-7712-7.ch015

Söbbing, T., Dechamps, C., Frase, H., Fritzemeyer, W., Funk, A., Heinbuch, H., & Schrey, J. (2015). *Handbuch IT-Outsourcing: Recht, Strategien, Prozesse, IT, Steuern und Cloud Computing [In English: Handbook IT Outsourcing: Law, Strategies, Processes, IT, Taxes and Cloud Computing]* (4th ed.). Heidelberg: CF Müller.

Society of American Engineers. (2021). *Levels of driving automation*. Retrieved February 20, 2021, from https://www.sae.org/search/?qt=levels+of+driving+automation

Solli-Sæther, H., & Gottschalk, P. (2015). Stages-of-growth in outsourcing, offshoring and backsourcing: back to the future? *Journal of Computer Information Systems, 55*(2), pp. 88-94. doi:10.1080/08874417.2015.11645760

Somekh, B., & Lewin, C. (2005). *Research methods in the social sciences.* London: Sage.

Statista. (2021a). *Umsatz-der-deutschen-automobilindustrie [In English: Turnover of the automotive industry in Germany from 2010 to 2020]*. Retrieved August 12, 2021, from https://de.statista.com/statistik/daten/studie/160479/umfrage/umsatz-der-deutschen-automobilindustrie/#professional

Statista. (2021b). *Automobilhersteller nach weltweitem Fahrzeugabsatz [In English: Largest car manufacturers worldwide by vehicle sales in 2020]*. Retrieved August 12, 2021, from https://de.statista.com/statistik/daten/studie/173795/umfrage/automobilhersteller-nach-weltweitem-fahrzeugabsatz/

Statista. (2021c). *Anzahl der Betriebe in der Automobilindustrie in Deutschland von 2010 bis 2020 [In English: Number of companies in the automotive industry in Germany from 2010 to 2020]*. Retrieved October 22, 2021, from https://de.statista.com/statistik/daten/studie/253827/umfrage/anzahl-der-betriebe-in-der-automobilindustrie/

Statista. (2021d). *Gesamtumsatz der globalen Top-100-Automobilzulieferer von 2011 bis 2020 [In English: Total turnover of the global top 100 automotive suppliers from 2011 to 2020]*. Retrieved October 22, 2021, from https://de.statista.com/statistik/daten/studie/419500/umfrage/umsatz-der-globalen-automobilzulieferindustrie/

Statista. (2022). *Market Capitalisation*. Retrieved March 08, 2022, from https://de.statista.com/statistik/daten/studie/1187049/umfrage/marktkapitalisierung-gafam/

Stockhinger, J., & Teubner, A. (2019). *How digitalization drives the IT/IS strategy agenda.* ERICS Working Paper, No. 31, Westfälische Wilhelms-Universität Münster, European Research Center for Information Systems (ERCIS), Münster, Germany. Retrieved February 22, 2020, from http://hdl.handle.net/10419/213281

Stroh, C. (2021). Dominoeffekt: Die Chronik der Halbleiterkrise [In English: Domino effect: The chronicle of the semiconductor crisis]. *Automobil Produktion, 2021*(06), pp. 4-7.

Szalavetz, A. (2020). Digital entrepreneurs in factory economies. In J. Drahokoupil (Ed.), *The challenge of digital transformation in the automotive industry: Jobs, upgrading, and the prospects for development.* Brussels: European Trade Union Institute.

Tapscott, D. (2001). Rethinking strategy in a networked world or why Michael Porter is wrong about the internet. *Strategy and Business, 24*, pp. 34-41.

Tashakkori, A., Teddlie, C., & Teddlie, C. B. (1998). *Mixed methodology: Combining qualitative and quantitative approaches* (Vol. 46). London, UK: Sage.

Taylor, J. E., Dossick, C. S., & Garvin, M. (2011). Meeting the burden of proof with case-study research. *Journal of Construction Engineering and Management, 137*(4), pp. 303-311. doi:10.1061/(ASCE)CO.1943-7862.0000283

Tellis, W. M. (1997). Application of a Case Study Methodology. *The Qualitative Report, 3*(3), pp. 1-19. doi:10.46743/2160-3715/1997.2015

Teubner, R. A., & Ehnes, D. (2018). The Corporate IT/IS Function: Competences and Organization for a (Digital) Future. *Multikonferenz Wirtschaftsinformatik 2018*, (pp. 1825-1836). Lüneburg, Germany.

Teubner, R. A., & Stockhinger, J. (2020). Literature review: Understanding information systems strategy in the digital age. *The Journal of Strategic Information Systems, 29*(4). doi:10.1016/j.jsis.2020.101642

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management, 14*(3), pp. 207-222. doi:10.1111/1467-8551.00375

Tucci, L. (2021). *Ultimate guide to digital transformation for enterprise leaders*. Retrieved September 20, 2021, from https://searchcio.techtarget.com/feature/Ultimate-guide-to-digital-transformation-for-enterprise-leaders

Tuli, F. (2010). The basis of distinction between qualitative and quantitative research in social science: Reflection on ontological, epistemological and methodological perspectives. *Ethiopian Journal of Education and Sciences, 6*(1), pp. 97-108. doi:10.4314/ejesc.v6i1.65384

Turchi, P. (2018). *The Digital Transformation Pyramid: A Business-driven Approach for Corporate Initiatives*. Retrieved October 04, 2021, from https://www.thedigitaltransformationpeople.com/channels/the-case-for-digital-transformation/digital-transformation-pyramid-business-driven-approach-corporate-initiatives/

Turner, P. J. (2021). Disruptive Technology, Value Proposition, and Business Model Change Management in a Multi-Faceted SME: Towards an Analytical Framework. In M. G. Wynn (Ed.), *In Handbook of Research on Digital Transformation, Industry Use Cases, and the Impact of Disruptive Technologies* (pp. 291-319). IGI Global. doi:10.4018/978-1-7998-7712-7.ch016

Ulrich, P., & Lehmann, S. (2018). Das Spannungsfeld zwischen CFO, CIO und CDO [In English: The tension between CFO, CIO and CDO]. *Controlling & Management Review, 62*(8), pp. 66-71. doi:10.1007/s12176-018-0065-3

Umweltbundesamt. (2021). *Wirtschaft und Umwelt: Green Economy*. Retrieved October 16, 2021, from https://www.umweltbundesamt.de/themen/wirtschaft-konsum/wirtschaft-umwelt

Urabe, K. (1988). Innovation and the Japanese management system. In K. Urabe, J. Child, & T. Kagono (Eds.), *Innovation and Management International Comparisons.* Berlin: Walter de Gruyter. doi:10.1515/9783110864519-005

Urbach, N., & Ahlemann, F. (2016). *IT-Management im Zeitalter der Digitalisierung [In English: IT Management in the Digital Age].* Berlin Heidelberg: Springer Gabler. doi:10.1007/978-3-662-52832-7

Urbach, N., & Ahlemann, F. (2017). Die IT-Organisation im Wandel: Implikationen der Digitalisierung für das IT-Management [In English: The changing IT organisation: implications of digitalisation for IT management]. *HMD Praxis der Wirtschaftsinformatik, 54*(3), pp. 300-312. doi:10.1365/s40702-017-0313-6

Urbach, N., Ahlemann, F., Böhmann, T., Drews, P., Brenner, W., Schaudel, F., & Schütte, R. (2019). The Impact of Digitalization on the IT Department. *Business & Information Systems Engineering, 61*(1), pp. 123-131. doi:10.1007/s12599-018-0570-0

US Department of Transportation. (2015). Retrieved April 10, 2020, from http://www.its.dot.gov/connected_vehicle/connected_vehicles_FAQs.htm/

Van Alstyne, M. W., & Parker, G. G. (2021). *Digital Transformation Changes How Companies Create Value*. (Harvard Business Review) Retrieved February 08, 2022, from https://hbr.org/2021/12/digital-transformation-changes-how-companies-create-value

Van Dyk, R., & Van Belle, J. P. (2019). Factors influencing the intended adoption of digital transformation: a South African case study. In *Proceedings of the Federated Conference on Computer Science and Information Systems (FedCSIS)* (Vol. 18, pp. 519-528). doi:10.15439/2019F166

Veltri, N. F., Saunders, C. S., & Kavan, C. B. (2008). Information systems backsourcing: correcting problems and responding to opportunities. *California Management Review, 51*(1), pp. 50-76. doi:10.2307/41166468

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences, 39*(2), pp. 273-315. doi:10.1111/j.1540-5915.2008.00192.x

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *Management Information Systems Quarterly, 2*(3), pp. 425-478. doi:10.2307/30036540

Verband der Automobilindustrie. (2021a). *Annual Report 2020. The automotive industry in facts and figures*. Retrieved February 06, 2021, from https://www.vda.de/en/services/Publications/vda-anual-report-2020.html

Verband der Automobilindustrie. (2021b). *The automotive industry in facts and figures*. Retrieved October 22, 2021, from https://en.vda.de/en/services/Publications/the-automotive-industry-in-facts-%26-figures%2C-edition-2021.html

Verband der Automobilindustrie. (2021c). *The Economic Situation of the Automotive Industry in 2020*. Retrieved June 24, 2021, from https://www.vda.de/en/services/Publications/the-economic-situation-of-the-automotive-industry-in-2020.html

Verband der Automobilindustrie. (2021d). *Fit-for-55*. Retrieved August 10, 2021, from https://www.vda.de/de/presse/Pressemeldungen/210714_Fit-for-55_Ambitionierte-Ziele-brauchen-Technologieoffenheit-und-die-richtigen-Rahmenbedingungen.html

Verband der Automobilindustrie. (2021e). *The battery: Charged with potential*. Retrieved October 16, 2021, from https://www.vda.de/vda/de/themen/elektromobilitaet/batterie

Verband der Automobilindustrie. (2021f). *VDA Ladenetz-Ranking Europa [In English: VDA Charging Network Ranking Europe]*. Retrieved October 16, 2021, from https://www.vda.de/vda/de/themen/elektromobilitaet/ladenetze/Ladenetze-EU-Europa

Verina, N., & Titko, J. (2019). Digital transformation: conceptual framework. In *Proc. of the Int. Scientific Conference "Contemporary Issues in Business, Management and Economics Engineering 2019"* (pp. 719-727). Vilnius, Lithuania. doi:10.3846/cibmee.2019.073

Vial, G. (2021). Understanding digital transformation: A review and a research agenda. In A. Hinterhuber, T. Vescovi, & F. Checchinato (Eds.), *Managing Digital Transformation* (pp. 13-66). London: Routledge.

Volkswagen. (2020). *Volkswagen Sustainability Report 2019.* Retrieved September 09, 2020, from https://www.volkswagenag.com/presence/nachhaltigkeit/documents/sustainability-report/2019/Nonfinancial_Report_2019_e.pdf

Volkswagen. (2021a). *Group Strategy NEW AUTO Mobility for Generations to come*. Retrieved August 10, 2021, from https://www.volkswagenag.com/presence/konzern/strategie/2021/2021-07-13_Strategy_Day_Value_AA_IR-Website.pdf

Volkswagen. (2021b). *Volkswagen Sustainability Report 2020.* Retrieved April 02, 2021, from https://www.volkswagenag.com/presence/nachhaltigkeit/documents/sustainability-report/2020/Nonfinancial_Report_2020_e.pdf

Volkswagen. (2021c). *Volkwagen Annual Report 2020.* Retrieved August 12, 2021, from https://annualreport2020.volkswagenag.com/

Von Bary, B., & Westner, M. (2018). Information systems backsourcing: A literature review. *Journal of Information Technology Management, 29*(1), pp. 62-78.

Von Jouanne-Diedrich, H., Zarnekow, R., & Brenner, W. (2005). Industrialisierung des IT-Sourcing [In English: Industrialization of IT sourcing]. *HMD-Praxis der Wirtschaftsinformatik, 245*, pp. 18-27.

Von Stamm, B. (2008). *Managing innovation, design & creativity* (2nd ed.). London: John Wiley & Sons.

Wade, M., Noronha, A., Macaulay, J., & Barbier, J. (2017). *Orchestrating digital business transformation.* Retrieved April 21, 2020, from Global Center for Digital Business Transformation (GCDBM): https://www.imd.org/research-knowledge/reports/digital-orchestra/

Wahyuni, D. (2012). The research design maze: Understanding paradigms, cases, methods and methodologies. *Journal of Applied Management Accounting Research, 10*(1), pp. 69-80.

Walchshofer, M., & Riedl, R. (2017). Der Chief Digital Officer (CDO): Eine empirische Untersuchung [In English: The Chief Digital Officer (CDO): An Empirical Study]. *HMD Praxis der Wirtschaftsinformatik, 54*(3), pp. 324-337. doi:10.1365/s40702-017-0320-7

Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems, 15*(3), pp. 320-330. doi:10.1057/palgrave.ejis.3000589

Walter, S. M., Böhmann, T., & Krcmar, H. (2007). Industrialisierung der IT-Grundlagen, Merkmale und Ausprägungen eines Trends [In English: Industrialization of IT - basics, features and characteristics of a trend]. *HMD Praxis der Wirtschaftsinformatik, 44*(4), pp. 6-16. doi:10.1007/BF03340302

Weber, M. (2008). *Terminologie Outsourcing Vorschlag zur Vereinheitlichung von Begriffsinhalten im Outsourcing-Umfeld [In English: Terminology Outsourcing Proposal for standardising terminology in the outsourcing environment].* BITKOM Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e. V, Berlin. Retrieved June 14, 2020, from http://www. bitkom. org/files/documents/Leitfaden-Outsourcing-Terminologie.pdf

Weill, P., & Woerner, S. L. (2018). Is your company ready for a digital future? *MIT Sloan Management Review, 59*(2), pp. 21-25.

Weinert, S., & Meyer, K. (2005). *The evolution of IT outsourcing: From its origins to current and future trends.* Arbeitspapiere des Fachbereichs Wirtschafts- und Sozialwissenschaften, 202, Wuppertal. Retrieved March 20, 2019, from http://elpub.bib.uni-wuppertal.de/servlets/DerivateServlet/Derivate-775/ab0501.pdf

Weiß, N., Schreieck, M., Brandt, L. S., Wiesche, M., & Krcmar, H. (2018). Digitale Plattformen in der Automobilbranche – Herausforderungen und Handlungsempfehlungen [In English: Digital platforms in the automotive industry - challenges and recommendations for action]. *HMD Praxis der Wirtschaftsinformatik, 55*(2), pp. 349-365. doi:10.1365/s40702-018-0415-9

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 5*(2), pp. 171-180. doi:10.1002/smj.4250050207

Wiegard, S. W. (2020). *Make, buy or ally? Comparing practical software sourcing decision factors with transaction cost economics, resource-based and knowledge-based view: a case study in the automobile industry [Master Thesis, University of Twente].* Retrieved April 19, 2020, from http://essay.utwente.nl/80900/1/Wiegard_MA_BMS.pdf

Willcocks, L. P., Venters, W., & Whitley, E. A. (2013). Cloud sourcing and innovation: slow train coming? *Strategic Outsourcing: An International Journal, 6*(2), pp. 184-202. doi:10.1108/SO-04-2013-0004

Willcocks, L., Oshri, I., & Rottman, J. (2015). Forword to MISQEs special theme book on outsourcing. *MIS Quarterly Executive Special Theme Book on Outsourcing*, pp. 3-5.

Wilson, J. (2014). *Essentials of business research: A guide to doing your research project* (2nd ed.). Sage.

Winkelhake, U. (2017). *Die digitale Transformation der Automobilindustrie: Treiber-Roadmap-Praxis [In English: The digital transformation of the automotive industry: driver roadmap practice].* Berlin: Springer. doi:10.1007/978-3-662-54935-3

Wittenstein, D. (2021). *Managing Digital Transformation - Evidence from Hidden Champions and Measurement Approaches.* München: Springer Gabler. doi:10.1007/978-3-658-36695-7

Wynn, M. G. (2018). Preface. In M. G. Wynn (Ed.), *University-Industry Technology Transfer in the UK: Emerging Research and Opportunities.* IGI Global.

Wynn, M. G. (2021). *Handbook of Research on Digital Transformation, Industry Use Cases, and the Impact of Disruptive Technologies.* IGI-Global, USA.

Wynn, M. G. (2022). Special Issue Editors. *Sustainability: Special Issue "E-business, Information Systems Management and Sustainable Strategy Development in the Digital Era", 14*.

Wynn, M. G., & Jones, P. (2019). Context and entrepreneurship in knowledge transfer partnerships with small business enterprises. *The International Journal of Entrepreneurship and Innovation, 20*(1), pp. 8-20. doi:10.1177/1465750318771319

Xu, X., Ji, Y., Bian, Y., & Sun, Y. (2017). Service outsourcing under co-opetition and information asymmetry. *Journal of the Operational Research Society, 68*(6), pp. 666-677. doi:10.1057/s41274-016-0111-5

Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (6th ed.). London: Sage.

Youseff, L., Butrico, M., & Da Silva, D. (2008). Toward a unified ontology of cloud computing. In *IEEE Grid Computing Environments Workshop* (pp. 1-10). doi:10.1109/GCE.2008.4738443

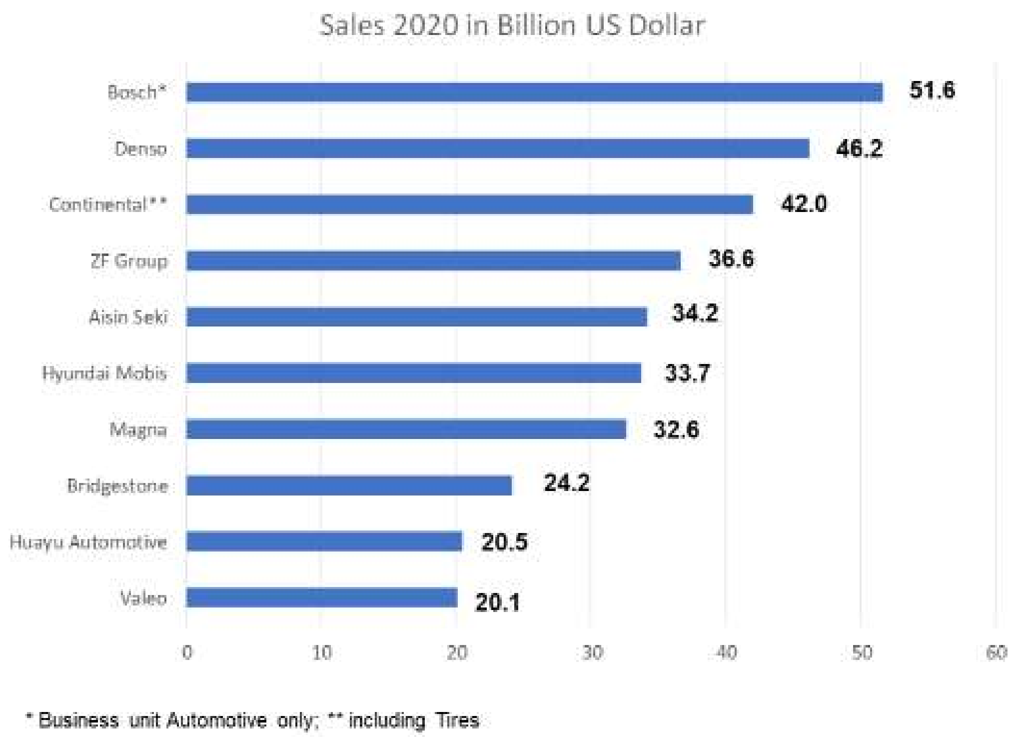
Zarnekow, R. (2007). *Produktionsmanagement von IT-Dienstleistungen: Grundlagen, Aufgaben und Prozesse [In English: Production management of IT services: Fundamentals, Tasks and Processes].* Berlin: Springer-Verlag.

Zeichhardt, R. (2018). E-Leader, CDOs & Digital Fools - Eine Führungstopologie für den Digitalen Wandel [In English: E-Leaders, CDOs & Digital Fools - A Leadership Topology for Digital Transformation]. In F. Keuper, M. Schomann, L. Sikora, & R. Wassef, *Disruption und Transformation Management* (pp. 3-21). Wiesbaden: Springer Gabler. doi:10.1007/978-3-658-19131-3

10 Appendices

10.1 Appendix: Turnover of the World's top Automotive Suppliers 2020

Figure 41: Turnover of the world's top automotive suppliers 2020

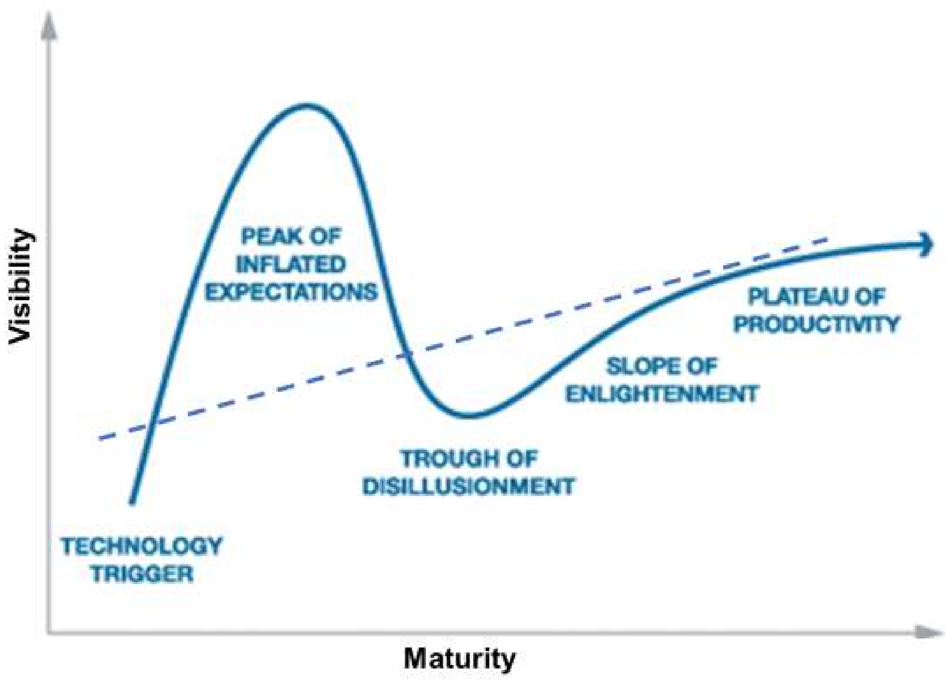


Source: Berlin (2021)

10.2 Appendix: Gartner Hype Cycle for Emerging Technologies 2021

Mertens and Wiener (2018) referred to the investment phases along the Gartner Hype Cycle (Figure 42) and warned that the digitalisation wave can lead to a waste of resources in research and practice in the upswing phase and to overreactions up to panic in the downswing phase. It was suggested not to climb the "peak of inflated expectations" and ideally to follow a more moderate and constant development path along the dotted line. According to Gartner (2021), the Hype Cycles should help to separate the hype from the real drivers of a technology's commercial promise, to reduce the risk of technology investment decisions and to understand the business value of a technology.

Figure 42: Investment phases along the Gartner Hype Cycle



Source: Gartner (2021); Mertens & Wiener (2018)

Each Hype Cycle is divided into the five most important phases of a technology's life cycle. *Technological trigger*: A potential technological breakthrough gets things rolling. Early proof-of-concept stories and media interest trigger a lot of publicity. Often there are no viable products and commercial viability is not proven. *Peak of inflated expectations*: Early publicity produces a series of success stories - often accompanied by a multitude of failures. Some businesses take action; many do not. *Valley of disappointments*: Interest wanes when experiments and implementations are unsuccessful. Technology manufacturers are purged or fail. Investment continues only if surviving vendors improve their products to the satisfaction of early adopters. *Path of enlightenment*: More and more examples of the benefits of the technology to the business crystallise and become better understood. Second and third generation products appear from technology vendors. More businesses fund pilot projects; conservative businesses remain reluctant. *Plateau of productivity*: Mainstream adoption begins. Criteria for assessing vendor viability are more clearly defined. Broad market applicability and relevance of technology pays off.

The Hype Cycle provides also graphical representation of the maturity and adoption of technologies and applications, and their potential relevance to solving real business problems and capitalising on new opportunities. The methodology gives an overview of how a technology or application will evolve over time, providing a sound source of insight to guide its deployment in the context of specific business goals.

According to Gartner (2021) there are a few takeaways concerning emerging technologies in 2021 worth pondering: *Artificial intelligence's* impact on generating code, augmenting design and innovation is all 5- to 10-years away. *Industry clouds* are just beginning on the hype cycle with a plateau reached in 5- to 10-years. That take is interesting given industry clouds are everywhere from multiple vendors. *Digital humans* are being talked about a good bit, but Gartner reckons the technology is more than 10 years away from productivity gains. Quantum-based machine learning is also more than 10 years out.

10.3 Appendix: IT Sourcing Landmarks in the German Automotive Industry

As the aim of this study is to understand evolving IT sourcing strategies in the German automotive industry it is worth taking a retrospective glance at some landmarks of IT sourcing in the German automotive industry from the start of IT sourcing until the present. According to Kreutter and Stadtmann (2009, the breakthrough to IT outsourcing in the German automotive industry was mainly the result of two large "spin-offs", also called captives. In 1983, Volkswagen decided to change its IT strategy and developed a concept for the Group IT department and founded the VW-Gedas-Group which thus assumed the function of an internal service provider. The intention was also to use the existing internal expertise and know-how in the external market. The most prominent example originated in 1990, when Daimler-Benz founded Daimler-Benz Interservices (debis), as part of its diversification strategy to establish a comprehensive technology group (Söbbing et al., 2015). The core of the IT service subsidiary was formed by the computer centres and system development departments of the Daimler-Benz group companies. All former IT departments were concentrated and consolidated in the new company. According to Kreutter and Stadtmann (2009), the founding of debis is considered the 'birth' of the IT outsourcing industry in Germany. Through several large outsourcing transactions, debis prepared the ground for this new business model in Germany and thus also for other providers (like IBM) who entered the IT sourcing industry in the following years or became more active in Germany. Leimbach (2010) explained, as part of the diversification strategy, debis was to become another major "high-tech" cornerstone of the Daimler-Benz Group, but to achieve this goal it was necessary to be represented not only in Germany. In this context, Daimler-Benz had acquired 34 per cent of the France Cap Gemini Sogeti group. The resulting construct then temporarily traded under the name CAP debis. Other companies from the automotive industry followed these models to exploit internal information technology expertise in the external market. However, market entry required the setting up of sales structures and sales know-how with the aim of drastically increasing the external share of sales (Weinert & Meyer, 2005). This shifted the focus of the captives away from the mother company as more and more resources were allocated to acquiring external customers.

According to publicly available information, a so-called shakeout of the captives began in the year 2000 (Table 19). In the scarcely available scientific literature, various reasons are given for this. Buchta et al. (2009) stated, despite all efforts of the management of the group-bounded captives the long-term chances of survival were rather bad. Even very successful spin-offs are sold off by their respective parent companies. Most prominent example was debis. Despite rapid and profitable growth, large third-party market share and well positioned in the market, Daimler preferred to disinvest. Buchta et al. (2009) and Söbbing et al. (2015) attributed this to the fact that companies are increasingly concentrating on their core business again and divested non-core business. Kreuter and Stadtmann (2009) assumed economic pressure or increased liquidity requirements on the side of the parent company in some cases. However, Kreuter and Stadtmann (2009) and Friedmann (2005) also assumed that from the outset the IT subsidiaries were not to be seen as a long-term business segment, but were founded with the clear objective of their subsequent sale. They argued that the market entry was only an intermediate step (transitional model) to restructure the own IT and to make the captives attractive by winning external customers in order to ultimately sell them at maximum value. Especially in times of limited financial resources, the high sales profit represented an additional cash flow incentive.

Table 19: Examples of IT spin-offs in the German automotive industry

Spin-off			Sold	
Parent Company	**Year**	**New Subsidiary**	**Year**	**To**
DaimlerChrysler AG	1990	debis AG / debis Systemhaus	2000	Deutsche Telekom AG / T-Systems
Volkswagen AG	1983	gedas AG	2005	Deutsche Telekom AG / T-Systems
Siemens AG	1995	Siemens Business Services (SBS)	2011	Atos
ThyssenKrupp	2000	Triaton	2004	HP
Freudenberg AG	1995	Freudenberg IT	2019	Novokap

Source: Buchta et al. (2009); CIO (2004); Söbbing et al. (2015); Kreutter & Stadtmann (2009); Weinert & Meyer (2005)

The literature shows different arguments regarding the sourcing definition of captives /spin-offs. From a legal perspective, Weber (2008) already regarded spin-offs as outsourcing by transferring IT functions to legally independent service providers, whether or not they were still owned by the parent company. Kreuter and Stadtmann (2009) declared, as a consequence, the simple accounting transfer of the company's IT to a group-owned subsidiary would already be considered as outsourcing. Söbbing et al. (2015) labelled this as internal outsourcing. Barthelemy and Geyer (2005) regarded it as quasi outsourcing. Hohnhaus and Kreutter (2003), Loh and Venkatraman (1992) and Söbbing et al. (2015) only regarded a spin-off as outsourcing if it also has customers outside the parent company. They argued, only then has it the same characteristics as an outsourcing project with a third-party provider.

In the German automotive industry, there have also been some IT-backsourcing initiatives of high-profile / large-scale outsourcing projects in the past. In 1987 **Porsche** outsourced its CAD systems to EDS (now Hewlett-Packard). Due to efficiency problems, large parts of IT, including CAD systems, were outsourced to a joint venture with IBM in 1993. The decision was mainly made under the aspect of cost, as Porsche was in economic difficulties at the beginning of the 1990s. In 1998, Porsche terminated the outsourcing project and bought back the joint venture company shares from IBM (Computerwoche, 2003; Söbbing et al., 2015). In 1996 Daimler founded the **Daimler Smart** division and handed over the design of all processes and IT systems, including the operation of the IT infrastructure, to Andersen Consulting. The service provider was also requested to provide all preliminary services at its own investment and risk. In terms of payment, the partners agreed on an innovative model. The IT costs were linked to the success of the product, i.e., the service provider received a certain amount per vehicle produced. The calculation was based on annual capacity planning. In 1998, the contract was terminated prematurely for reasons of inefficiency as part of an IT backsourcing project (Computerwohe, 2003). **Daimler** announced in 2013 that it would return large parts of its SAP operations back to the group (Computerwoche, 2013). From a local perspective and as an organisational practice, Daimler established a competence centre for SAP services in India. Internal capacities are also to be expanded in Turkey. With the "Save for Growth" return campaign, all SAP systems have been running again under their own responsibility since the end of 2015. T-Systems has lost a major contract from **ThyssenKrupp**. A contract with a term of 7 years and a volume of around +€700 million was signed in 2014. Around 80,000 computer workstations and 10,000 server systems were to be transferred to the T-Systems cloud. The deal failed and 100 employees who had transferred from ThyssenKrupp to T-Systems under the outsourcing agreement were returned to ThyssenKrupp at the end of 2018 (CIO, 2018).

10.4 Appendix: Online Survey Invitation Letter

UNIVERSITY OF GLOUCESTERSHIRE
at Cheltenham and Gloucester

11 November 2020

Research on IT Sourcing in the German automotive industry

Dear Madam or Sir,

I am currently investigating "Evolving IT sourcing strategies in the German automotive industry" at the University of Gloucestershire (UK), School of Computing and Engineering. This research study aims to explore and understand how and why the German automotive industry might be reviewing its Information Technology (IT) sourcing strategies in order to reflect the anticipated implications of megatrends, Industry 4.0 and digital transformation.

This is based on the assumption that digitalisation is the innovative use of new IT technologies and IT becomes the architect of the digitalized company. As a result of digitalisation, the entire business becomes "software-defined", spanning three technology fields: traditional corporate IT, product IT such as connected cars / Car IT as well as cloud-based platforms and ecosystems. The constant emergence of new digital technologies requires a high level of IT competency in order to master their deployment in a way that benefits the company. Hence, many companies most likely face the challenge of defining their own core competency. In this context, strategic decisions are necessary regarding the future optimal ratio between insourcing (in-house provision of IT services) and outsourcing.

After an academic literature review, I am now in the process of setting up two steps for data collection. The first step is an anonymous online survey to evaluate the results from the literature review with IT executives / practitioners from the German automotive industry.

The following link will take you to the survey, where you will be presented with statements and asked to rate your level of agreement or disagreement. The survey should take you no more than 10 minutes to complete.

Link: https://glos.onlinesurveys.ac.uk/evolving-it-sourcing-strategies-in-german-automotive-industry

After the responses, the second step will include a number of semi-structured interviews. Prior to conducting the interview, I will send out some themes / open questions in advance as a starting point for discussions. The interviews will be conducted in the German language.

Your responses from the survey and the interviews are important in enabling me to obtain as full an understanding as possible of evolving IT sourcing strategies. Therefore, I kindly ask you to assist my data collection and help me with some of your time for this survey and a subsequent interview.

Of course, the results of the survey plus the analysis of the follow-up interviews and the research as a whole will be made available for you.

If you have any questions or concerns about your participation in the study or elements of this survey please do not hesitate to get in touch. I am also completely flexible in terms of how the interview will be conducted (personal meeting at your place of work or online).

On the next page you will find a consent form and I would like to politely ask you to respond by indicating whether you would like to participate in the study, the survey and an interview.

Thank you very much indeed! I very much hope that you are able to become involved in the project.

Yours sincerely,

Kerstin Felser

University of Gloucestershire (UK),

School of Computing and Engineering

Consent form

We agree to take part in the research

YES		NO	

We will respond to the survey

YES		NO	

We will be available for a more in-depth interview to discuss some specific topics regarding emerging IT sourcing strategies

YES		NO	

Company:

Participant name:

Email:

Date:

10.5 Appendix: Online Survey Results

Table 20: Results of first online survey

SA: Strongly agree; A: Agree; U: Undecided; D: Disagree; SD: Strongly disagree

Survey Statements concerning digital transformation strategy	Survey Results				
	SA	A	U	D	SD
1. Digital information technologies have the power to radically change the automotive industry and undermine existing business models.	**10**	**6**	**2**	**0**	**0**
2. The company has a digital transformation strategy, which requires more than the traditionally existing IT strengths of the company.	**12**	**5**	**1**	**0**	**0**
3. The so-called 'megatrends' (C.A.S.E.) and Industry 4.0 have been triggered by the emergence of digital technologies.	**9**	**7**	**2**	**0**	**0**
4. Amongst the digital technologies, artificial intelligence combined with self-learning algorithms is gaining increasing industrial relevance and is becoming a decisive competitive factor.	**10**	**7**	**0**	**1**	**0**
5. Digital technologies are neither revolutionary nor disruptive. Their innovative strength is rather the result of the resultant increased efficiencies, significantly better networking possibilities, and their widespread use.	**2**	**5**	**6**	**4**	**1**
6. The shortage of skilled experts has been the biggest hurdle for digitalization and hampers the speedy implementation of digital innovation projects.	**5**	**8**	**3**	**1**	**1**

7. IT organizations of the German automotive industry must undergo enormous structural and cultural changes in order to be the architect of a digitalized enterprise.	SA	A	U	D	SD
	9	**6**	**2**	**1**	**0**
8. The advent of digital technologies and associated transformation strategy has led to a significant re-definition of core competencies in IT that were lost in the past.	SA	A	U	D	SD
	8	**4**	**5**	**0**	**0**
Survey Statements concerning digital entrepreneurship	Survey Result				
9. The deployment of digital transformation strategies depends mostly on the availability of external IT resources.	SA	A	U	D	SD
	2	**6**	**6**	**4**	**0**
10. It is a clear strategic goal to have the key IT capabilities and related resources for digital technology deployment inhouse in the long run.	SA	A	U	D	SD
	13	**2**	**2**	**1**	**0**
11. IT sourcing management must take on new roles and competencies to enable and support digital transformation and innovation.	SA	A	U	D	SD
	6	**11**	**1**	**0**	**0**
12. While traditionally the main reason to outsource was cost savings, in the new digital era, changes in sourcing strategy are driven by a search for talent, to close digital skills gaps, or to acquire new digital services or development capabilities.	SA	A	U	D	SD
	5	**12**	**1**	**0**	**0**
13. Digitalization is the innovative use of information technologies and systems. Therefore, IT sourcing is responsible for acquiring the relevant capabilities to successfully shape the necessary digital transformation of the company.	SA	A	U	D	SD
	5	**7**	**6**	**0**	**0**
14. IT sourcing strategies are a proven source of sustained competitive advantage for the company.	SA	A	U	D	SD
	1	**13**	**3**	**1**	**0**

Survey Statements	SA	A	U	D	SD
15. The company has an evaluation system that demonstrates how successfully digital transformation and innovation has been supported by appropriate IT sourcing strategies.	**0**	**4**	**7**	**6**	**1**
16. The company has decision-making criteria and a review system for constantly monitoring whether IT sourcing strategies still meet current business requirements.	**0**	**4**	**5**	**8**	**1**

Survey Statements concerning IT sourcing strategy	SA	A	U	D	SD
17. Digital technologies and the megatrends have made IT sourcing a much more complex and multi-layered process which must provide the digital capabilities for the business.	**10**	**6**	**0**	**2**	**0**
18. The introduction of digital technologies leads to a higher degree of vertical integration and thus an increased provision of IT services in-house.	**5**	**8**	**5**	**0**	**0**
19. Digitalization leads to a re-positioning of IT core competencies and companies therefore do not continue to invest in outsourcing.	**0**	**6**	**3**	**6**	**3**
20. Due to the continuing trend towards standardization of IT infrastructure components and services, an almost complete outsourcing of IT infrastructure services is expected in the future.	**3**	**4**	**6**	**4**	**1**
21. Further outsourcing of commodities (e.g. infrastructures) will create flexibility to focus resources on strategic tasks such as software engineering.					

	8	**5**	**3**	**2**	**0**
22. Cloud sourcing will become our digital backbone for standardized infrastructure and application services.	SA	A	U	D	SD
	6	**8**	**2**	**2**	**0**
23. Digitalization encourages bringing IT services back inhouse in order to strengthen core competencies, regain ownership and control, be more flexible, and respond more effectively to rapidly changing demands.	SA	A	U	D	SD
	3	**9**	**6**	**0**	**0**
24. In future, IT has to organize and manage advanced forms of sourcing with international tech-players to close existing resource and competency gaps in order to achieve competitive advantages that cannot be achieved individually.	SA	A	U	D	SD
	13	**5**	**0**	**0**	**0**

10.6 Appendix: Interview Brief for semi-structured Interviews

11. January 2021

Interview Brief

Research on IT Sourcing in the German automotive industry

Contact:

Kerstin Felser

University of Gloucestershire (UK),

School of Computing and Engineering

Email: [redacted]

Website: www.glos.ac.uk

Purpose of the research

This research study investigates "Evolving IT sourcing strategies in the German automotive industry" at the University of Gloucestershire (UK), School of Computing and Engineering. It aims to explore and understand how and why the German automotive industry might be reviewing its Information Technology (IT) sourcing strategies in order to reflect the anticipated implications of industry "megatrends", Industry 4.0 and digital transformation. The study seeks to answer the following three research questions:

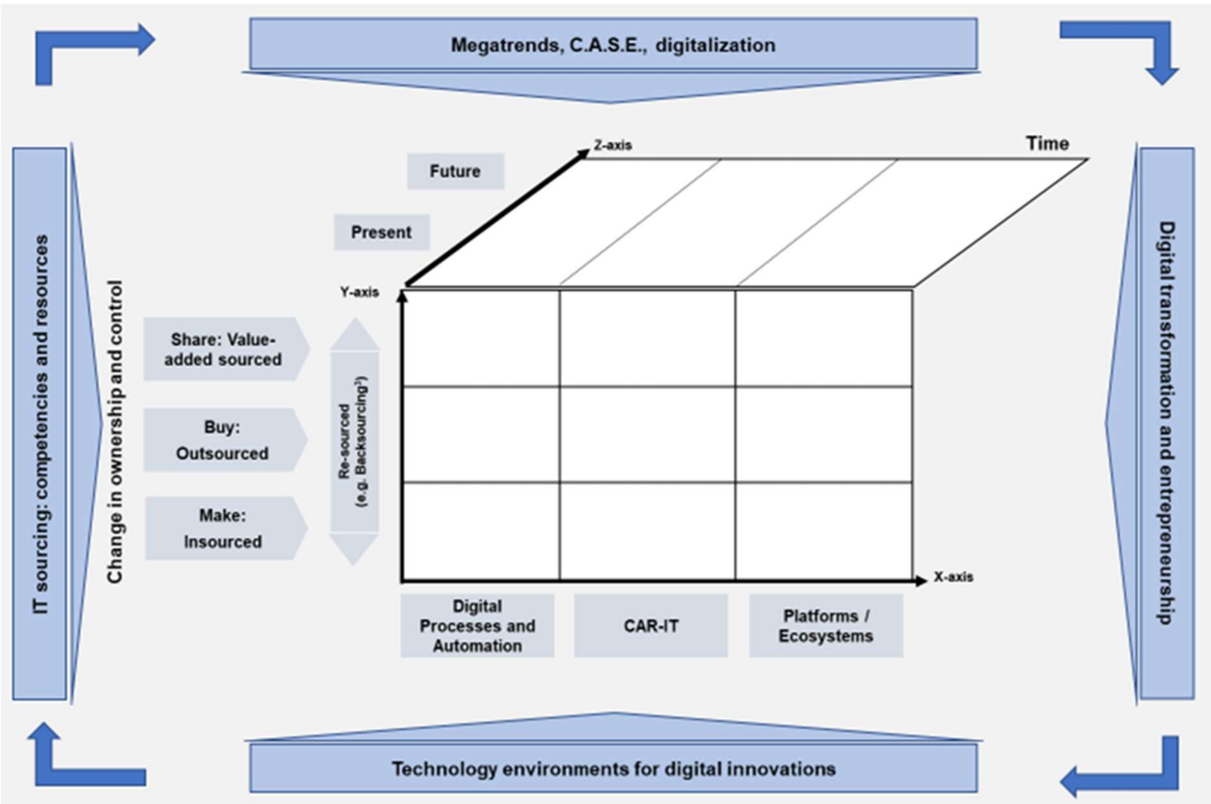
- RQ1: To what extent has digitalisation influenced the German automotive industry's strategy regarding IT sourcing?

- RQ2: What are the new entrepreneurial competencies for the successful transitioning to new IT sourcing strategies in the German automotive industry?

- RQ3: What operational model can be developed to aid practitioners in the German automotive industry in the re-assessment of their IT sourcing strategy?

Methodology

Central to the study is a preliminary conceptual framework, reflecting presumed interactions between contextual factors which, consequently, lead to evolving sourcing strategies. It starts with the assumption that digitalisation (as a representative term and trigger for megatrends and C.A.S.E.) requires a digital transformation strategy and digital entrepreneurship, with relevant core competencies and capabilities, to successfully shape the necessary digital transformation of the company. As a result of digitalisation, the entire business becomes "software-defined", spanning three technology fields: traditional corporate IT, product IT such as connected cars / Car IT, and cloud-based platforms and ecosystems. In this context, strategic decisions are necessary regarding the future optimal ratio between insourcing (in-house provision of IT services) and outsourcing.



Provisional conceptual framework

The core of the framework consists of a three-dimensional matrix. The first dimension encompasses all IT technology environments in the automotive industry. The second dimension involves a three-way classification of sourcing options and both dimensions will be applied in the third dimension to the present and the future to see how and why IT sourcing concepts are changing and evolving.

The **first dimension** of the framework **(x-axis)**, technology environments for digital innovations, is divided in three areas and encompasses the current and future scope of business.

> ***Digital processes and automation*** apply to the traditional processes of the automotive industry for the development, production and distribution of vehicles. This consists of numerous complex and highly automated and IS supported processes, which should ideally be integrated into one seamless system using state-of-the-art technologies. In this area, it is assumed the automotive industry has extensive business and IT expertise. However, digital information technologies provide additional opportunities for digital innovations and sustainable competitive advantages.
>
> ***Car-IT*** refers to digital information technologies to network the car with its environment, which allow for a step-by-step development up to fully autonomous driving. These technologies relate to three domains: the vehicle itself, consisting of the on-board network and the control units, the portal at the car manufacturer and the communication link between them.
>
> Then, based on connected cars, innovative automotive companies will be able to use ***platform*** technologies to create an ***ecosystem*** together with other actors with the aim of holding and controlling a strategic position in the new value chain of mobility services.

The **second dimension** of the framework **(y-axis),** IT sourcing, competencies and resources, is related to consideration of where and how IT must be positioned or re-positioned as a core or non-competency. Innovative companies have to consider how fast-paced technological developments go beyond traditionally existing strengths of competencies, and, in response, to address gap-closing strategies. In general, there are four options available to companies:

Make: Insourcing is seen as a company's dependence on an internal department to provide IT services. In this case it is irrelevant whether the service was previously outsourced or was provided internally from the outset.

Buy: Outsourcing is defined as handing over the management of a function, assets, people, or activity to a third party for a specified cost, time and level of service. Conversely, in this case, it is of no importance whether the outsourced function was previously located within the company or was outsourced from the outset.

Share: Value-added sourcing is also termed co-sourcing, joint equity deals, joint ventures or network partnerships. It is sometimes seen as a so-called "gap-closing alliance", to close existing resource and competency gaps in order to achieve competitive advantages that cannot be achieved individually. The term reflects alternatives to pure external and internal sourcing in order to organise complementary competencies more sensibly.

Backsourcing is defined as bringing previously outsourced activities back in-house. The term determines a change in ownership.

The **third dimension (z-axis)**, time frame, refers to the evolution of IT sourcing strategies in the German automotive industry. It addresses the established strategies and concepts, the current considerations in the digital transition phase, as well as the future mode of operation. In sum, this will also indicate the extent to which changes are required.

The value and validation of this framework will depend largely on its ability to successfully provide a rational explanation of a company's IT sourcing decisions. Therefore, it needs to be validated in a range of situations through semi-structured interviews with practitioners from the German automotive industry. A previous online survey has led to open-ended themes and questions to be further discussed in the interviews.

Semi-structured interview and areas of discussion (themes)

1. Impact of so-called "megatrends" and economic changes on IT sourcing strategies. • Megatrends o Industry 4.0, Automation, Smart Factory; o C.A.S.E. (Connectivity, Autonomous Driving, Shared & Services, Electromobility); o Digitalisation and digital transformation strategy (as representative term and trigger for megatrends and C.A.S.E.); • Changes in the industrial structure (economic cycles, competition, cost and cash preservation).
2. Key IT requirements from the Board of Directors and business lines that directly or indirectly result in changing IT sourcing strategies.
3. Most important digital technologies for digital innovations in the company. Are digital technologies seen as disruptive (leading to radical change) or just evolutionary (a continuation of new technology development)?
4. Dependencies on external resources within the three technology environments and specific digital technologies. What are the measurements to reduce the dependencies?
5. Roles and core competencies IT sourcing management must take on to enable and support innovation and digital transformation. What are the biggest differences between traditional IT sourcing processes and the elements that will contribute to a company's success in the 2020s?
6. IT sourcing as a source of sustainable competitive advantages (a firm's unique market position that enables it to earn returns above the average for the industry).
7. Current and future sourcing mix in the company.
8. Value-added sourcing as an alternative to insourcing and outsourcing. What are the main reasons?
9. Preferred models of cloud sourcing.
10. Intentions for backsourcing (change in ownership).
11. Biggest challenges to successfully support the company in managing the transformation.

Expected benefits

This research aims to assist in the development of best practice advice for IT sourcing strategies in practice in the German automotive industry. It cannot be promised that the study will help you personally but the results created might help improve how organisations manage IT sourcing. You will receive first hand results of the study in an executive summary presentation, made available to you once the study is completed. You will also get the summarised results of the prior online-survey. There are no foreseen risks associated with involvement in the study.

Your Involvement

Taking part in the research will involve talking to the researcher from the University of Gloucestershire for up to an hour, at a time and location that is convenient to you. All information will remain strictly confidential, and all names will be anonymised.

Confidentiality

The information that you provide is anonymous. The information will be stored using study numbers on a password-protected computer within a locked space. Your name will not be stored with your interview data. No information about any single individual will be made available to any other person. Only group information will be given in any reports of the study with no indication of any participant's identity. When the research is completed and reported, all data will be stored securely for a period of 10 years to allow for checking the accuracy of the information if necessary, during that period.

Results

The results of this research will be part of the doctoral thesis. The research will also be published in the form of academic papers in management journals and presented at academic conferences in order to disseminate the research findings.

Researcher and supervisors

Dr. Martin Wynn and Professor Kamal Bechkoum (University of Gloucestershire, UK) are the principal supervisors for the study who will oversee the work of the researcher. Kerstin Felser is the researcher on the project, and will be conducting the research for her doctoral thesis.

Further information

If you have any questions about this research, or require further information, please contact the study researcher at the email address indicated above. ***Thank you for your interest and participation!***

10.7 Appendix: Other Perspectives from the Interviews

In context with the car operating system, P08 raised the issue that software will be decoupled from hardware and will no longer be embedded in the ECU. This means above all to harmonise hardware with software development and a critical point for the future will be the integration of product engineering with IT. "*Above all, the automotive industry needs to re-organise the interface between software and hardware development, because these two areas use completely different methods and also have very different technology cycles.*" Modern ways of software development follow completely different rules. The focus is on a design principle that is not at all acceptable to car manufacturers: trial and error. Trial and error replace peer-to-peer evaluation. It is spontaneously considered, quickly translated conceptually, repeatedly reprogrammed, immediately tested and discarded again. The rapid and apparently sustainable market success of the digital companies, is based on this central principle: The measure of all things is the immediate utility value. This is not achieved immediately, but in iterative loops with potential or actual users of a technology. In this context, an industry culture and a collective body of knowledge that has been developed and handed down over many decades play a much smaller role: People think, plan, try things out, and then re-think and discard them. In rapid succession and with a high surplus of ideas, which are filtered less through peers and validated directly in the context of use. In this way, a practical value can emerge much faster.

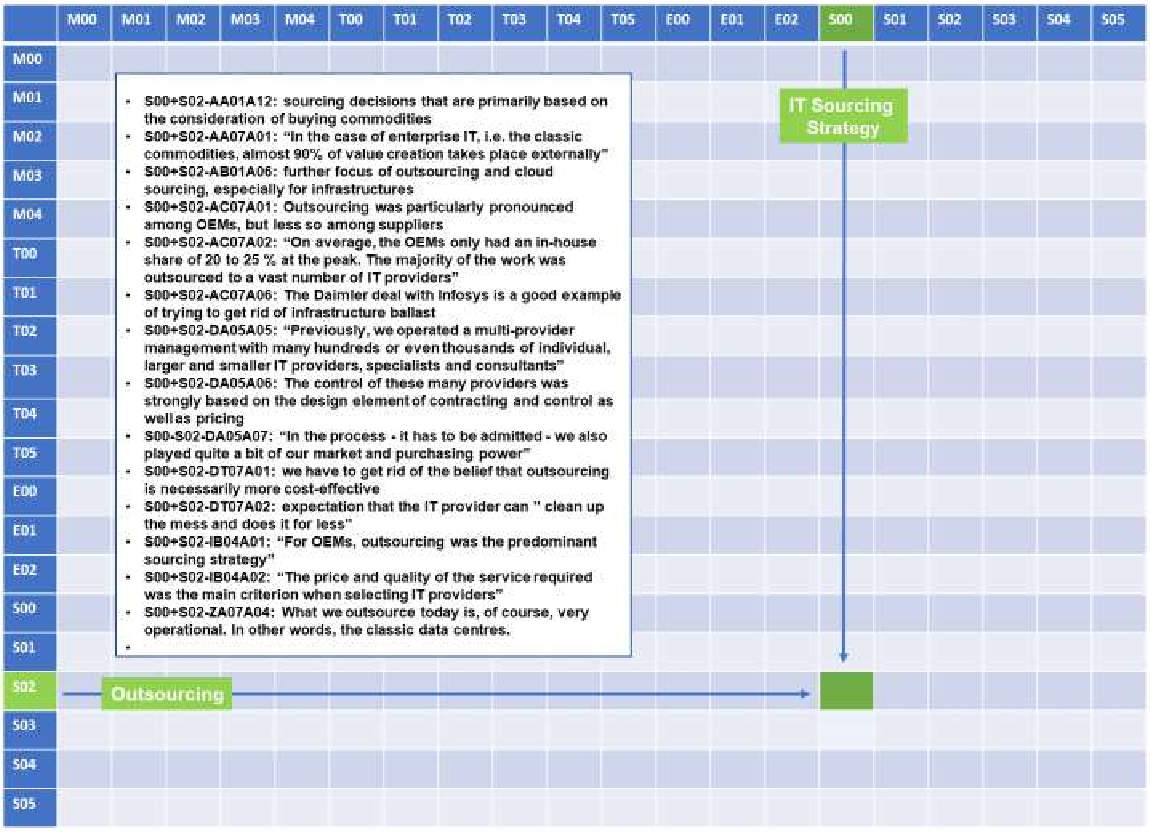
Classic hardware development has to follow a strict waterfall principle. P08 insisted "*with a computer, we are used to the fact that it sometimes hangs up and is then simply rebooted; the smartphone is quickly switched off and on again. Unthinkable for car development.*" P13 stated that a software for automated or autonomous driving consist of "*complex algorithms based on billions of kilometres are driven to make the right decisions in autonomous driving.*" The knowledge to make the right decision in every situation must be learned and transferred to the software. "*In principle, a system must be developed here that replaces the muscles, the nervous system, the senses, the brain, and the experience and innate reflexes stored in them.*" What took the evolution millions of years to achieve must now be taken over by computing power, sensors, actuators and software. Therefore, in vehicle and software development, a sequential approach has to be followed. "*You can't use trial and error and simply skip a few crash tests*" (P05). Car software has to function safely and reliably in a complex environment, independent of time and place.

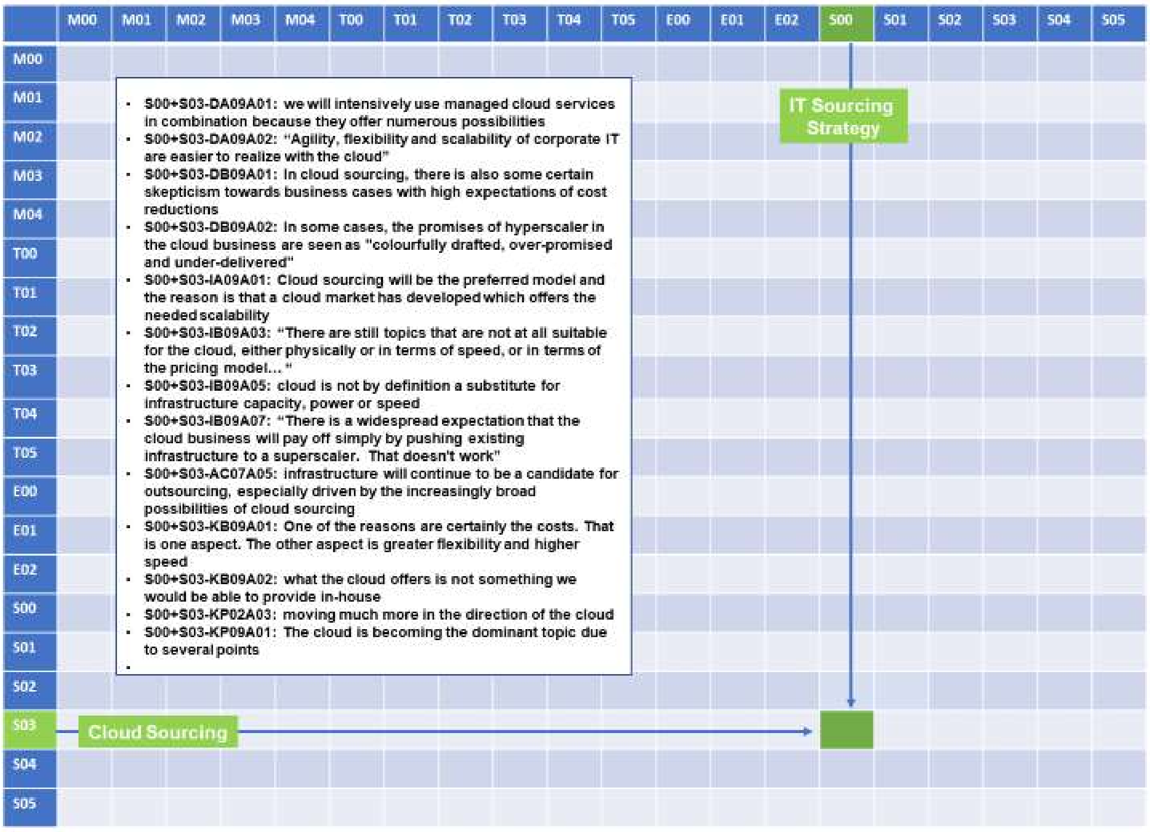
P08 raised the issue that this is now leading to the fact that IT and vehicle engineering are becoming such an inherent part of the new business models. "*A common understanding must be developed of how the different life cycles of software and hardware will look once hundreds of thousands of autonomous vehicles are driving around on the road.*" This war reinforced by P03: "*With the topic of car-IT, IT suddenly has to deal intensively with the interface to car development.*" Until now, the software in the car has not been the subject of traditional IT. And the software in the car has never been the subject of engineering IT. Engineering IT has always placed its electronics on the on-board units from the suppliers.

Interviewees also stated that the development trends of electrified, autonomous, connected and shared are leading to a significant increase in the pace of innovation in the automotive industry. Model cycles of five to eight years, which have been common in the industry up to now, are likely to soon be a phenomenon of the past. Instead, the model range will be updated annually to again reflect the latest software and hardware developments.

10.8 Appendix: Example of Excel Sheet for Data Analysis

Figure 43: Example of Excel sheet for data analysis




M00 M01 M02 M03 M04 T00 T01 T02 T03 T04 T05 E00 E01 E02 S00 S01 S02 S03 S04 S05
IT Sourcing Strategy
Cloud Sourcing
• S00+S03-DA09A01: we will intensively use managed cloud services in combination because they offer numerous possibilities
• S00+S03-DA09A02: "Agility, flexibility and scalability of corporate IT are easier to realize with the cloud"
• S00+S03-DB09A01: In cloud sourcing, there is also some certain skepticism towards business cases with high expectations of cost reductions
• S00+S03-DB09A02: In some cases, the promises of hyperscaler in the cloud business are seen as "colourfully drafted, over-promised and under-delivered"
• S00+S03-IA09A01: Cloud sourcing will be the preferred model and the reason is that a cloud market has developed which offers the needed scalability
• S00+S03-IB09A03: "There are still topics that are not at all suitable for the cloud, either physically or in terms of speed, or in terms of the pricing model…"
• S00+S03-IB09A05: cloud is not by definition a substitute for infrastructure capacity, power or speed
• S00+S03-IB09A07: "There is a widespread expectation that the cloud business will pay off simply by pushing existing infrastructure to a superscaler. That doesn't work"
• S00+S03-AC07A05: infrastructure will continue to be a candidate for outsourcing, especially driven by the increasingly broad possibilities of cloud sourcing
• S00+S03-KB09A01: One of the reasons are certainly the costs. That is one aspect. The other aspect is greater flexibility and higher speed
• S00+S03-KB09A02: what the cloud offers is not something we would be able to provide in-house
• S00+S03-KP02A03: moving much more in the direction of the cloud
• S00+S03-KP09A01: The cloud is becoming the dominant topic due to several points