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# Digitalisation and Change in the Management of IT

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**Abstract:** As digitalisation sweeps through industries, companies are having to deal with the resultant changes in business models, core processes and organisational structures. This includes the reassessment of the role of the IT department, traditionally the guardians of technology standards and providers of corporate systems and infrastructure, and their ongoing maintenance. This article investigates this dynamic in two research studies. Study 1 focuses on the German automotive industry and adopts a qualitative inductive approach based on interviews with IT practitioners to ascertain the key aspects of digitalisation impacting the industry and to chart the emergence of a new model for the management of IT. Study 2 then reviews the deployment of digital technologies in other industry sectors via questionnaire responses from senior IT professionals in eight organisations. The results suggest that the transfer of IT roles and responsibilities to business functions, evident in the German automotive industry, is being replicated in other organisations in which digital technologies are now embedded in an organisation's products or services. This article concludes with a model for cross-referencing the role of the IT function with the impact of digital technologies, representing a contribution to the growing literature on digital technology deployment in organisations.

**Keywords:** digitalisation; digital transformation; IT management; German automotive industry; new model

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## 1. Introduction

Digitalisation has brought new challenges in the development and implementation of IT strategies and raised questions about the future management of IT in organisations. In the German automotive industry, digitalisation—combined with the transition to electric vehicle production and automated driving cars—has required the industry to continuously reassess its business strategy, underpinning business models. The industry is undergoing a transformation from the traditional automotive companies into hybrid autotechnology enterprises, specialising in vehicle-related computer programs and mobility services [1].

The first research study analyses how digitalisation is impacting the German automotive industry, focusing particularly on the management of IT, and identifies an emerging model for IT management in the industry. In a second research study, questionnaire responses from IT professionals in a cross-section of other organisations were analysed to ascertain whether the changes taking place in the management of IT in the German automotive industry may be setting a precedent for what will follow in other industries, particularly where digital technologies are now embedded in the organisation's products or services.

Following this brief introduction, this article comprises five further sections. In the following section, more background is provided in combination with a brief overview of relevant literature, and three research questions are put forward. The methodology for

the two research studies is then set out and discussed, being inductive and qualitative, and largely based on feedback from interviews and questionnaires with industry practitioners. The ensuing section reports on the findings and directly addresses the research questions, setting out the model for the transitioning of the management of IT to a more devolved structure. There then follows a discussion section which reviews and assesses some of the emerging themes from the research, notably some observations on implications for the conceptualisation of digitalisation and digital transformation. Finally, the concluding section pulls together some of the key aspects of the research and sets out possibilities for subsequent research agendas that could profitably build upon the research outcomes discussed in this article.

## 2. Background and Relevant Literature

### *2.1. The German Automotive Industry*

For over a century, the German automotive industry set international standards in automobile manufacturing. German pioneers, engineers, entrepreneurs, visionary designers and highly competent and skilled workers played a major role in shaping the industry. Until the 1970s, the industry was classic "old economy", but by the 1980s, things were starting to change. Electronics started to feature in car development, for fuel injection, for example, and as electronics became more powerful, the software share in the car slowly increased. Since the beginning of the 2010s, electronics and software have dominated automobile development. Today, the German automotive industry consists of original equipment manufacturers (OEMs) and a three-tier supplier network. The German-based OEMs Volkswagen, Daimler and BMW remain among the top 10 car manufacturers worldwide according to turnover in 2023 [2].

The 2020s will be marked by a longer-term structural change. The industry is currently characterised by two disruptive and interrelated "megatrends"—decarbonisation and digitalisation. The decarbonisation of the transport sector and the associated switch to alternative drive systems or fuels is taking place in parallel with advancing digitalisation, which in combination are having a major impact on vehicle production and mobility offerings [3]. In 2016, Daimler created the acronym C.A.S.E. for the main challenges faced by the automotive industry: connectivity, autonomous driving, shared services and electric [4]. Here, C.A.S.E. is taken to be a part of digitalisation in the industry. Software for highly automated or autonomous driving and permanently internet-connected vehicles will account for a large share of the value creation of automotive mobility services in the future [5]. Software expertise is becoming a central competency of automotive companies [6]. These changes are forcing Germany's flagship industry to invest considerable resources in new knowledge, research and development.

### *2.2. Digitalisation and Digital Transformation*

The "digital technologies" are constantly being developed and evolving, but the terms SMAC (social media, mobile, analytics/big data and Cloud) and BRAID (blockchain, robotics, automation of knowledge work/artificial intelligence, internet of things and digital fabrication) are generally used as acronyms [7]. The extant literature includes a number of different perspectives and definitions of the terms "digitalisation" and "digital transformation", and they are sometimes used interchangeably. Tonder et al. [8] concluded that "there is no universally accepted, robust conceptual framework that can assist businesses, practitioners and academics to understand the constructs of digitalisation, digital transformation and business model innovation" (p. 112). Nevertheless, digitalisation is seen by some authors as the deployment of digital technologies to support improvements in existing processes, whereas digital transformation is viewed as constituting a more significant transition to a new business model or at least a new way of working in a significant part of the business. Pratt and Sparapani [9] (para. 1), for example, define digital transformation as "the incorporation of computer-based technologies into an

organization's products, processes and strategies". This is discussed and assessed with reference to a variety of environments and contexts in the extant literature [10–13].

Van Alstyne and Parker [14] also stress the significance of external factors. They associate digital transformation with the transition to what they term the "inverted firm", which involves "a change in organizational structure that affects not only the technology but also the managerial governance that attends it". They conclude that "digital transformation is about changing where value is created, and how your business model is structured. More and more, value creation comes from outside the firm not inside, and from external partners rather than internal employees" (para. 1). Ismail et al. [15] (p. 6) also note the complexity of digital transformation and conceptualised it as "the process through which companies converge multiple new digital technologies" to achieve superior business performance and competitive advantage. This would involve "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)". This suggests that digital transformation involves the deployment of digital technologies in the organisation's products or services, which will be the catalyst for changes in operations, people skilling and value networks. These perspectives resonate with the current changing environment in the German automotive industry, where the scale of change and business reinvention is such that the ownership and operation of the IT function may change significantly in the coming years.

### *2.3. The Future of the IT Function*

The roles, tasks and competencies of the IT function, and specifically that of the Chief Information Officer (CIO), are discussed in the academic literature, which reveals differing perspectives on the role of the CIO. Alt et al. [16], for example, argued that the increasing relevance of IT for an organisation would shift the strategic responsibility for IT from the CIO to the business executives, but Liebe [17] concluded that the CIO has finally become a member of the top management team, responsible for developing the IT strategy, building and maintaining the IT architecture, and ensuring the smooth operation of all IT systems. According to Gerth and Peppard [18], the lack of clarity regarding the role of the CIO is one of the main reasons why companies struggle with digital transformation, and additional positions have emerged as a result. Indeed, studies by Singh and Hess [19] and Stockhinger and Teubner [20] highlighted emerging roles for digital innovation such as Chief Technology Officer (CTO) and Chief Digital Officer (CDO), sometimes located in the business areas, outside of the IT department. Singh et al. [21] positioned 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 most appropriate when both the pressure to innovate and the complexity of an organisation are particularly high.

Some authors have addressed the possible redefinition of the IT function, largely focusing on its evolution from a centralised function to one of shared ownership across the organisation. Qin [22], for example, noted that digital transformation involves a number of trade-offs, notably the paradox of "flexibility and stability of organization structure", indicating the need to introduce greater agility in the way IT operates, whilst at the same time ensuring that strategic imperatives such as data integrity and cybersecurity are properly managed. More pointedly, Bergmann [23] (p. 370) claimed that "the IT department in the classical form is an obsolete model", and Urbach and Ahlemann [24] concluded that digital transformation would lead to fundamental changes in process, personnel and cultural aspects of organisations. The terms "IT organization" or "IT function" usually refer to a corporate IT department led by the CIO, but Schröder and Müller [25] view this more 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.

A related theme has been the growth of "shadow IT" in organisations. Kopper et al. [26] view this phenomenon as any software, hardware or IT service that may be used or developed autonomously by the business without involving the company's formal IT function. Despite the loss of transparency and the IT function's loss of control, and the associated negative connotation of the term, shadow IT may nevertheless act as a driver for user-driven innovations and process improvements [27]. In some organisations, the increase in shadow IT may result from the increased number of technically skilled employees who are able to procure or develop IT solutions themselves, combined with the increased availability of Cloud services and user-friendly software development environments [26].

In this context, this article addresses the following research questions (RQs):

RQ1. What are the key issues and challenges impacting the management of IT in the German automotive industry?

RQ2. What new model is emerging for the management of IT in the German automotive industry?

RQ3. Are other industry sectors and organisations experiencing similar changes in the management of IT?

## 3. Research Method

The overall research approach is qualitative and inductive, based on in-depth interviews with industry practitioners and questionnaire feedback. There are two distinct studies in this research (Figure 1), which are outlined below.

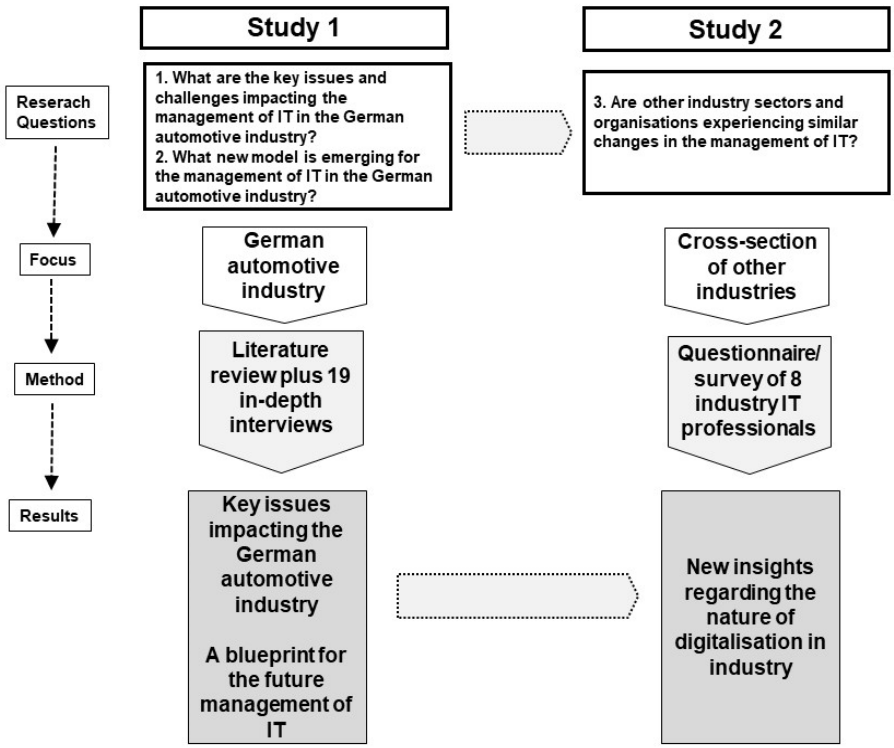


**Figure 1.** The two studies of research in the overall project.

Study 1 focused on the German automotive industry [28]. Expert interviews were the main applied methodology with the aim of acquiring a rich and deep understanding of the impacts of digitalisation on the German automotive industry to provide answers to RQ1 and RQ2. This followed an initial scoping literature search that was first undertaken as "a means of gaining an initial impression" [29] (p. 97) of relevant themes. The target

group for the semi-structured interviews in Study 1 consisted of IT executives from the German automotive industry (OEMs, suppliers and IT consultancies). 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. In total, 19 semi-structured interviews were performed between February and May 2021. (These are coded as P1–P19 in Table 1 and in the results section below). All interviewees were participants from middle or top management levels and were directly involved in the decision making in IT management, IT strategy or digitalisation projects (Table 1).

**Table 1.** Interviewees in the German automotive industry (Study 1).

| Code | Organisation Profile | Role Profile |
|---|---|---|
| P1 | OEM | IT Director Strategic Planning |
| P2 | OEM | IT Director Sourcing Strategy |
| P3 | International Consultancy | Partner Automotive Business Engagements |
| P4 | Tier-1 Supplier | CIO |
| P5 | International Consultancy | Partner Automotive Business Engagements |
| P6 | OEM | CIO |
| P7 | Tier-1 Supplier | IT Manager Strategic Planning |
| P8 | International Consultancy | Partner Automotive Business Engagements |
| P9 | Tier-1 Supplier | Chief Digital Officer |
| P10 | OEM | Director Application Development |
| P11 | Tier-1 Supplier | CIO |
| P12 | OEM | IT Manager Application Development |
| P13 | Automotive Research Consultancy | Director |
| P14 | Tier-1 Supplier | CIO |
| P15 | Tier-1 Supplier | CIO |
| P16 | Tier-1 Supplier | CIO |
| P17 | Tier-1 Supplier | Chief Digital Officer |
| P18 | OEM | IT Director Strategic Sourcing |
| P19 | OEM | CIO |

The data were analysed, coded and recorded using a spreadsheet for the development of linkages between interviewee material and the identification of emergent themes. This was an iterative process that spanned several weeks of sifting through qualitative data and identifying relevant facts and quotations from the interview transcripts. This allowed the identification of key themes relating to the impact of digitalisation and the construction of a model representing the on-going change in the management of IT in the German automotive industry. As Sandelowski [30] observed, the generation of ideas and themes is a creative process which is needed to fully appreciate the contextual meanings of the notes from the interviews. The interview findings, particularly the transition model, were validated using an online survey comprising six statements and a five-point Likert scale (ranging from strongly agree to strongly disagree) covering the main elements of the developed model, as discussed in Section 4.2 below. The survey was conducted in January 2022 when the 19 participants from the semi-structured interviews were contacted again and asked to participate in the follow-up survey. A total of 17 responses were received.

In Study 2 of this research, a questionnaire was sent to eight IT professionals employed in different organisations in May 2022 to assess the relevance and applicability of the Study 1 findings across other industries and organisations. More specifically, the objectives were first to establish the degree to which digital technologies were being deployed in other companies and second, to gain an impression of whether the transition in IT management experienced in the German automotive industry was in evidence in these

organisations. The findings were based on the information provided by these eight professionals who were known to the authors and who, it was considered, would give an honest and reliable assessment of the use of technologies in their organisations. The questionnaire replies were followed up by virtual interviews and subsequent emails, and the authors believe that the data overall provide a reliable and useful snapshot of digital technology deployment in these organisations and its impact on the management of IT. The methodology was again mainly qualitative, focusing on the details provided by respondents on the use of digital technologies in their companies and the impact on IT management. The job roles of the eight respondents (anonymised and coded C1–C8) and the outline profiles of their organisations are shown in Table 2.

**Table 2.** Cross-industry questionnaire respondents (Study 2).

| Code | Organisation Profile | Staff | Role Profile |
|---|---|---|---|
| C1 | UK SME in Product Assembly and Sales | 51 | IT Manager |
| C2 | German Multi-National Conglomerate | 160,000 | Business Process Manager |
| C3 | Global Semi-Conductor Manufacturer | 12,000 | Senior Programme Manager |
| C4 | UK Mid-Range University | 1500 | Library and Information Services Director |
| C5 | Swiss Medium-Sized Manufacturing Industry | 700 | IT Director |
| C6 | German Health Insurance Company | 7000 | Senior Business Analyst |
| C7 | German Aircraft Maintenance, Repair and Overhaul (MRO) Company | 20,000 | Senior IT Project Manager |
| C8 | UK Medical Products Group | 720 | IT Director |

## 4. Results

In this section, the three RQs set out at the end of Section 2 are addressed in Sections 4.1–4.3.

### *4.1. What Are the Key Issues and Challenges Impacting the Management of IT in the German Automotive Industry? (RQ1)*

The majority of the nineteen practitioners interviewed in Study 1 confirmed the general picture of a rapid transformation of the industry as a result of digitalisation and the associated megatrends. P9 summarised the situation as follows: "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", and P3 confirmed "that the industry recognises that the end of the previous business model with internal combustion engines is in sight". More specifically, P6 concluded "as a result of the megatrends, we have to rebuild practically the entire IT organisation". The interviewees highlighted a number of issues of particular significance in this rebuilding and transition process (Figure 2).

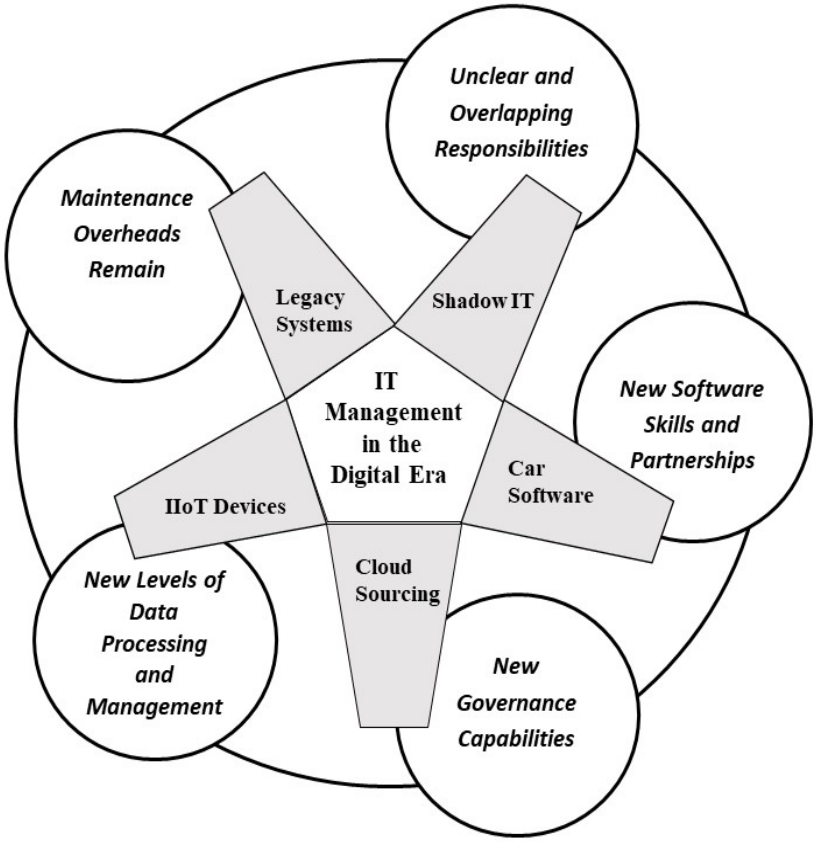


**Figure 2.** Key issues (grey) and challenges facing IT management in the German automotive industry.

#### 4.1.1. The Overhead of Legacy Systems

A typical IT department in the German automotive industry mirrors the functional organisation of the business in its management of the company's main information systems, being structured into individual sections that support the main business areas (engineering, logistics and production, marketing, etc.). As a result, a myriad of functionally oriented IT systems has been developed or provided by multiple IT suppliers, leading to heterogeneous infrastructures and legacy systems which represent a barrier to digital transformation. P9 gave examples of how one of the most important databases in the automotive industry—the bill of materials (BoM)—containing all of the geometric product descriptions is still stored and updated in several different systems. Databases are thus often inconsistent and incur high maintenance and support overheads.

Even standard software packages sometimes constitute a form of legacy. P15, for example, reported that his company had five separate instances of the SAP ERP system in operation, each one being heavily customised to the individual processes of the particular business area and no longer upgradeable. Legacy systems remain a barrier to effective Cloud sourcing and digitalisation in general. Almost all interviewees confirmed that their companies are suffering from fragmented IT systems which have been developed, amended and customised over decades and which preclude the cost-effective automation and re-engineering of business processes. Legacy systems no longer meet the latest technical standards, do not follow best practices and sometimes constitute considerable security problems, caused either by the technical deficiencies of the software or by the expiry of the software provider's support agreement. Interviewees suggested that as much as 60% of a company's total IT costs are spent on the maintenance of legacy systems.

#### 4.1.2. Car Software

Software development and deployment is now a core competency in the industry, as the car—especially in the last decade—has become a complex IT product. Software has become the centrepiece of the vehicle, and 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. P1 forecasts 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". P2 observed that "creating an autonomous vehicle is perhaps one of the automotive industry's biggest computing challenges".

One major area of development concerns software-defined vehicle architectures and the operating systems for connected vehicles. P10 stated that the focus is primarily on everything that happens around the vehicle, but that "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, automotive companies will need partners due to a lack of expertise in software development for connected cars, and thus value-adding sourcing is of particular significance. In this context, P14 confirmed that the industry has now concluded a whole series of strategic partnerships in connection with Car-IT and automated/autonomous driving.

#### 4.1.3. Industrial IoT (IIoT) Devices and Data Management

Almost all interviewees confirmed the importance of IIoT technologies in the future development of platforms for manufacturing that connect production facilities worldwide. IIoT devices, which combine a variety of digital technologies as part of Industry 4.0 (the so-called "Smart Factory"), will regulate the flow of data between plants and control all logistics for parts, procurement, production and distribution. This will entail integration with robotics and digital twin technologies, generating data for use in analytics and AI applications which facilitate the monitoring and support of production in real time. P16 reported that Siemens and Daimler are cooperating on the development of a fully digitised model factory for the Mercedes plant in Berlin-Marienfelde, which is to become a pioneer for all 30 Mercedes plants worldwide. P5 noted that IIoT combined with "digital assistance systems, data analytics, artificial intelligence and machine learning are rapidly changing the value creation processes in the industry".

P2 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 for change. P2 also noted that "put simply, IIoT collects the data and AI interprets it: everything that can be networked will be networked". However, P16 observed that the "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".

The proliferation of IIoT devices—often termed "edge computing"—means that there will be a huge number of smart endpoints in factories which operate autonomously with advanced sensor technology, computer vision and AI, and which produce and share large amounts of data. Interviewees noted two complementary characteristics of these technologies: first, Cloud-based data management and second, reliable real-time capability via edge computing with low latencies and high security. The same applies to the digital car, which is considered an edge device in the IIoT platform. 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 data about their environments will be collected as well. Several interviewees underlined the new relevance of

data for future digital business models. P11 observed that "something very important has changed in our company and in the entire industry: we are becoming data-driven".

#### 4.1.4. The Growth of Shadow IT

The interview evidence suggests that collaboration between the IT function and user departments has been suboptimal in recent years. Business areas have often acted independently of the IT function when developing or buying IT based solutions for process innovations. Shadow IT activities have emerged in the business areas, and a considerable amount of IT expenditure has been spent directly by the business lines independently of the central IT function, creating unclear or overlapping responsibilities for the management of IT.

Digitalisation has been a catalyst for further expansion of shadow IT, with the emergence of new organisational units and roles outside of the IT function—incubators, innovation labs, design labs, new business functions for Car-IT and digital factories, plus the new roles of CDO and CTO which are sometimes within the IT function and sometimes outside of it. Examples of shadow IT were evident in many of the interviewees' companies—workflow applications, Excel spreadsheets, special Cloud services or even self-programmed complex applications, including databases, as well as the use of open-source applications. Large standard integrated software packages such as SAP are normally supported by the central IT function, but shadow IT applications such as end-user databases have often been developed around these systems because the individual departments and users are dissatisfied with the standardised reports from the centrally maintained systems. Shadow IT is particularly evident in product development, with special software for mathematical calculations, and in sales and marketing, where business intelligence software has been acquired and deployed independently from the central IT function. In this context, P4 observed that "digitalisation teams have been placed in the company, not just in IT; these teams are organisationally very close to the Board, but work quite separately from IT". All of these initiatives have the aim of accelerating the development and adoption of digital innovations, working largely outside of the existing bureaucratic organisational structures and operating independently of, and usually not coordinated with, formal IT strategies and policies. The overall control of policies and standards by the central IT function is now in danger of being seriously undermined in practice by the emergence and development of shadow IT units. P8 concluded that there was a "disconnect between IT and Industrial Internet of Things devices, because most of these Internet-of-Things devices are completely decoupled from classic IT".

#### 4.1.5. Cloud and Sourcing Strategy Issues

Based on an analysis of the IT budgets of the OEMs in the study, the ratio of insourcing to outsourcing has evolved over the last two decades in the industry to be, on average, 20 to 25 percent insourcing and 75 to 80 percent outsourcing. There are some contrasting trends within this general picture. On the one hand, interviewees confirmed that the intention is to strengthen in-house software development, especially for Car-IT and in applications that are directly visible and tangible to the customer. New partner, contract and supplier relationships are emerging with specialised software companies for the codevelopment of car operating systems or the networking of factories with IIoT technologies. On the other hand, commodities such as infrastructure will continue to be candidates for outsourcing, driven by the increasingly broad possibilities of Cloud sourcing. Companies no longer want to devote resources to running their own data centres. P13 cited the outsourcing of Daimler's entire IT infrastructure to Infosys, for which both companies have announced a long-term strategic partnership, with strategic benefits for both parties: Daimler will expand its IT expertise, focusing on more mission-critical technologies, and Infosys will further strengthen its automotive industry knowledge and expertise [31].

The perceived benefits of Cloud sourcing include the resulting elasticity and scalability of service provision, and most companies confirmed that they are adopting a multi-

Cloud policy. P07 stated that "the Cloud is our most important backbone for digitalisation of our business. First and foremost, because of the scalability of services". Nevertheless, interviewees noted a number of problematic issues as regards Cloud sourcing. P13 stated that "hyperscaler offerings vary widely, making it difficult to move from one Cloud to another" and noted that "there is a lack of standards in the multi-Cloud world", maintaining that systems run one way on platform A and quite differently on platform B. The Cloud providers may have world-class development platforms, but the interoperability between their Clouds is poor. P13 concluded that "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". As part of corporate governance, companies are required to have mechanisms in place so that they can move data back and forth between different Cloud environments with minimal effort or additional costs. P13 questioned, however, "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".

P8 and P10 noted that a common misunderstanding is that unlimited resources are available within the Cloud. This can lead to uncontrolled and expensive growth in the consumption of Cloud resources. A highly competent central unit is needed that reviews cross-company requirements, serves them quickly, automates them and has Cloud governance capabilities to monitor consumption. Without this, the Cloud can become a huge cost trap when everyone in the company is free to approach and engage the provider of their choice.

### *4.2. What New Model Is Emerging for the Management of IT in the German Automotive Industry? (RQ2)*

The issues discussed above illustrate the tensions in the German automotive industry that are leading to the reallocation of responsibilities in the management of IT. P17 insisted that the IT function must move closer to the business, noting that "we are firmly convinced that the current organisational model for digitalised IT must change to a decentralised or federal IT", and P4 observed that "in the context of digital transformation, the Board must become aware that a new interaction between business and IT is necessary. Today's divides between business and IT must disappear". P17 concluded that IT solutions must "satisfy the customer 100% functionally and solve 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". The interviews evidenced the emergence of a new model for the management of IT involving the controlled transfer of IT roles and responsibilities into the business lines, and the emergence of two separate functions: "Business IT"—represented by IT Competence Centres in major business lines—and "Corporate IT", which remains as the guardian of many cross-company standards and associated roles and responsibilities (Figure 3).

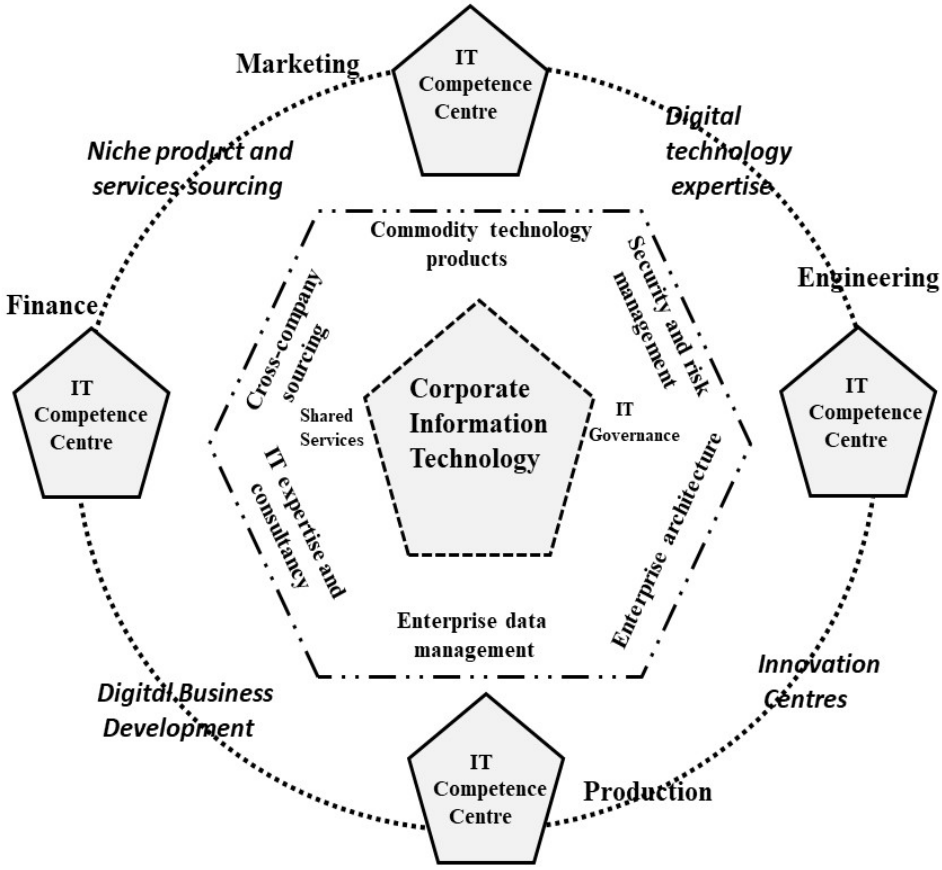


**Figure 3.** New model for the management of IT in the German automotive industry.

4.2.1. Business Line IT Competence Centres (Business IT)

The redistribution of IT management gives the business functions greater autonomy to develop digital products and services. The model is based on establishing an IT Competence Centre in each business line or core process area in which digital technologies are actively deployed. This will apply to nearly all business lines, in which IT-specific competencies relating to digital technologies will be required and where the focus is on digital innovations that are competition-differentiating. P17 envisioned this as creating "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". This would give the business lines full responsibility for the creation of digital products and services. They would have ownership of their business requirements as well as the IT technologies and projects necessary for their implementation. This allows more flexibility in accelerating the development and adoption of digital innovations. Although a high level of domain-specific knowledge is required, there is usually only minimal interaction with other business areas, and thus business lines can act more or less autonomously. Complex and costly coordination processes and lengthy development cycles can be minimised or eradicated altogether.

Business-embedded IT management will need new capabilities, including provider networking skills and an aptitude for taking responsibility for IT-related matters. Strong leadership in IT sourcing is required to attract the appropriate partners from among the powerful technology companies and the promising start-ups. The development of multi-layered relationships with partners from the industrial automation and software technology sectors will require the capabilities to negotiate contracts with previously unaccustomed partners, to prevent vendor lock-in and to maintain the independence of the automotive companies. Due to the strategic importance of these collaborations, they will be

made by the senior executives in the business lines and require the cooperation of many employees from both the automotive company and its development partners to develop joint solutions. In this scenario, the business function is the digital innovator which implements the innovation projects with its experts and collaborates with the IT providers, and the business management decide which partner networks to work with.

#### 4.2.2. Corporate IT

Corporate IT remains the provider of services with a high synergy across IT business functions and is responsible for the management of a range of corporate governance functions. Shared Service Centres will offer the business functions commodity IT services that are not competition-differentiating but are nevertheless necessary for business operations. Corporate IT can provide these services more effectively and cost-efficiently than if they were devolved to the business functions. These services may be provided internally or by external service providers, but migrating these services to the Cloud is likely to be the norm and is already well underway in some of the companies studied. This includes the maintenance of all standard software products, notably the ERP modules, computer workstations with group-wide office software, networks, data centres and general service management functions such as incident management. However, certain services may be managed entirely in-house for strategic or other reasons. Sourcing partners will include the traditional IT providers who are engaged in the provision and maintenance of old legacy systems, as well as most of the standard software packages, and the operation of supporting infrastructures.

The Shared Service Centres will also offer specific IT expertise that can be used by the business functions, acting as an internal consultant to provide support on a range of IT issues. Interviewees P9 and P17 highlighted the importance of technology radar and supplier radar services as roles that the Corporate IT function should fulfil. The technology radar will investigate and assess new technologies under development, identifying where in the company they may be effectively implemented and how they fit into the overall IT architecture of the company. The supplier radar provides a scouting service, having a global overview of mission critical IT resources. It assesses the reliability and risk profile of IT providers and determines for which competitors these companies currently work and how these resources can be best utilised.

IT-related governance functions remain in Corporate IT, with the overall aim of ensuring that all IT-related processes adhere to a coherent approach and are handled consistently for reasons of compliance. P8 suggested that the IT function should "always be the overall architect of the IT technologies and not allow an infrastructure circus via the many different providers", whilst P18 asserted that "a very critical issue is governance—this is taking on a whole new significance". Corporate IT has the responsibility for the overall enterprise architecture management (EAM), which aims to introduce standardisation initiatives and advanced architecture concepts that should improve systems integration and efficacy. This is clearly problematic when core data and information are stored in legacy systems that are often run and supported by third party, Cloud-based, entities. These issues have barely been addressed to date in the German automotive industry, and current IT architectures are often unsuitable for agile digital transformation projects.

Ownership of the enterprise data model (EDM) will also reside in Corporate IT, which will need to accommodate a range of Cloud-based data sources, sometimes termed data lakes, which need to adhere to the EDM. This may again be problematic and require regular review and update of the EDM and careful monitoring of the use of external data sources by the business functions. Corporate IT also has the overall responsibility for IT security, cybersecurity and data protection. Recruiting a workforce with the requisite skills and know-how and training the existing workforce to be resilient in the face of cyberattacks are current challenges. Interviewees reported that the appointment of a Chief Information Security Officer (CISO) is being discussed in some companies to take charge

of these issues. Cars will be much more connected in the future, based on 5G networks, and new and different cybersecurity risks will arise that need to be addressed.

#### 4.2.3. Model Validation and Summary

To validate the model discussed above, the 19 interviewees were sent six survey statements, along with a summary report of the results of the interviews. The summary statements (Table 3) focused mainly on the new model. Interviewees were asked to assess the six statements in terms of their agreement or disagreement, and they were also asked to comment as and when appropriate, particularly if they disagreed with a statement. In general, all participants were positive about the statements, and the majority of participants considered that the model represented the future direction for IT management in the automotive industry.

**Table 3.** Model validation statements: interviewee assessment. (SA: strongly agree; A: agree; U: undecided; D: disagree; SD: strongly disagree).

| Validation Statements | Interviewee Assessment | | | | |
|---|---|---|---|---|---|
| 1. Digital technology development and application will become the core competency of the German automotive industry. | SA | A | U | D | SD |
| | **13** | **4** | | | |
| 2. 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. | SA | A | U | D | SD |
| | **8** | **9** | | | |
| 3. 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. | SA | A | U | D | SD |
| | **5** | **9** | | **3** | |
| 4. 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. | SA | A | U | D | SD |
| | **6** | **9** | **1** | **1** | |
| 5. 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. | SA | A | U | D | SD |
| | **8** | **7** | **2** | | |
| 6. 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. | SA | A | U | D | SD |
| | **8** | **8** | **1** | | |

However, there was some disagreement with statements 3 and 4, and some ambivalence as regards statement 5 (Table 3). Concerning statements 3 and 5, some participants reported that their companies are tending to move towards the model, but that clear conclusions and executive decisions have yet to be made. P03 and P12 reported that there is a reluctance to create new management positions, and interim solutions are thus likely, whereby the CIO also acts as the head of engineering IT. P16 pointed out that although some software resources are now managed in the business functions, the organisation of interfaces to the backend systems remains with central IT. P16 pointed out that 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". Another perspective was put forward by P15, who reaffirmed the strict governance function for Corporate IT but suggested that in contrast to the blueprint model, IT would have to take on more business functions, arguing for a fusion of HR and IT as the future organisational entity responsible for managing the human workforce, robotics and AI. This highlights the likely future disruptive influence of AI and its potential impact on company structures and management. Notwithstanding

these viewpoints, the majority of respondents supported the model as representative of the transition currently underway in the industry.

Indeed, the new model for IT management is already being implemented in some automotive companies. Budget responsibility for IT projects and services is being transferred to business functions, and business process owners increasingly control the applications to be developed and the services to be delivered. Rather than emphasising the separation of business and IT, however, the model allows for distributed leadership with improved managerial processes for IT value creation. The previous orientation of the central IT function as the body responsible for all IT-related systems and services is being replaced by a clearer role for Corporate IT as the provider of shared services and IT governance. This will allow shadow IT to be formally recognised and embedded as a core function of the business which empowers business lines to develop or attain all of the IT competencies that they need for their value creation. 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 the required flexibility on the other, as strong formal IT governance practices may moderate or reduce the speed of digital transformation in the business lines. As concluded by Hsu et al. [32] (pp. 3–4), in the context of digitalisation, "the transformation of IT departments should be considered part of a broader process of organizational transformation", and it should be noted that "the transformation process is complex, chaotic, and dynamic, and may thus fashion a new form of cross-functional department".

### *4.3. Are Other Industry Sectors and Organisations Experiencing Similar Changes in the Management of IT? (RQ3)*

In Study 2 of this research, eight organisations of varying sizes and from a range of sectors (Table 2) were contacted to ascertain to what extent digital technologies were deployed in the organisation and to gain an impression of the impact of digitalisation on the management of IT.

#### 4.3.1. Digital Technology Deployment

Questionnaire responses indicated the wide adoption of the SMAC and BRAID technologies across the eight organisations (Table 4). Social Media was used in all eight organisations for a range of purposes mainly linked to marketing, recruitment and communications. For example, the IT director at C5 noted "marketing and global presence" as the main purpose of social media, whilst at C7, an aircraft maintenance, repair and overhaul (MRO) company, it was used for "image films and job offers within platforms like Facebook and Instagram".

Mobile computing is also deployed in all of these organisations for a range of purposes mainly related to field operations, data input for transaction processing, and at the mid-range university (C4), "student engagement apps". At the aircraft MRO business, the technology was used for "mobile teams at the customer for repair processes of aircraft engines". Cloud was widely used for accessing systems and for data storage. At C4, they had "some hosted SaaS" applications, whilst C7 noted that "data are stored in the Cloud for maintenance, repair and overhaul operations within a digital platform". C2 had a "Cloud only approach" as part of its future IT strategy, whilst C8 were "migrating to Microsoft 365 during 2022", but "Environmental, Health and Safety, HR [human resources], and CRM [customer relationship management] systems" were already Cloud-based. At C1, "Email and Intune" were accessed via the Cloud, and the company had a "plan to migrate further services to the Cloud in 2022–2023".

**Table 4.** Digital technology deployment (Study 2 organisations).

| Digital Technology/Organisation | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Social Media | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Mobile Computing/Apps | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 |
| Analytics and Big Data | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 7 |
| Cloud Computing | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 |
| Blockchain | | Yes | | | | | Yes | | 2 |
| Robotics | | Yes | Yes | | Yes | Yes | Yes | | 5 |
| Artificial Intelligence/Knowledge Work Automation | Yes | Yes | Yes | | Yes | Yes | Yes | | 6 |
| Internet of Things | | Yes | Yes | Yes | Yes | Yes | Yes | | 6 |
| Digital Fabrication/Digital Twin/3-D Printing | | Yes | Yes | | Yes | | Yes | Yes | 5 |
| Total used by organisation | 4 | 9 | 8 | 5 | 8 | 7 | 9 | 5 | |

Analytics and big data were used in all organisations with the exception of C1—a UK small to medium-sized enterprise (SME) which assembles, sells and markets equipment for the elderly and disabled. Digital technologies were used in support of the core business processes of these organisations and included "algorithms, forecasts, [and] cancellation predictions" (C6), "air quality measurements from over 100,000 devices" (C5) and "analysis of turbine spare parts" (C7). AI tools were used by six of the organisations, again for a similar range of applications, including the "reduction of deviations during production" (C3), analysis of the hospitalisation rate of clients (C6) and "automated paper documentation filing and route planning" (C1). IoT is also used in six of the organisations. In the aircraft MRO company (C7), IoT "digitizes product development and design processes", and "the platform supports facility monitoring, automation and data-driven decision making". At the semi-conductor manufacturer (C3), IoT has been deployed for "production automation and control" for the past 10 years, and at the university (C4), "building management IoT sensors" are deployed.

Five organisations are using robotics. At the aircraft MRO company (C7), it is "for maintenance, completions, repair, and overhaul of airplane parts", and at manufacturers C3 and C5, "for material transfer and storage" and "process automation in manufacturing", respectively. At the health insurance company C6, a somewhat different application is evidenced, with robotics being used for "case management and payment of dental bills". Digital fabrication/digital twin feature at the manufacturing companies is used for "R&D prototyping" (C5), "smart factory based in the Cloud" (C2) and "engineering prototypes of applicators for surgical glue and sealant products" (C8). Only the two largest companies are deploying blockchain. At the international conglomerate C2, blockchain is used for "logistics, pallet and container management", whilst at the aircraft MRO company (C7), the respondent noted that "blockchain technology makes the supply chain of aircraft components seamlessly and transparently documentable". In summary, these findings suggest that all organisations are engaged in digital technology deployment, and that in some, this has been accompanied by significant changes in business processes and procedures.

#### 4.3.2. The Impact of Digitalisation on the Management of IT

Respondents were asked about the impact of digitalisation on the management of IT in their organisation and were offered four choices, as set out in Table 5. In four of the eight organisations, the IT respondent confirmed that digitalisation had been the catalyst for a major change in how the organisation operates, with the business lines now owning large elements of IT strategy development and implementation. Of these four organisations, three are in the manufacturing sector and the fourth is a health insurance company. The IT director at the Swiss manufacturing company (C5) saw this reallocation of responsibilities as the best way "to be early adopters of new technologies that lead us against our competitors in a global market. We want to use as many Cloud services as possible according to our global IT architecture and security policies, especially for our air quality

data". At the aircraft MRO company (C7), the respondent noted that "a new business area—Digital Fleet Solutions—was founded in 2017 to promote digitisation", and that this was the catalyst for a change in the management of IT. At the healthcare insurance company (C6), the respondent highlighted the growing significance of robotic process automation for a range of activities across the company as the main driver of change in the ownership of IT.

**Table 5.** Impact of digitalisation on the management of IT (Study 2 organisations).

| Impact of Digitalisation on the Management of IT | Interviewee |
|---|---|
| **No major impact**—these technologies have been assessed and planned for, like all other IT technologies and systems. | C8 |
| Digitalisation has required **a significant re-think of strategy**, involving new external IT partners and providers, greater involvement of user functions in the planning and implementation of strategy, and a major re-skilling of IT and user staff. | C4 |
| Digitalisation has been the catalyst for **a major change in how the organisation operates**, with user functions now owning large elements of IT strategy development and implementation. | C2 C5 C6 C7 |
| Another perspective. | C1 C3 |

In contrast, the IT director at the medical products company (C8) considered that digitalisation has had no major impact on the ownership of IT, noting that "digital technologies are deployed to fulfil a need which is driven by the business. IT is an enabler and supporter for the requirements, rather than a driver". However, the IT director at the mid-range university (C4) considered that digitalisation has required a significant re-think of strategy (rather than a wider change in how the organisation operates) and observed that "the university increasingly depends on digital solutions to operate the business, to deliver high quality teaching and learning, and to support excellent research", and that "IT systems are now considered one of the key pillars to enable successful delivery of the organisation's strategy, alongside people, finance, estates and governance".

Two companies offered alternative views on how the management of IT has been impacted by digitalisation. At the UK SME (C1), the IT manager highlighted the impact of COVID-19 and a subsequent cyberattack as key issues that have prevented any serious consideration of changing responsibilities for IT management. He concluded that "digitalisation as a concept has been utilised to fight COVID-19, but existing plans were, and continue to be, disrupted". A similar picture was in evidence at the semi-conductor company, where the IT department "struggle with hidden IT solutions and other legacy tools which are still critical for production. Hence, the IT strategy is still rather conservative". At these two companies, digitalisation does not appear to have had any major impact on how IT is managed to date.

## 5. Discussion

The results derived from Studies 1 and 2 of this research raise some issues worthy of further discussion. Firstly, as regards the German automotive industry, there is a significant knowledge deficit as regards what is required for successful transitioning to a new model of IT management. In the Corporate IT function, new skillsets and capabilities will be required in establishing their revised role as part of company-wide digitalisation, being less concerned with resource management but acting more as a guardian of company-wide governance functions. Corporate IT need to proactively manage and navigate the transition process of shifting roles, competencies and responsibilities to the Business IT Competence Centres. Changes in sourcing management, which involve mutual dependencies and relationships between the IT organisation and the business functions, will need careful management to ensure a balanced transformation process. Another key challenge

requiring new skills will be to design and implement an alignment structure for corporate governance, which is particularly important since all partners will be pursuing their individual business agendas. P13 stressed that in the future, IT executives must be better able to communicate the value of digital technologies for the future of the organisation. They must have the appropriate vision and be able to articulate it in the context of the digital transformation of the company.

Secondly, there are clearly risks involved in such a transition. Despite the problems with multiple versions of mainstream ERP packages evidenced in the interviews, many companies—within the automotive sector and outside of it—have achieved hard-won standardisation and consolidation of IT applications and infrastructures since the turn of the century, which may now be threatened by the new autonomy of the business functions. The re-distribution of IT tasks and responsibilities could complicate and delay compliance with new corporate standards for digital technology deployment, which may result in suboptimal technology implementation and a higher cost of ownership. Standards and structures for data integration and adherence to the EDM must be agreed so that different technologies can communicate with each other and have access to common databases. Another dynamic that needs careful management is the fast pace of technology evolution—what are currently seen as competition-differentiating technologies will become commoditised in the future and will then be managed by Corporate IT.

Thirdly, the model developed in this research is more specific than the existing literature (e.g., Urbach and Ahlemann [24]; Schröder and Müller [25]) as regards the reallocation of IT roles and responsibilities, and although it was developed from interview evidence from the German automotive industry, the findings from the eight organisations interviewed in Study 2 suggest that this may be a blueprint that some other industries will adopt. Ismail et al. [15] noted that digital transformation will likely involve the introduction of new digitally enabled products or services, and evidence from Study 2 of this research suggests that this is a key driver of the transition to greater user ownership of IT. In the four organisations in which there was perceived to be a major change in IT ownership, with user functions now taking responsibility for large elements of IT strategy development and implementation, digital technologies have already had a major impact on and were integral to the organisations' products or services. At company C2, a multi-national manufacturing conglomerate, digital technologies were already used and integrated within the company's products. At C7, the aircraft MRO company, digital technologies—notably analytics, AI, mobile and robotics—were embedded in their replacement products and in their services. Indeed, the respondent noted that the company's main strategic objective was now to pursue "mobile solutions and digitalisation". These two companies—the two largest of the eight studied—were the only two where all nine of the listed technologies were deployed. At C5—a manufacturer of air purification systems—digital technologies were integral to their products and services, including the use of IoT and analytics for air quality measurement devices, AI for air quality predictions and forecasts, mobile computing in the company's AirQuality app, and robotics for process automation in manufacturing. At the health insurance company (C6), robotics were used in many areas of the company for customer service enhancement and support. So, here in this latter case, it was the service-oriented processes of the company, and notably the interface with the customer, rather than its products, in which digital technologies were embedded. In these four organisations, the management of IT has already changed and moved towards the business user functions. In the other four organisations, although digital technologies are reasonably widely deployed, there is little direct impact on their products and services, and the ownership of IT remains largely in the central IT function.

Fourthly, these results contribute to the development of theory regarding digitalisation, digital transformation and IT strategy. Hitherto, models of information technology adoption and strategy development have often had three main elements, relating to the technology itself, business processes—which are often re-engineered as a result of technology implementation (sometimes combined with organisational or structural change)—

and people skills and competencies, which are impacted both by the new technologies and the resultant changes in working practices [33–35]. The main impact of digitalisation has been on the processes of an organisation, with expected benefits centring on greater efficiencies, lower costs and better customer service (Figure 4). Process owners are often identified within the ranks of business line management to oversee process change, and data ownership and maintenance have also been in the main moved out of the IT function into end-user departments.

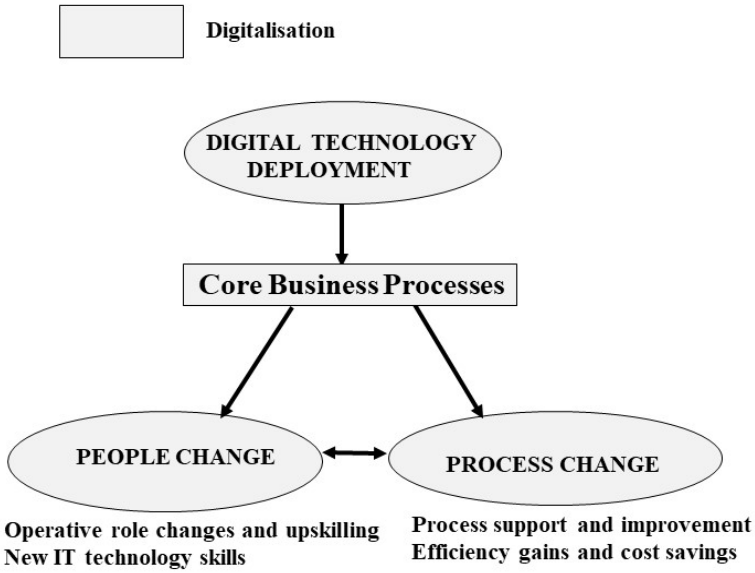


**Figure 4.** Digitalisation: process support and improvement.

With digital transformation, a key difference is the deployment of digital technologies within the products or services offered by the organisation. When this happens, digitalisation becomes digital transformation, sparking significant additional change in business processes and people competencies that may in some cases constitute the transitioning to a new business model (Figure 5). The management of IT is part of this intensified change process; the more that digital technologies are deployed in the company's products or services, the greater will be the transition of IT roles and responsibilities out of central IT and into the business lines. Technology ownership will be added to process and data ownership as business line management roles, as evidenced in the Business Line Competency Centres discussed above in the context of the German automotive industry.

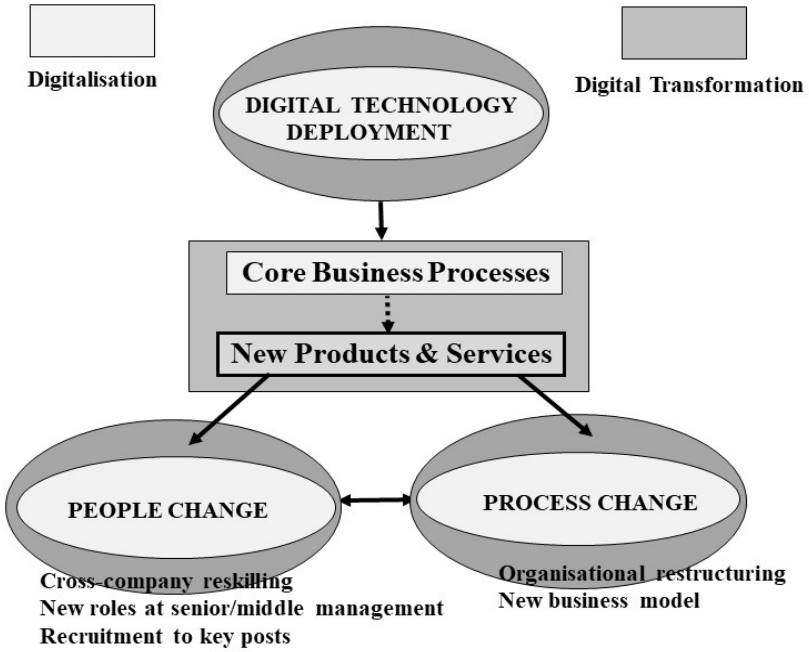


**Figure 5.** Digital transformation: digital technologies are used in company products or services.

The evolution of the IT function will thus depend somewhat on how the deployment of digital technologies impacts the organisation. If digital technologies are embedded in the organisation's products or services, then the pull factor from business departments to take ownership of traditional IT roles and responsibilities will develop and grow. The IT function is well placed to coordinate this transition and provide leadership on its remaining core functions of shared services and IT governance. If, however, digital technologies are mainly used to facilitate and support existing business practices and procedures, without any significant process re-engineering, then the IT function is likely to remain largely "as-is" in a centralised IT department.

The eight organisations in Study 2 of this research provide some useful illustrations of this difference (Figure 6). At one extreme, C1 is a conservative SME, having had a steady turnover and headcount over the past 5 years, using—as regards digital technologies—social media, mobile apps and cloud, plus some AI developments for route planning and document filing. There is no significant use of these technologies in the company's customer services process or in its products, which are largely bought in and assembled. The pull factor from user departments to take ownership of IT issues is non-existent. At the other extreme, C2 is a multi-national conglomerate, well advanced in its use of digital technologies to support customer-facing processes and engaging in smart factory operations based in the Cloud. Here, IT roles and responsibilities have moved into the user functions, with a more focused centralised IT unit managing corporate IT governance, cybersecurity, ethics, technology re-skilling, corporate data architecture, process improvement and commodity services [36]. If there is a strong pull factor from end-user departments, often evidenced by growing shadow IT activity, then the IT function can enhance their value by facilitating and supporting the transition in the management of IT. To contest it may risk fracturing the relationship between business and IT. Of the companies investigated in Study 2, most companies are moving towards a digital enterprise in a balanced manner, with only C3, the semi-conductor manufacturer, possibly at risk of unwarranted overcentralisation of roles and responsibilities in the face of increasingly rapid digitalisation.

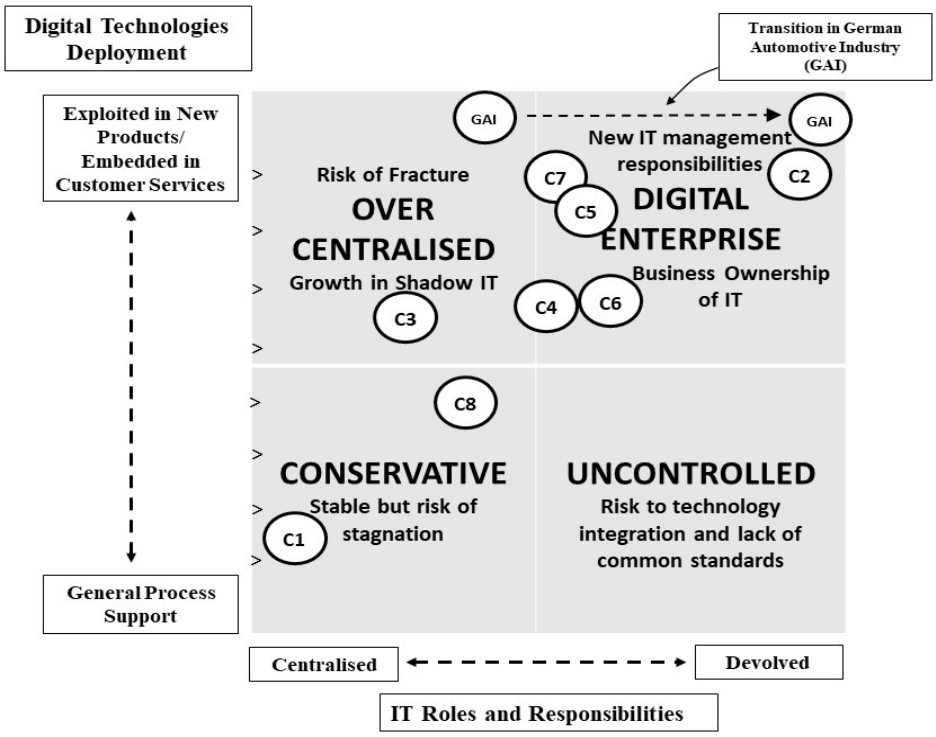


**Figure 6.** IT management profiles of the eight Study 2 organisations.

## 6. Conclusions

Digitalisation in the German automotive industry has produced new technology environments that will be central to determining the future business success of the industry. The requirement for digital innovations and IT solutions goes far beyond the traditional strengths and competencies of the automotive industry. Automotive companies have to decide how to re-position their core competencies within the transition from a product-centric business model to a software-enabled car company and mobility services provider. This will entail a major change in the manner in which IT, and digital technology utilisation in particular, is managed within these companies. Away from the automobile sector, other organisations are undergoing parallel changes, albeit largely at a lesser pace in most instances. Only where an organisation's products or processes have become intertwined with digital technology deployment will the transition of IT roles and responsibilities match that of the German automotive industry. Figure 6 provides a matrix in which practitioners can assess their current position and assess strategic options for transitioning to a new form of IT management as the organisation moves towards a digital enterprise (as depicted in Figure 3).

There are clearly limitations to this study. Study 1 findings were based on interviews with expert practitioners in the German automotive industry. Most other automotive industries worldwide (with the exception of the TESLA company) are subject to the same change dynamics, and it seems reasonable to generalise about the automotive industry as regards the change in the management of IT. Beyond this industry sector, evidence from the questionnaires completed by IT professionals in Study 2 provides a snapshot of the situation in some other sectors. However, the number of questionnaire returns was limited to just eight, and just one from each organisation, and this makes wider generalisation inappropriate. Nevertheless, the findings suggest that the model for the future management of IT in the German automotive industry will likely be relevant to those organisations where digital technologies are an essential part of the product or are directly and deeply involved in the value creation process, notably in the provision of services at the customer interface (e.g., by the use of chatbots and AI). This reallocation of IT roles and

responsibilities can be seen as one element of digital transformation that entails a wider set of transitions in the process and people dimensions of digital technology deployment.

This points to some possible avenues for future investigation. Further research into industries where digital technologies are now embedded in company products or services could assess if the transition in the management of IT, reported upon here, is in evidence and provide the basis for review and refinement of the model developed here. This would allow further assessment of the significance of the deployment of digital technologies within the product or services of an organisation as the catalyst for digital transformation. The role of specific digital technologies could also be identified and researched to determine which of the SMAC and BRAID technologies, if any, play the leading role in sparking digital transformation and how this may differ in different industry sectors or business environments. Collectively, such initiatives could help develop the fledgling theoretical strands associated with digitalisation and digital transformation.

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