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Digitalization and Corporate Social Responsibility: A Case Study of the Moroccan Auto Insurance Sector

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Abstract: The aim of this article is to explore the impact of digitalization on corporate social responsibility (CSR) in the automobile insurance sector in Morocco. This article first explores the theoretical and conceptual foundations of digital transformation and CSR. A mixed methods approach is then used, combining qualitative interviews with a wider quantitative survey, to investigate how digital innovations influence CSR practices. Interview analysis provides the basis for the development of a conceptual framework and eight hypotheses, which are then tested using quantitative techniques to analyze survey data. The results reveal several links between the benefits of digitalization and CSR. Claims management platforms, digital roadside assistance tools, and digital vehicle assessment and inspection all positively impact policyholders' well-being in terms of compensation and asset preservation, thereby enhancing the CSR profile of automobile insurers. Similarly, augmented reality (AR) and virtual reality (VR) training and simulation, as well as repair assistance, have positive impacts on policyholders' well-being and advance the CSR positioning of automobile insurers. This article has limitations as it is based on a narrow industrial sector in a single country, but it nonetheless highlights certain relevant interrelationships between digitalization and CSR, contributing to the development of theory and practice in these research areas.

Keywords: digitalization; corporate social responsibility; CSR; automobile insurance sector; claims management; digital technologies

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1. Introduction

There is no universally agreed upon definition of digitalization, but here it is taken to mean the integration of digital technologies into organizational processes to transform data, automate operations, and improve efficiency. This aligns with the definition put forward by SAP (2024), which states that digitalization occurs "when data from throughout the organization and its assets is processed through advanced digital technologies, which leads to fundamental changes in business processes" (para. 9). This has brought well-documented benefits to various industries, including logistics (Richert and Dudek 2023), finance (Pangalos 2023), and many aspects of manufacturing (Wynn 2021). In the financial sector, insurance companies have not been excluded from the impacts of digitalization, as practices and operational processes have been re-engineered. The industry is built around collecting, processing, and analyzing data on economic activity, relying on the prediction of future events to ensure appropriate decision-making (Ciarli et al. 2021). This approach is based on an ethical code that requires insurance companies to act responsibly toward their clients, respecting their privacy and protecting their personal data (Quach et al. 2022).

Insurance companies are responsible for covering potential risks affecting individuals' lives and properties in exchange for a financial contribution—commonly referred to as an insurance premium. The integration of digital technologies into insurance companies'

operating systems and processes offers greater transparency, which in turn is likely to make corporate practices more responsible toward social and environmental stakeholders, thereby strengthening corporate social responsibility (CSR) strategies and activities (Alieva and Powell 2023). Digitalization can thus be seen as the cornerstone of strengthening CSR within companies in terms of the involvement of stakeholders and a responsibility toward them (Zhang and Liu 2022). However, other authors have pointed out that poor management of the digitalization process can exacerbate social and environmental issues and hinder economic growth within companies (Chen et al. 2023).

Xin et al. (2022) investigated how CSR can underpin social and environmental goals in such a way as to support the financial performance of insurance companies (Xin et al. 2022). Although companies' perceptions of CSR dimensions may vary across different sectors (Dudek et al. 2023), CSR has clearly become an indispensable concept in insurance company management (Ruiter 2022), generating positive gains in terms of company performance (Kavitha and Anuradha 2016). One dimension of CSR in the insurance industry involves providing financial assistance based on the principle of risk sharing in the event of unforeseen events. It also involves offering expertise to policyholders to help mitigate the consequences of environmental disasters, promote human rights, and ensure societal safety (Ruiter 2022). Strengthening CSR among insurers can contribute to ensuring an upward trend in sustainable growth and, consequently, continued economic development in the insurance sector, whilst at the same time exhibiting socially responsible strategies (Khovrak 2020).

However, there are relatively few studies that examine the links between digitalization and CSR. In the context of the textile and clothing industry, Wiegand and Wynn (2023) demonstrated how digitalization promotes transparency in supply chains, while Eling and Lehmann (2018) explored the impact of digital technologies on sustainability practices in the financial sector. The literature concerning the interaction between digitalization and CSR in the insurance sector is similarly scant. This study aims to address this gap in the current literature and, more specifically, investigates the extent to which the digitalization of insurance companies' operational processes, particularly in the automobile insurance sector, enhances the implementation of CSR, especially concerning the social dimension focused on policyholders (clients). This study assesses the impact of a set of factors related to digitalization on the adoption and perception of CSR among insurers and policyholders and contributes to the current literature by offering an innovative conceptual framework for understanding the impact of digitalization on CSR, particularly in the insurance sector. From a practical perspective, the results offer specific recommendations for insurers regarding the integration of digital technologies into their CSR strategies, thereby facilitating better claims management and a more responsive assistance process.

This article consists of six sections. Following this introduction, Section 2 briefly reviews and reports the relevant literature, a conceptual framework of digital determinants is established, and eight hypotheses are set out. Section 3 then details the research methodology and techniques used to analyze qualitative (interviews) and quantitative (survey) data. Section 4 reports the main results of hypothesis testing, and Section 5 discusses a series of emerging issues relevant to the overall research objective. Finally, Section 6 summarizes the main aspects of the study, discusses limitations, and highlights possible areas for future research in this field.

2. Literature Review and Hypotheses Development

This section explores the relevant literature pertaining to our research aims and objectives, focusing on the interconnections between digitalization and CSR in the car insurance industry. Firstly, the two primary domains investigated in this research—digitalization and corporate social responsibility—are reviewed, and the definitions of these concepts used in the existing literature are briefly discussed. Section 2.2 then examines the impact of these concepts on the insurance sector. This is followed by a discussion of some of the theories and frameworks used in this research area, and the final Section 2.4 identifies the research

gap, sets out a conceptual framework based on digital determinants, and develops eight related hypotheses.

2.1. Digital Transformation and CSR

There are different perspectives and definitions of the terms "digitalization" and "digital transformation." As van Tonder and Petzer (2018) observe, "there is no solid and universally accepted conceptual framework that can help companies, practitioners, and academics understand the constructs of digitalisation, digital transformation, and business model innovation" (p. 112). Some authors consider digitalization as the deployment of digital technologies to support the enhancement of existing processes, while digital transformation is sometimes seen as constituting a more significant transition towards a new business model or, at the very least, a new way of working in a substantial part of a business.

Most authors recognize the main dimensions of CSR as being environmental, ethical, philanthropic, and economic, even though, in the digital age, new sets of responsibilities are becoming increasingly important. In this context, investment in "intangible capital"—the development of employees' skills and capabilities—is essential for successfully adapting to continuous technological change (Chien et al. 2021). Digitalization involves moving from an offline logic to online exchange, with the conversion of analog data into a digital format (Van Veldhoven and Vanthienen 2023), and this requires the development and adoption of a new digital culture, something which is increasingly seen as an element of CSR (Ahmad et al. 2024). Indeed, some authors also view corporate digital responsibility (CDR) as a new component of CSR (Wynn and Jones 2023).

Many organizations now place significant importance on social responsibility towards employees and stakeholders as part of their CSR strategy (Ahmad et al. 2024; Hernández et al. 2020). Social innovation, conflict mitigation, improved working conditions, and increased organizational competitiveness are the results of well-thought-out CSR policies (Murray et al. 2021). CSR not only advances the social prerogatives of employees and company partners, but also improves the environmental and economic prerogatives. This responsibility covers employees, customers, suppliers, shareholders, investors, and all partners operating within the company's business network (Carroll and Shabana 2010). The need for digital responsibility and the alignment of business practices with sustainability principles illustrates the close link between CSR and digitalization (Janiszewska-Kiewra et al. 2024; Yokoi et al. 2023). The digitalization of operational activities can underpin CSR strategies by improving communication and information exchange between employees at different hierarchical levels and with partners involved in the company's supply chain (Martínez-Caro et al. 2020). The effective integration of these concepts into an overall business strategy can improve the employee experience and enhance the environmental and economic performance (Esposito and Ricci 2021).

Closely related to CSR reporting and strategy development is 'environmental, social and governance (ESG)', which is a framework used to monitor business performance in these three areas of activity and is sometimes used to assess a company's sustainability. Zhang and Huang (2024) point out that, although some scholars have examined the relationship between digital transformation and corporate ESG performance, there is a lack of detailed research into the mechanisms underpinning such change. The authors conclude that "understanding how various circumstances influence the effectiveness of digital transformation in achieving ESG goals can provide companies with more nuanced guidance as they plan and implement their digital development strategies" (p. 2).

In this context, it must be recognized that whilst digitalization has some positive environmental impacts, there are also negatives. On the one hand, the use of dematerialized platforms and the rise of artificial intelligence can optimize the use of natural and energy resources (Wagner 2015). The United Nations Environment Programme (2021) concluded that "a digital ecosystem of data platforms will be crucial to helping the world understand and combat a host of environmental hazards, from air pollution to methane emissions"

(para. 5). On a more local scale, digitalization can strengthen the bonds between employees and their company, help in the development of new skills, and reduce physical work and travel, thereby reducing the carbon footprint of companies. On the other hand, as observed by DataCamp (2023), "an increasing number of studies are alerting us to the significant climate and environmental impact of our digital activities" (para. 2). The data centers upon which digitalization depend, which are major energy users and thus contribute greenhouse gas emissions and climate change, are examples of this.

2.2. Digital Transformation and CSR in the Insurance Sector

The deployment of digital technologies can positively impact the value chain of insurance providers through the improved assessment of unforeseen future events, which in turn improves the insurability of probable risks affecting individuals' lives and properties (Eling and Lehmann 2018). Digitalization can transform operational methods and risk assessment processes to reduce the likelihood of insolvency among insurers. In addition, the digitalization of operational processes in the insurance sector has produced innovative working practices that enhance sustainability and compliance with environmental standards (Ehrentraud et al. 2020).

Digitalization impacts various insurance functions, enabling improved pricing processes, policy underwriting, and claims management when insured risks materialize (Mizgier et al. 2018). The digitalization of operational processes can reduce service and processing costs, adapt pricing to potential risks when underwriting insurance policies, mitigate human errors, and expand the insured base, allowing reinvestment in other innovative products (Porter and Heppelmann 2017). Claims management processes have been enhanced, and fraud detection has been strengthened (Garde and Prasad 2018).

Insurance companies are increasingly integrating digital tools to optimize their operations, enhance efficiency, and meet consumer expectations. These technologies include AI, blockchain, the Internet of Things (IoT), and Big Data, as well as claims management platforms, online customer portals, and digital roadside assistance. They not only reshape insurers' internal processes but also redefine interactions between businesses and their customers, directly impacting the risk management process. AI, for example, can accelerate processes and procedures, and can also improve the accuracy of forecasts and claims assessments, a key factor in remaining competitive in an increasingly digitalized market (Erem Ceylan 2022). Furthermore, integrating blockchain into insurance processes helps to reduce fraud risk while increasing transaction transparency, thereby strengthening customer trust (Popovic et al. 2020). IoT devices can enhance real-time data capture capabilities to enable the creation of more dynamic insurance products, tailored to individual customer behaviors. This technology is particularly useful in digital vehicle assessment, allowing for faster and more accurate inspections after a claim. Additionally, predictive analytics based on Big Data identifies previously invisible trends, paving the way for increased service personalization and better risk management.

The use of advanced security technologies and data analysis for personalization further enhances insurers' ability to offer customized products that meet specific customer needs. Insurers adopting these digital platforms are thus better positioned to provide personalized services and improve customer satisfaction, a crucial issue in a competitive context (Eckert et al. 2022). Personalization is also enhanced via the use of augmented reality (AR) and virtual reality (VR) to simulate and evaluate risks interactively, as well as by integrating e-commerce to simplify the purchase and management of insurance policies. In this context, the impact of these innovations on CSR becomes central. Digital technologies not only modernize the insurance sector, but they also transform CSR approaches, enabling insurance companies to better meet societal and environmental expectations. By integrating these technologies, insurers can enhance transparency, inclusion, sustainability, and social engagement, contributing to developing more robust and relevant CSR practices suitable for contemporary challenges.

2.3. Relevant Theories and Frameworks

There are a number of theories and models with relevance to this study. The dynamic capabilities theory asserts that public or private organizations must regularly channel their skills and allocate human, technical, and financial resources to adapt to continuous technological changes in order to meet society's growing expectations (Teece 2018). Simultaneously, the sustainable innovation theory posits that these new technologies lead to ongoing changes in sustainable operating modes and stimulate responsibility towards employees and partners in social, environmental, and economic areas (Schaltegger et al. 2016). These two theories are complementary, highlighting the interconnection between allocated resources, technological advancements, and operational practices. This suggests that any organization motivated by the need to adapt to an ever-changing environment must continuously invest in new technological processes to keep pace with evolving operating modes.

Beyond the traditional economic approach based on the usual production factors—capital and labor—the resource-based theory identifies intangible elements in order to create value from available resources. The theory asserts that intangible resources far exceed tangible resources in importance in the value creation process within companies (Salvi et al. 2021). This reflection has been endorsed by a large part of the scientific community (for example, Haji and Mohd Ghazali 2018; Ahmad et al. 2023). The imperatives to enhance intangible resources and companies' awareness of the importance of digital culture explain the progress of CSR in terms of its various social, environmental, and economic dimensions (Ahmad et al. 2023).

In this context, Heeks's model (Heeks 2002) for information systems implementation, which examined the gap between design and actuality (the "design–actuality gap"), is of relevance. Heeks identified four dimensions of change when implementing new technologies: technology, processes, people, and structures. From a purely technological perspective, digital transformation involves the adoption of new digital technologies such as mobile technologies, advanced analytics, and augmented reality. In terms of process (or organizational) change, business processes are reshaped to create new, flexible, and consistent management practices (Hanelt et al. 2021). At the same time, the 'people' (or social) dimension of digital transition may involve re-skilling and changes in roles and responsibilities (Reis et al. 2018). Finally, the integration of digital technologies within an organization aims to establish an innovative digital management model that drives growth and value creation, which may involve structural change within the organization (Verhoef et al. 2021).

Some of the recent debate around digitalization and digital transformation builds upon the change dimensions identified in Heeks' model. As noted above, there are various perspectives in the current research literature as to what exactly constitutes digital transformation. Pratt (2023), for example, sees a digital transformation strategy as amounting to the deployment of digital technologies to continuously create new products, services, processes and engagement channels, whilst Van Alstyne and Parker (2021) highlight the role of factors and entities external to the organization. Ismail Abdelaal et al. (2018) see digital transformation as resulting in the development of a new business model with new digitally enabled products and services, while simultaneously impacting people (including skills, talent, and culture), processes, and networks. Digital transformation, then, can be differentiated from digitalization by the deployment of digital technologies in the organization's products and/or services. This is in addition to the more general role of improving cross-company business processes that epitomizes "normal" digitalization. Digital transformation, by directly changing a company's product offering and/or service provision, will lead to a more radical change in business processes, people's competencies and skills, and value networks.

In summary, the dynamic capabilities theory is particularly useful for understanding how insurers continually adapt to rapidly evolving digital technologies in order to remain competitive. This theory highlights the need for companies to acquire, combine, and

reorganize their resources in the face of technological change. Also of relevance is the theory of sustainable innovation, which highlights the importance of integrating technological solutions that promote sustainability, which is crucial for CSR initiatives in the insurance sector. Finally, Heeks' model offers an approach with which to evaluate the effectiveness of digital infrastructure in promoting sustainable development. These theories will help structure the conceptual framework and contribute to the development of hypotheses.

2.4. Conceptual Framework and Hypotheses Development

Digital transformation in the insurance sector, particularly in Morocco, raises new questions about integrating CSR activities within a fast-changing technology environment. While digital technologies offer significant opportunities to improve the efficiency and transparency of insurance processes, their impact on achieving CSR objectives remains largely unexplored. Current research reveals significant gaps in evaluating how these innovations can align with CSR strategies, particularly concerning the specific needs of the automobile insurance sector. To address this gap in the literature, this research uses a conceptual framework based on digital determinants (related to specific digital technologies) of successful CSR. This framework was developed from an analysis of the extant literature, which identified the digital technologies likely to play a key role in promoting effective and adapted CSR practices. These determinants, selected for their relevance and the potential they demonstrated in terms of enhancing sustainability, fairness, and satisfaction among stakeholders in the insurance sector, are as follows: claims management platforms and online customer portals; digital roadside assistance; digital vehicle assessment and inspection; advanced security technologies; data analysis for personalization; and enhanced customer experience through augmented reality (AR) and virtual reality (VR). These are explored in more detail below.

Claims management platforms and online customer portals: A claims management platform is a digital system used by insurance companies to centralize, automate and track the claims process. These platforms help reduce processing times, minimize human errors, and improve the transparency of operations. Several studies highlight the advantages of using digital platforms for claims management. Yun and Barde (2024) conclude that the use of digital dashboards for automobile warranty management improves payment accuracy, whilst Muiru (2024) found that the automation of claims management processes improves the operational efficiency of companies and increases policyholder satisfaction.

The innovative use of digital platforms in the insurance sector thus offers various advantages. They support routine and administrative tasks, contribute to complex decision-making tasks, and manage operational processes. These digital platforms aim to relieve insurance organizations of operational tasks and help them to focus on strategic decisions (Nicoletti 2020). Online mobile channels present rigorous alternatives to traditional management tools, enabling mass data collection, real-time analysis, behavior-based underwriting and pricing, and agile compensation in the event of insured risks, resulting in remarkable operational efficiency (Albrecher et al. 2019). The use of online management platforms combined with the application of artificial intelligence to assess insurability allows insurance companies to accurately predict loss probabilities, reduce information asymmetry, and rethink insurance coverage to offer policies that align with risks and meet policyholders' expectations (Eling et al. 2022). In contrast to archaic methods of claims management in the insurance industry, the introduction of technologies such as blockchain strengthens the transparency, standardization, and reliability of data. The implementation of this digital process through online interfaces in claims management and compensation involves reducing operational costs and improving operational processes in terms of standardization and data reliability, demonstrating an immutable character (Gillis 2023). However, digital transition and dematerialized platforms are likely to affect the entire value chain of insurers and increase policyholder responsiveness (Eling and Lehmann 2018).

Digital roadside assistance: Digital roadside assistance can be defined as the emergency services provided to drivers through mobile platforms and applications. This involves

the use of technologies such as the Internet of Things (IoT) to improve the efficiency and responsiveness of interventions in the event of a breakdown or accident. Mattioli et al. (2024) show that the adoption of IoT-optimized roadside assistance systems enables the real-time monitoring of vehicle health and the prediction of breakdowns, contributing to faster and more efficient interventions. These systems reduce operational costs by optimizing support team journeys, and Donald and Brail (2024) found that digital platforms can effectively coordinate road services, including waiting times, and improve the quality of services provided to policyholders. Digital roadside assistance reduces wait times and improves customer satisfaction, contributing to the transparency and speed of interventions (Ren and Chen 2024). The digitalization of claims processes and the provision of digital roadside assistance to policyholders improves service delivery and enhances operational efficiency, allowing insurers to focus more on the customer experience (Kemboi 2022).

Digital vehicle assessment and inspection: This concerns the use of digital technologies, such as AI and sensors, to assess and inspect vehicle damage, often through automated systems or apps. Bianchi et al. (2024) found that digital inspection technologies improve the accuracy of assessments by minimizing human errors and speeding up decision-making processes. AI enables deeper damage analysis and more objective decision-making, thereby improving claims transparency and policyholder satisfaction. The adoption of these technologies has a direct effect in terms of reducing compensation times, and also improves customer service as a result of the speed and accuracy of assessments (Wang et al. 2024).

Indeed, the digitalization of insurance company functions and the use of artificial intelligence in their operational modes now cover the entire insurance lifecycle, particularly the compensation process, encompassing evidence collection, claims file analysis, damage assessment, compensation, and fraud detection (ChAD 2021). These technological devices fully automate the compensation process, from evidence collection to decision-making regarding claim resolution. Automated compensation relies on different data from similar previous cases to determine how to resolve a new claim and calculate the amount of compensation to be paid. This method ensures fast claim processing and a low risk of errors (IndustryWired 2021).

Advanced security technologies: These include monitoring and anomaly detection systems, such as anti-theft sensors and driver assistance devices, which improve the safety of vehicles and policyholders. Ren and Chen (2024) demonstrate that the integration of these technologies into vehicles contributes to better risk management, thus strengthening road safety and policyholder satisfaction. These innovations also reduce claims incidents, contributing to lower costs for insurance companies. The use of advanced security technologies helps to reduce claims while improving policyholder satisfaction. More generally, the integration of artificial intelligence into insurance operating processes can not only predict risks but can also mitigate them by encouraging policyholders to adopt safe behaviors (Kelley et al. 2018; ChAD 2021).

Data analysis for personalization: Data analysis allows insurers to personalize their offers based on the specific behaviors and needs of policyholders, thereby improving satisfaction and loyalty. Stanly and Aruna (2024) reported that data analysis in the insurance sector makes it possible to offer services that are more adapted to policyholders, improving their satisfaction while optimizing company offers. Data analysis improves the personalization of offers and strengthens the relationship between insurers and policyholders, which contributes to better customer satisfaction (Kelley et al. 2018; Ross 2020). These technological advances not only allow for the analysis of collected mass data but also predict and identify new needs, establish new risk profiles, and offer competitive premiums tailored to policyholders' specificities (Lustman 2021). The digitalization of operational processes and the use of artificial intelligence tools contribute to calculating the probability of risk occurrence based on policyholders' historical data to help make decisions on subscriptions and the renewal or termination of insurance contracts. The personalization of insurance services, particularly the modular services desired by policyholders, is a key competitive

action that requires the availability of data and a reduction in information asymmetry to achieve a favorable market position (Trescases 2019).

Augmented reality (AR) and virtual reality (VR) for enhanced customer engagement: AR and VR are among the interactive technologies that bridge the gap between digital and physical reality (Oyewole et al. 2024). These two emerging technologies offer strong customer engagement in both virtual and physical domains (Goyal et al. 2023) and provide a level of interaction that was previously inaccessible through traditional digital channels. The immersive nature of these devices creates a simulated environment where financial concepts and products can be visualized and understood more intuitively, leading to better-informed decisions and higher customer satisfaction (Soni et al. 2022). As regards auto insurance, the use of AR enables customers to better understand the complex terms of insurance policies and visualize the consequences of different accident or claim scenarios. Additionally, VR can simulate virtual road environments where drivers can experience the benefits of various coverage levels in real-life conditions (Wieland et al. 2024). This innovative approach goes beyond merely presenting products; it fosters more engaging interaction and allows users to compare insurance options in real-time based on their specific profile and needs (Nicoletti 2021). In this way, companies in the insurance sector can enhance their business efficiency while improving customer satisfaction.

In summary, claims management platforms enable more transparent and efficient claims handling, thereby reducing fraud risks and improving customer satisfaction; digital roadside assistance, which provides fast and personalized help to policyholders, enhancing customer safety and trust; and digital vehicle assessment and inspection tools, which facilitate accurate and quick damage assessment, contributing to fair and data-driven decisions. Additionally, online customer portals offer policyholders centralized and simplified access to their information, improving transparency and communication between the insurer and the customer. Advanced security technologies, in turn, enhance accident and claim prevention, thereby reducing risks and better protecting policyholders. Data analysis enables personalized insurance offers, meeting specific customer needs while promoting fairness. Furthermore, augmented reality and virtual reality can be used to train policyholders and employees, improving their understanding of insurance products and associated risks. Finally, integrated e-commerce simplifies access to insurance products and associated services, streamlining the purchasing process and enhancing customer accessibility.

Integrating these technologies within the CSR framework allows insurance companies to not only improve their operational efficiency but to also proactively respond to societal and environmental expectations. This conceptual framework serves as the basis for developing the following hypotheses to test the impact of these technologies on CSR in the automobile insurance sector (Figure 1).

H1. *Claims management platforms (process automation and transparent communication) positively impact policyholders' well-being in terms of compensation and asset preservation by pooling risks, thereby contributing to the success of CSR use among automobile insurers.*

H2. *Digital roadside assistance (assistance applications and accident help) positively impacts policyholders' well-being in terms of compensation and asset preservation by pooling risks, thereby contributing to the success of CSR use among automobile insurers.*

H3. *Digital vehicle assessment and inspection (virtual inspections and image and video analysis) positively impacts policyholders' well-being in terms of compensation and asset preservation by pooling risks, thereby contributing to the success of CSR use among automobile insurers.*

H4. *Online customer portals (self-service and historical tracking) positively impact policyholders' well-being in terms of compensation and asset preservation by pooling risks, thereby contributing to the success of CSR use among automobile insurers.*

H5. *Advanced security technologies (anti-theft systems and driver assistance through sensors and cameras) positively impact policyholders' well-being in terms of compensation and asset preservation by pooling risks, thereby contributing to the success of CSR use among automobile insurers.*

H6. *Data analysis for personalization (customized offers and rewards) positively impacts policyholders' well-being in terms of compensation and asset preservation by pooling risks, thereby contributing to the success of CSR use among automobile insurers.*

H7. *Augmented reality (AR) and virtual reality (VR) (training and simulation, repair assistance) positively impact policyholders' well-being in terms of compensation and asset preservation by pooling risks, thereby contributing to the success of CSR use among automobile insurers.*

H8. *Integrated e-commerce (the purchase of parts and services, price comparison, etc.) positively impacts policyholders' well-being in terms of compensation and asset preservation by pooling risks, thereby contributing to the success of CSR use among automobile insurers.*

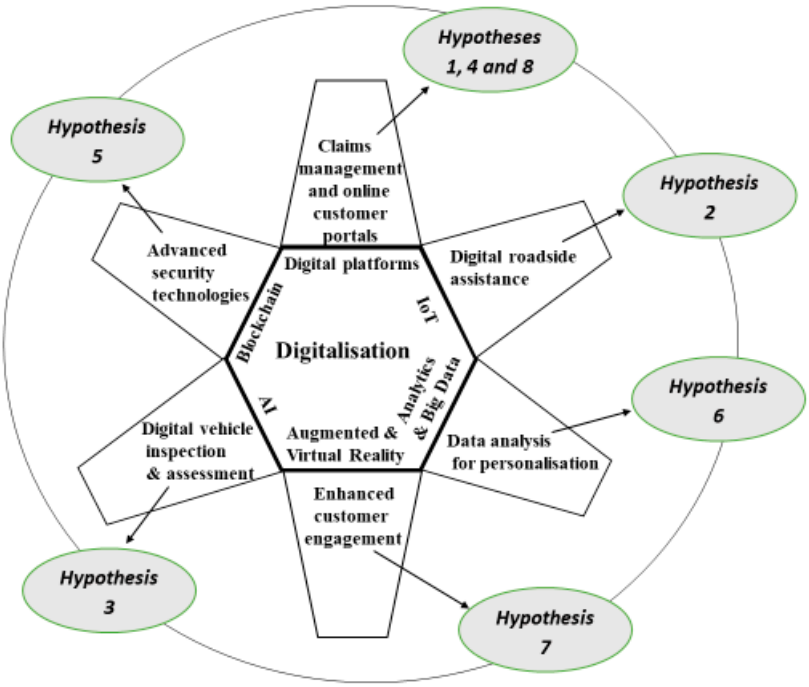

Figure 1. Digital technologies, digital determinants, and related hypotheses (conceptual framework).

3. Research Method

This study focuses on the intersection of digitalization and CSR in the car insurance industry (Figure 2), and more specifically investigates the car insurance sector in Morocco, examining how operational processes have been impacted by digitalization, and how this has affected CSR. Morocco has benefitted from government initiatives to promote digitalization, making it fertile ground for studying the impacts of digital innovation on corporate social responsibility (CSR) in the insurance sector. As the leading automotive player in Africa, Morocco has been able to leverage its strategic position in the Middle East and North Africa (MENA) region to modernize its financial services sector, integrating advanced technologies that meet growing consumer demands and sustainability standards. As a leader in the automobile industry in Africa, Morocco plays a crucial role in regional dynamics. Its commitment to modernizing financial services and integrating digital technologies allows it to serve as a model for other developing countries. The lessons learned from the Moroccan experience can be extrapolated to other emerging markets, thus strengthening the relevance of this study and its results.

Figure 2. Research focus: the interaction between digitalization, CSR, and the car insurance industry.

The development of a research methodology for such a project typically begins with a fact or theory. This is followed by data collection to clarify the problem in order to either accept or reject the theory. Finally, tests are conducted to complete the process (Park et al. 2020). In this project, the research centers on the automobile insurance sector in the Rabat-Salé-Kenitra region of Morocco. Positivism is adopted as the epistemological paradigm within a hypothetico-deductive reasoning framework to support the research process (Park et al. 2020; Hofmann 2022). A mixed method was adopted, combining qualitative interviews with quantitative data drawn from surveys. This approach provides a comprehensive and nuanced view of the effects of digitalization on claims management and roadside assistance processes. Whilst the overall methodology could be viewed as a form of pragmatism, the authors believe that the rigorous testing of hypotheses supports a positivist stance.

There were four main phases in this research study (Figure 3). Phase 1 entailed a comprehensive review of the pertinent literature. A qualitative approach was adopted to identify key themes related to digitalization that could also potentially advance sustainability in the insurance sector. Content analysis was used to extract and categorize key themes from the relevant documentary sources, focusing on recurring themes and important variables. This produced an initial list of ten key themes, which were termed "digital determinants". Then, in Phase 2 of the study, a questionnaire was developed based on the digital determinants identified in the literature review, and this was used in direct face-to-face interviews with over 100 policyholders and insurers in the automobile sector to gather their views on the impact of the digital determinants in terms of the possible enhancement of CSR amongst insurers.

Using multiple correspondence analysis (MCA) (Ge and Whitmore 2010; Adwere-Boamah and Hufstedler 2015), data were analyzed to identify those digital determinants that had a highly significant impact on the success of CSR in the automobile insurance branches. MCA is similar to principal component analysis in that it is used to analyze the pattern of relationships between several qualitative dependent variables (Abdi and Valentin 2007). This method is particularly suited to the study of correspondences between several qualitative variables, making it possible to visualize the interrelations between the factors identified from the interviews and the data collected via the survey. Statistical analyses, including logistic regression and AUC (area-under-the-curve) tests, were performed to measure the impact of digital determinants on CSR success in the auto insurance sector (see Appendix D). Reliability tests and chi-square tests were also undertaken, and the results confirmed the existence of a highly significant association between explanatory variables (such as claims management platforms and advanced security technologies) and CSR success, with p-values of less than 0.05. This approach not only made it possible to validate the proposed hypotheses, but also contributed to better understanding the specific

impact of each digital determinant on CSR in the automobile insurance sector. The MCA thus made it possible to visualize the interrelations between these determinants and the success of CSR in the insurance sector. This is discussed in more detail in Section 5 below.

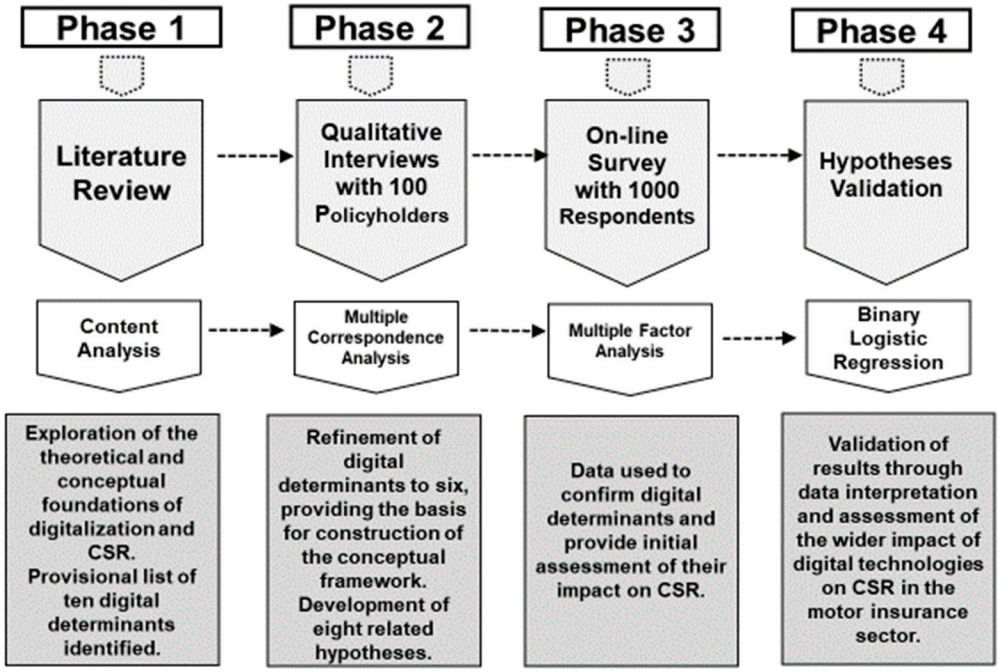

Figure 3. Research process of this study.

This led to a reassessment of the significance of the digital determinants, with four being rejected on the basis of interview feedback, leaving a remaining core of six digital determinants. Phase 2 also facilitated the development of hypotheses built around the remaining six digital determinants. Overall, eight hypotheses were generated for testing in Phase 3.

Phase 3 of the research used an online survey (Liu and Jung 2021) to further refine the digital determinants and test the hypotheses. The online survey was set up to estimate the impact of each previously identified digital determinant on the success/failure response variable of the CSR concept with regard to insurance companies. The participants were selected according to precise inclusion criteria. We selected policyholders who had taken out a car insurance contract for at least one year in the regions of Rabat, Salé, and Kénitra. Participants who did not meet these criteria were excluded to ensure the representativeness of the sample. The exclusion criteria were clearly defined to avoid any bias in the responses.

In the survey, the introductory section focused on the respondent's (policyholder's) personal information and their relationship with their insurer (the gender of the policyholder, age group, city of residence, socio-professional category, the insurance companies contracted by the policyholder, the types of insurance contracts, and the frequency of automobile insurance subscription). The second section was dedicated to responses to multiple-choice questions related to the digital determinants explaining the dependent variable. These were assessed using a Likert scale. In the final section, the survey contained questions regarding the perceived success or failure of CSR. We contacted a sample of 1100 automobile insurance policyholders, and 1000 valid survey responses were obtained. The demographic profile of the 1000 respondents is included as Appendix A. The data were analyzed to identify the digital determinants with a very significant impact on CSR success in the automobile insurance sector.

Phase 4 used the survey data to test the hypotheses, applying generalized linear models (GLMs), particularly the logit extension and the binary logistic regression models. This made it possible to model the impact of numerical determinants on the success or

the failure of CSR (Banerjee et al. 2024; Kumar and Gota 2023) (see Appendix B). The survey used a 5-point Likert scale to assess respondents' perceptions of the impact of digital technologies on CSR. The survey items (questions, scales, etc.) were carefully developed from the existing literature, including the work of Ge and Whitmore (2010) and Adwere-Boamah and Hufstedler (2015), and were adapted to align with the specificities of the insurance sector in Morocco. The complete results of the reliability analysis, such as Cronbach's alpha ($\alpha = 0.881$), show satisfactory internal consistency for the six numerical determinants studied.

The GLMs use the logit function to model the log odds of an event as a linear combination of independent variables. This method provides the binary response variable (success/failure) of the CSR concept in the automobile insurance sector (Leukel et al. 2024). The logit statistical model was used to evaluate the impact of the digital determinants, identified from the interview analysis, on the success of CSR among automobile insurers. The β parameters are the coefficients that reflect the influence of explanatory variables on the dependent variable in logistic regression. They allow for the measurement of the effect of digital determinants on the probability of CSR success in the automobile insurance sector. To estimate these parameters using the nonlinear equations of the Bernoulli distribution, the maximum likelihood estimator (MLE) was employed (see Appendix C).

In summary, the research methodology combined epistemological rigor and robust statistical tools, constituting a solid basis for analyzing the impact of digital determinants on the success of CSR in the automobile insurance sector. This integrated approach, based on the combination of qualitative and quantitative methods, not only ensured the validity of the results obtained but also their applicability to the specific context of the Moroccan market. The application of binary logistic regression allows for a more in-depth examination of the complex relationships between the variables studied, providing relevant insights into the dynamics underpinning the effectiveness of CSR in this sector.

4. Results

This section presents the main findings of the hypothesis testing, derived from the statistical analysis of the data collected through interviews and online surveys. The results are discussed in relation to the digital determinants identified in the conceptual framework (Figure 1) and their impact on the success of CSR uptake among automobile insurers in Morocco. The subjects in the sample chose to take out their automobile insurance contracts with a number of different insurance companies, most of them well-known brands (Table 1). To ensure the rigor of the results, we assessed the reliability of the quantitative data using Cronbach's alpha ($\alpha = 0.85$), with results indicating high internal consistency. The validity of the results was confirmed by convergent and discriminant validity tests. An exploratory factor analysis was conducted to identify the key dimensions of digital determinants that influence CSR. Logistic regression was then used to test the hypotheses regarding the relationships between these dimensions and the success of CSR initiatives.

Table 1. Insurance companies contracted by respondents.

	Respondents	Percentage	Cumulative Percentage
Allianz Maroc	26	2.6%	2.6%
Atlanta	45	4.5%	7.1%
AXA Assurance	114	11.4%	18.5%
MCMA	63	6.3%	24.8%
RMA	152	15.2%	40.0%
Saham Assurance	306	30.6%	70.6%
Sanad	49	4.9%	75.5%

Table 1. *Cont.*

	Respondents	Percentage	Cumulative Percentage
Wafa Assurance	179	17.9%	93.4%
Others	66	6.6%	100%
Total	1000	100%	-

The automobile insurance policies taken out were of three main types: civil liability (16.8%); civil liability + additional guarantees (damage and collisions) (61.2%); and fully comprehensive (22%). The contract subscription frequencies varied between annual policies (55.7%); half-yearly policies (12.8%); quarterly policies (23.6%); monthly policies (7.3%); and other policies (0.6%). More detail on the hypotheses testing method and validation is given in Appendix D.

4.1. Claims Management Platforms and Online Customer Portals (H1, H4, H8)

The analysis confirms that claims management platforms and online customer portals have a significant positive impact on the success of CSR in the automobile insurance sector. These digital platforms enhance operational efficiency by automating processes, reducing human errors, and ensuring transparency in communication. Policyholders benefit from more streamlined claims processing, quicker compensation, and greater accessibility to their insurance information, all of which contribute to their well-being and satisfaction.

- H1 is supported: the automation and transparency offered by claims management platforms positively influence policyholders' well-being by ensuring timely and fair compensation, which aligns with CSR objectives.
- H4 is supported: online customer portals improve policyholder engagement and trust by providing easy access to information and self-service options, thereby supporting CSR efforts.
- H8 is supported: the integration of e-commerce functionalities in these platforms enhances service personalization and accessibility, which further contributes to CSR success.

4.2. Digital Roadside Assistance (H2)

The findings indicate that digital roadside assistance significantly improves policyholders' perception of their insurance providers' responsiveness and reliability. The availability of instant, personalized assistance in the event of a breakdown or accident increases policyholder trust and loyalty, which is crucial for maintaining strong CSR practices.

- H2 is supported: digital roadside assistance positively impacts policyholders' well-being by providing timely and effective help during emergencies, thereby supporting CSR in the insurance sector.

4.3. Digital Vehicle Assessment and Inspection (H3)

This study reveals that digital vehicle assessment and inspection tools contribute to faster and more accurate damage evaluations, leading to fairer and more transparent compensation processes. This not only enhances policyholder satisfaction but also strengthens the insurer's CSR profile by ensuring that claims are handled equitably and efficiently.

- H3 is supported: The use of digital tools for vehicle assessment and inspection positively impacts policyholders' well-being by ensuring accurate and timely compensation, which aligns with CSR goals.

4.4. Advanced Security Technologies (H5)

The research confirms that advanced security technologies, such as anti-theft systems and driver assistance tools, play a critical role in preventing accidents and minimizing risks.

These technologies not only protect policyholders' assets but also promote safer driving behaviors, which is a key component of CSR.

- H5 is supported: advanced security technologies positively impact policyholders' well-being by reducing the likelihood of accidents and thefts, thereby contributing to the success of CSR initiatives.

4.5. Data Analysis for Personalization (H6)

The results highlight the importance of data analysis in personalizing insurance services. By leveraging Big Data and AI, insurers can offer customized policies that better meet individual policyholders' needs, leading to higher satisfaction and engagement. This personalization is crucial for maintaining a strong CSR stance, as it demonstrates a commitment to meeting the specific needs of customers.

- H6 is supported: data-driven personalization positively impacts policyholders' well-being by offering tailored insurance solutions that align with their specific needs, supporting CSR objectives.

4.6. Augmented Reality (AR) and Virtual Reality (VR) for Enhanced Customer Engagement (H7)

This study finds that AR and VR technologies significantly enhance policyholder education and engagement by providing immersive experiences that simplify complex insurance concepts. This not only improves policyholders' understanding but also builds trust in the insurer, which is essential for the successful adoption of CSR.

- H7 is supported: the use of AR and VR in training and customer engagement positively impacts policyholders' well-being by enhancing their understanding of insurance products, thereby supporting CSR efforts.

The qualitative interviews revealed several key themes, including the improvement of transparency and communication using digital tools. These qualitative results complement the quantitative data and offer additional insights into the mechanisms through which digitalization influences CSR. This is discussed in more detail below.

5. Discussion

The above results raise some issues worthy of further discussion. Firstly, the findings underline the interconnection of digitalization and CSR policies and operations. Digital technologies typically operate alongside standard information systems for processing and reporting transactions, and help insurers reduce production costs by limiting risks to policyholders and increasing their satisfaction levels (Bohnert et al. 2019; Hirsch-Kreinsen 2020). The dematerialization of insurance services (such as through the transition from physical to electronic certificates) and the disintermediation of operational processes (removing activities to improve process efficiency) have improved customer access to insurance services and also encouraged the financial inclusion of the wider population (Eling and Lehmann 2018). Digitalization is now integrated into the insurance sector as a key element of the overall strategy, enhancing risk assessment and creating new products tailored to policyholders' expectations (Stoeckli et al. 2018). AI and analytics, combined with Big Data, enable insurers to analyze and predict potential risks and offer insurance services tailored to different social strata, thereby promoting socially responsible behavior towards policyholders (Merrill et al. 2019).

Digitalization can contribute to reducing environmental footprints and ensuring sustainable development by minimizing physical transactions and promoting remote work (Eckert et al. 2021). This again highlights the interdependence between digital transition and CSR: the continued evolution and advancement of CSR in its multiple dimensions depends on innovation and the application of digital technologies. To this end, continuous investment in digital technologies is necessary to maintain a competitive edge and ensure the alignment of these technologies (Cirillo et al. 2023) with CSR objectives in order to

guarantee long-term sustainability. This aligns with the dynamic capabilities and sustainable innovation models noted above in Section 2.3. Secondly, the results of this study confirm the importance of digital determinants for the success of CSR in the automobile insurance sector, supporting several of the original hypotheses, with the findings being of relevance to the theoretical underpinnings of this study. For example, the results indicate that the automation offered by claims management platforms has a significant impact on policyholder satisfaction (OR = 9.034—i.e., Odds Ratio in the logistic regression), confirming the importance of having a dynamic capability to adapt processes to changing needs. This is consistent with dynamic capabilities theory, which suggests that organizations must mobilize their resources to respond to constantly changing external conditions (Teece et al. 1997). At the same time, the results show that the integration of advanced security technologies reduces risks for policyholders while promoting more responsible behaviors (OR = 7.242). These innovations contribute to the sustainability of insurance processes, supporting the theory of sustainable innovation, which highlights the importance of alignment between technological innovation and sustainable practices (Schaltegger and Wagner 2011). In connection with the theory of service personalization, this study indicates that the personalization of insurance offers not only strengthens policyholder satisfaction, but also contributes to more responsible practices, whilst at the same time improving customer–insurer relationships. This is consistent with work on customer satisfaction and social responsibility (Bendell 2005).

In this context, insurers are increasingly focusing on enhancing the customer experience through personalized services and user-friendly digital platforms (Bilgihan et al. 2016), aligning with CSR objectives to improve customer satisfaction, trust, and transparency. This customer-centric approach not only strengthens relationships with policyholders but also contributes to the broader CSR goals of fairness and equity in service delivery. However, the challenge lies in ensuring that these digital innovations genuinely meet customers' needs and are not merely used as marketing tools (Verma and Bala 2018). It is, therefore, crucial to continually evaluate and adjust digital strategies based on customer feedback and evolving expectations in order to maximize their positive impact on CSR outcomes.

Thirdly, based on the case study evidence, and given the two points discussed above, the impact of digital technology deployment in the car insurance industry can be viewed as transformative, in that digital technologies are used not just to support and modernize existing business processes, but are also now an intrinsic part of the industry's products and customer service provision. As noted above, this distinction between the two concepts has been made by a number of authors (Ismail Abdelaal et al. 2018; Wynn and Felser 2023), with digital transformation involving a more significant change process than digitalization. In this study, the transformative elements include the use of mobile apps for customer roadside assistance, personalized access to online portals, and online policy management services. Company skills and competencies have had to adapt, with new data analytical skills and VR/AR capabilities adopted, whilst process change has included virtual vehicle inspections and automated claims management (Figure 4).

The β coefficients represent the strength of the relationship between the independent variables and the dependent variable (CSR success).

Fourthly, as regards the theoretical contribution of this research, the above discussion indicates how the findings extend the dynamic capabilities theory, with the insurance companies having to continuously adapt to technological change to improve operational efficiency and policyholder satisfaction. In addition, this research contributes to sustainable innovation theory by showing how digital tools facilitate transparency, personalization, and responsible risk management practices. This dual contribution—strengthening CSR practices while enhancing operational processes—provides fresh insights into the role of digital transformation in shaping socially responsible business models within the insurance industry. In a wider context, the results also enhance the theoretical understanding of the relationship between digitalization and CSR, particularly in the context of the automobile insurance sector. It builds upon the limited body of literature on this subject (Eling and

Lehmann 2018; Kong and Liu 2023) by investigating how specific digital innovations positively affect CSR outcomes. During logistic regression, we obtained β coefficients for each relationship tested between the independent variables and the dependent variable, and these are shown in Figure 4. This indicates that automated claims management and advanced security technologies had the most positive impact on customer perception of CSR, but that other factors were also of significance. These findings provide the basis for further research and theoretical development regarding this relationship.

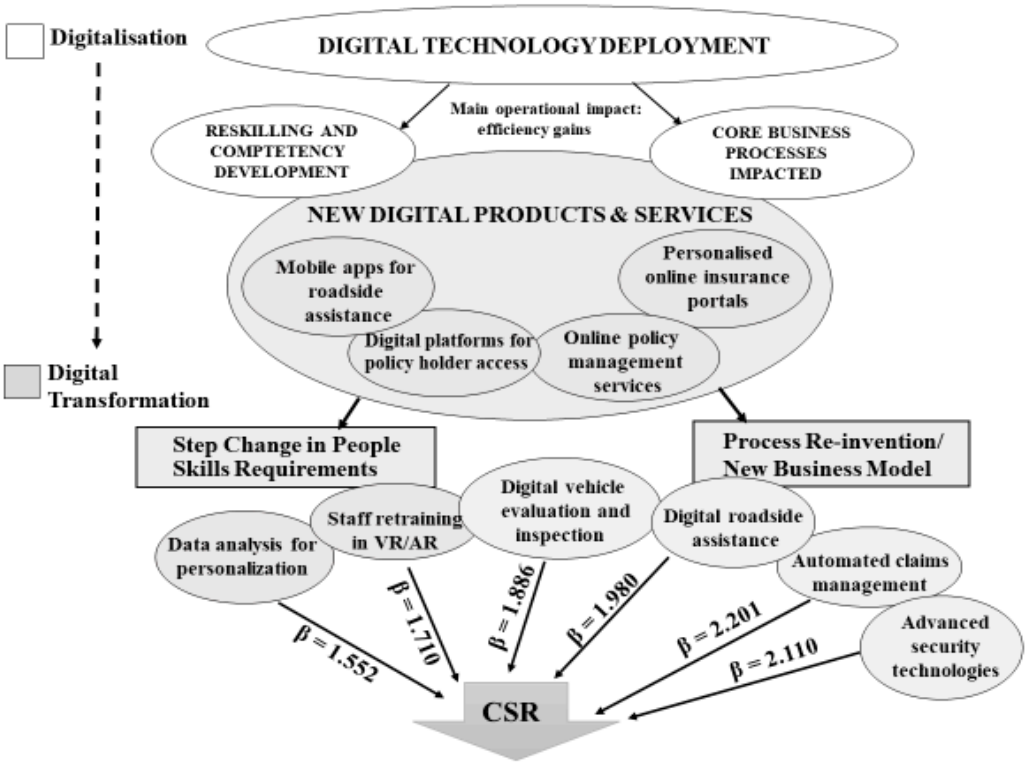

Figure 4. Digital transformation and CSR in the car insurance industry.

Fifthly, the integration of digital technologies into CSR strategies presents challenges related to change management within insurance companies. While digital technologies offer substantial advantages, their implementation, as noted above, will often disrupt existing processes and face resistance from employees (Zuperkienė et al. 2023). Effective change management is thus critical in order to ensure that digital initiatives are seamlessly integrated into operations without compromising productivity or CSR goals. In addition to investing in new technologies, insurers must prioritize staff training and support help them in terms of adapting to these changes, fostering a culture of innovation (Chaudhuri et al. 2023) aligned with CSR objectives. Successful digital transformation relies not only on technology but also on the organization's ability to embrace change in a way that strengthens its commitment to social responsibility (Varshney 2020). This aligns with Heeks' (2002) model, emphasizing the connectivity between the technology, people, and process dimensions of digital transformation. Sixthly, this study reveals the critical importance of addressing privacy and data security concerns within the context of digital transformation. With increasing reliance on artificial intelligence, Big Data, and digital platforms, protecting sensitive customer data becomes paramount (Asif et al. 2024). Insurers must implement robust cybersecurity measures and transparent data management practices to safeguard this information and maintain trust (Stewart 2023), which is a fundamental pillar of CSR. Compliance with data protection regulations, such as the GDPR, is essential, as non-compliance could result in legal, financial, and reputational risks (Voigt and Von Dem

Bussche 2017). Ensuring high standards of data security not only mitigates risks but also strengthens the insurer's ethical commitment to responsible business practices.

Finally, the environmental impact of digitalization must be considered as insurers adopt increasingly digital operational models. While digital technologies can reduce the use of physical resources—such as paper and in-person services—they also lead to increased energy consumption by data centers and electronic devices (Chen et al. 2020). It is essential to find a balance between the environmental benefits of digitalization and the associated energy needs for insurers aiming to align with global sustainability efforts. Investment in green technologies and energy-efficient practices can help to mitigate the environmental footprint of digital transformation (Feroz et al. 2021), thereby reinforcing insurers' commitment to sustainable development and combating climate change.

6. Conclusions

This study explores the complex relationship between digitalization and CSR in the Moroccan automobile insurance sector. The findings confirm that digital technologies, such as claims management platforms, digital roadside assistance, and advanced security systems, significantly contribute to the success of CSR initiatives by enhancing policyholder well-being, engendering transparent and fair processes, and promoting safer behaviors. The study's findings are consistent with those of Eling and Lehmann (2018), who also observed that the adoption of digital technologies leads to improved sustainability practices. However, this study explores the specific impacts of this on claims management and roadside assistance, two key areas for insurers. This study thus has significant theoretical implications, broadening the field of research on the interaction between digitalization and CSR, and demonstrating the relevance and application of dynamic capabilities and sustainable innovation theories. The findings also contribute to the debate on digital transformation and how it differs from digitalization; namely, products and services are significantly modified or reinvented. From a practical point of view, the article provides guidance for insurers seeking to improve their CSR practices through the adoption of digital platforms, with benefits in terms of transparency and customer satisfaction.

While the study provides valuable insights, it has its limitations. The research is confined to a specific sector within a single country, which limits the generalizability of the findings. Additionally, the rapidly evolving nature of digital technologies means that the results may become outdated as new innovations emerge and are embedded in the insurance industry processes. Nevertheless, the authors believe that the findings provide a platform for further research into the relationship between digital transformation and CSR, and that the study also makes a small contribution to the developing literature and theory on digital transformation.

Future research could explore the impact of digitalization on CSR in other sectors and countries. The approach of testing the relationship between selected digital determinants and CSR could be applied in other industries. Additionally, longitudinal studies could provide a deeper understanding of how the relationship between digitalization and CSR evolves over time. Further research could also investigate the role of emerging technologies, such as blockchain and AI, in shaping the future of CSR in the insurance industry.

In conclusion, this study highlights the critical role of digitalization in enhancing CSR within the Moroccan automobile insurance sector. By adopting innovative digital solutions, insurers not only improve operational efficiency but also strengthen their commitment to social responsibility, ultimately contributing to a more sustainable and customer-centric insurance industry. Such a transformation, however, requires a significant change in business model, involving new products and services that require major reskilling and competency development.

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Data Availability Statement: The data used in this article is stored in a university environment. Further information may be sought from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Demographic and Professional Profile of 1000 Survey Respondents

The sample demographics show that 52.6% of the sample is male and 47.4% is female. The data concerning the age of the sample studied indicate that 3.6% of policyholders are between 18 and 24 years old, that 50.3% are between 25 and 34 years old, that 28.7% are between 35 and 44 years old, that 14.4% are between 45 and 55 years old, and that 3% are over 55 years old. These frequencies reveal that more than half of the sample is made up of young people under the age of 35 (Table A1).

Table A1. Sex of policyholder respondents.

	Respondents	Percentage	Cumulative Percentage
Female	474	47.4%	47.4%
Male	526	52.6%	100%
Total	1000	100%	-

Out of the 1000 subjects, 394 or 34.9% of the subjects come from the city of Rabat, 311 or 31.1% reside in the city of Salé, and 340 or 34% live in the city of Kénitra. As for the socio-professional categories, the sample includes 76 executives, or 7.6% of the total; 207 subjects employed in liberal professions, or 20.7% of the total; 613 employees, or 61.3% of the total; 59 students, or 5.9% of the total; and 45 people practicing other professions than those mentioned above (Table A2). More than 60% of those surveyed are employees with more or less fixed incomes, possessing an inflexible purchasing power in relation to positive fluctuations in inflation rates and pricing policies of price increases.

Table A2. Survey respondent socio-professional categories.

	Respondents	Percentage	Cumulative Percentage
Executives	76	7.6%	7.6%
Professions	207	20.7%	28.3%
Employees	613	61.3%	89.6%
Students	59	5.9%	95.5%
Others	45	4.5%	100%
Total	1000	100%	-

Appendix B. Binary Logistic Regression: Logit Transformation

A sample of (n) policyholders belonging to the automobile insurance sector was analyzed to assess the success of CSR among automobile insurance service providers, as explained by a set of digital determinants.

The column vector = () was used, which accounts the dichotomous response variable reflecting the success or failure of the CSR concept among automobile insurers. In addition, we consider (p) independent qualitative digital determinants, organized in the matrix (X) = (). The column vector β, of dimension (p), contains the unknown parameters of the model, namely, the regression coefficients. The modeling of the dichotomous response variable (which relies on the statistical method of binary logistic regression $y_i y_1,\ y_2,\ \ldots,\ y_n X_1,\ X_2,\ \ldots,\ X_p y_i$) was performed as follows:

$$\text{Logit}(\pi) = \ln = \left(\frac{\pi}{1-\pi}\right) \sum_{k=0}^{p} \beta_k x_{ik},\ \text{With } i = 1,\ \ldots,\ n \tag{A1}$$

Via Logit transformation, we obtain Equation (A2) from Equation (A1):

$$\left(\frac{\pi}{1-\pi}\right) = \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \tag{A2}$$

Equation (A2) is evaluated to obtain π and $1-\pi$:

$$\pi = \exp\left(\sum_{k=}^{p} \beta_k x_{ik},\right) - \pi \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \tag{A3}$$

$$\pi + \pi \exp\left(\sum_{k=0}^{p} \beta_k x_{ik},\right) = \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \tag{A4}$$

$$\pi\left(1 + \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)\right) = \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \tag{A5}$$

$$\pi = \left(\frac{\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}{1 + \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}\right) \tag{A6}$$

$$\pi = \left(\frac{1}{1 + \exp\left(-\sum_{k=0}^{p} \beta_k x_{ik}\right)}\right) \tag{A7}$$

Similarly, $(1-\pi)$ is obtained as follows:

$$1 - \pi = 1 - \left(\frac{1}{1 + \exp\left(-\sum_{k=0}^{p} \beta_k x_{ik}\right)}\right) \tag{A8}$$

$$1 - \pi = \left(\frac{1}{1 + \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}\right) \tag{A9}$$

$$1 - \pi = \frac{\exp\left(-\sum_{k=0}^{p} \beta_k x_{ik}\right)}{1 + \exp\left(-\sum_{k=0}^{p} \beta_k x_{ik}\right)} \tag{A10}$$

Appendix C. Estimation of the β Parameters of the Nonlinear Equations of the Bernoulli Distribution Using the Maximum Likelihood Estimator (MLE)

The binarity of the response variable y_i requires that it must necessarily take two values: 0 or 1. Let y_i represent the probability of the success or failure of the CSR concept among insurers. This probability, noted as π, thus signifies the success of the CSR concept, given the independent variables X, expressed as P (y_i = 1 | X). Conversely, $1-\pi$ delimits that y_i which is equal to 0, thus indicating the failure of the CSR concept, expressed by P

($y_i = 0 \mid X$). When $y_i = 1$, the contribution to the likelihood function is π; when $y_i = 0$, the contribution is $1 - \pi$. Consequently, the likelihood function is formulated as follows:

$$\pi^{y_i} \ (1-\pi)^{1-y_i} \tag{A11}$$

At this point, the maximum likelihood estimator (MLE) is used to estimate the $(p + 1)$ unknown parameters β as follows:

$$L(y_1,\ y_2,\ \ldots y_n,\ \pi) = \prod_{i=1}^{n} \pi^{y_i}\ (1-\pi)^{1-y_i} \tag{A12}$$

The maximum likelihood method is introduced at this stage to estimate the values of the unknown regression parameters β to maximize the probability of the success of the CSR concept:

$$L(y_1,\ y_2,\ \ldots y_n,\ \pi) = \prod_{i=1}^{n} \pi^{y_i}(1-\pi)^{1-y_i} \tag{A13}$$

$$= \prod_{i=1}^{n} \left(\frac{\pi}{1-\pi}\right)^{y_i} (1-\pi) \tag{A14}$$

After changing the first term of Equation (A2) and the second term of Equation (A8), we obtain the following:

$$L(y_1,\ y_2,\ \ldots y_n,\ \beta_1,\ \beta_2,\ \ldots \beta_p,) = \prod_{i=1}^{n} \left(\exp\left(\sum_{k=0}^{p} \beta_k x_{ik},\right)\right)^{y_i} \left(1 - \frac{\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}{1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}\right) \tag{A15}$$

So,

$$L(y_1,\ y_2,\ \ldots y_n,\ \beta_1,\ \beta_2,\ \ldots \beta_p) = \prod_{i=1}^{n} \left(\exp\left(y_i \sum_{k=0}^{p} \beta_k x_{ik},\right)\right)\left(1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik},\right)\right)^{-1} \tag{A16}$$

To simplify the calculations, the logarithmic function of the likelihood function is introduced as shown below:

$$\ln(L(y_1,\ y_2,\ \ldots y_n,\ \beta_1,\ \beta_2,\ \ldots \beta_p)) = \ln\left(\prod_{i=1}^{n} \left(\exp\left(y_i \sum_{k=0}^{p} \beta_k x_{ik}\right)\right)\left(1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)\right)^{-1}\right) \tag{A17}$$

$$\updownarrow(y_1,\ y_2,\ \ldots y_n,\ \beta_1,\ \beta_2,\ \ldots \beta_p) = \sum_{i=1}^{n} y_i \left(\sum_{k=0}^{p} \beta_k x_{ik}\right) - \ln\left(1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)\right) \tag{A18}$$

Deriving the last equation from the natural logarithm of the likelihood function above, the following is obtained:

$$\frac{\partial \updownarrow(\beta)}{\partial \beta_k} = \sum_{i=1}^{n} y_i\ x_{ik} - \frac{1}{1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)} \times \frac{\partial}{\partial \beta_k}\left(1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)\right) \tag{A19}$$

$$\frac{\partial \updownarrow(\beta)}{\partial \beta_k} = \sum_{i=1}^{n} y_i\ x_{ik} - \frac{1}{1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)} \times \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \times \frac{\partial}{\partial \beta_k} \sum_{k=0}^{p} \beta_k x_{ik} \tag{A20}$$

$$\frac{\partial \updownarrow(\beta)}{\partial \beta_k} = \sum_{i=1}^{n} y_i\ x_{ik} - \frac{x_{ik}}{1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)} \times \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \tag{A21}$$

We know that

$$\frac{\partial}{\partial \beta_k} = \sum_{k=0}^{p} \beta_k x_{ik} = x_{ik} \tag{A22}$$

So,

$$\frac{\partial \updownarrow(\beta)}{\partial \beta_k} = \updownarrow'_{\beta_k} = \sum_{i=1}^{n} y_i \, x_{ik} - \pi . x_{ik} \tag{A23}$$

Estimating the parameters $\hat{\beta} = (\hat{\beta_0}, \hat{\beta_1}, \cdots, \hat{\beta_p})$ that maximize the log-likelihood function ($\updownarrow$) is achievable by setting the $(p + 1)$ equations of ($\updownarrow'$) (the gradient of $\updownarrow'$) to zero, as shown in Equation (A12), and ensuring that its Hessian matrix ($\updownarrow''$) is negative definite, i.e., every element on the diagonal of this matrix is less than zero.

$$\frac{\partial^2 \updownarrow(\beta)}{\partial \beta_k \, \partial \beta_{k'}} = \frac{\partial}{\partial \beta_{k'}} \sum_{i=1}^{n} y_i \, x_{ik} - \pi . \, x_{ik} \tag{A24}$$

$$\frac{\partial^2 \updownarrow(\beta)}{\partial \beta_k \partial \beta_{k'}} = \frac{\partial}{\partial \beta_{k\prime}} (-\pi . \, x_{ik}) \tag{A25}$$

$$\frac{\partial^2 \updownarrow(\beta)}{\partial \beta_k \partial \beta_{k'}} = -x_{ik} \frac{\partial}{\partial \beta_{k'}} \left(\frac{\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}{1 + \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)} \right) \tag{A26}$$

$$\updownarrow''_{\beta_{k\beta'_k}} = -x_{ik} \pi (1 - \pi) \, x_{ik} \tag{A27}$$

Estimating the parameters $\hat{\beta} = (\hat{\beta_0}, \hat{\beta_1}, \cdots, \hat{\beta_p})$ requires the use of the Newton–Raphson iterative optimization method. This method consists of starting the search with an initial value denoted β^0 or β^{old}. The result of this algorithm in matrix notation is written as follows:

$$\beta^{new} = \beta^{old} + \left[-\updownarrow'' \left(\beta^{old} \right) \right]^{-1} \times \updownarrow' \left(\beta^{old} \right)$$

Appendix D. Hypotheses Testing

Reliability testing was performed as follows: the reliability test marked a value of the "Cronbach's Alpha" coefficient $\hat{\alpha} = 0.881$, far exceeding the minimum conventional threshold of $\hat{\alpha} = 0.70$ (George and Mallery 2003). This confirmed that for this assortment of digital determinants, composed of six elements (Table A3), satisfactory internal consistency was achieved.

Table A3. The digital determinants associated with the success of the concept of CSR in the automobile insurance sector.

Digital Determinants	Code
Claims management platforms and online customer portals	PGL
Digital roadside assistance	ARN
Digital vehicle assessment and inspection	ENV
Advanced security technologies	TSA
Data analysis for personalization	ADP
Augmented reality (AR) and virtual reality (VR) for enhanced customer engagement	RAV
Response Variable	Notation
Success of CSR in the automobile insurance sector	Y = 1
Failure of CSR in the automobile insurance sector	Y = 0

Area-under-the-curve (AUC) analysis, widely used to measure the accuracy of diagnostic tests, expresses the probability of placing a positive element in front of a negative element (Figure A1). However, this technique proposes an AUC = 0.5 as a reference point that must be exceeded. At first glance, all results are highly significant, with a $p = 0.000 \leq 0.05$. Additionally, the table also reports AUCs that exceed the benchmark threshold

(AUC = 0.5), i.e., the explanatory variables used in the model all have a significant impact on the response variable. At this stage, claims management platforms and online customer portals (PGL) have a probability of 71.6% vis-à-vis stimulating the improvement of the uptake of the concept of corporate social responsibility (CSR) among motor insurance providers with regard to their policyholders. Likewise, digital road assistance (ARN) has a probability of 66.8% in terms of increasing the adoption of this social notion. Additionally, digital vehicle assessment and inspection (ENV), advanced safety technology (TSA), data analytics for personalization (ADP), and augmented reality (AR) and virtual reality (VR) (RAV), respectively, present probabilities of 64.1%, 79.1%, 61.7%, and 62.6% in terms of enhancing the uptake of the concept of CSR in the automobile insurance industry and consolidating the interrelations between policyholders and their insurance providers.

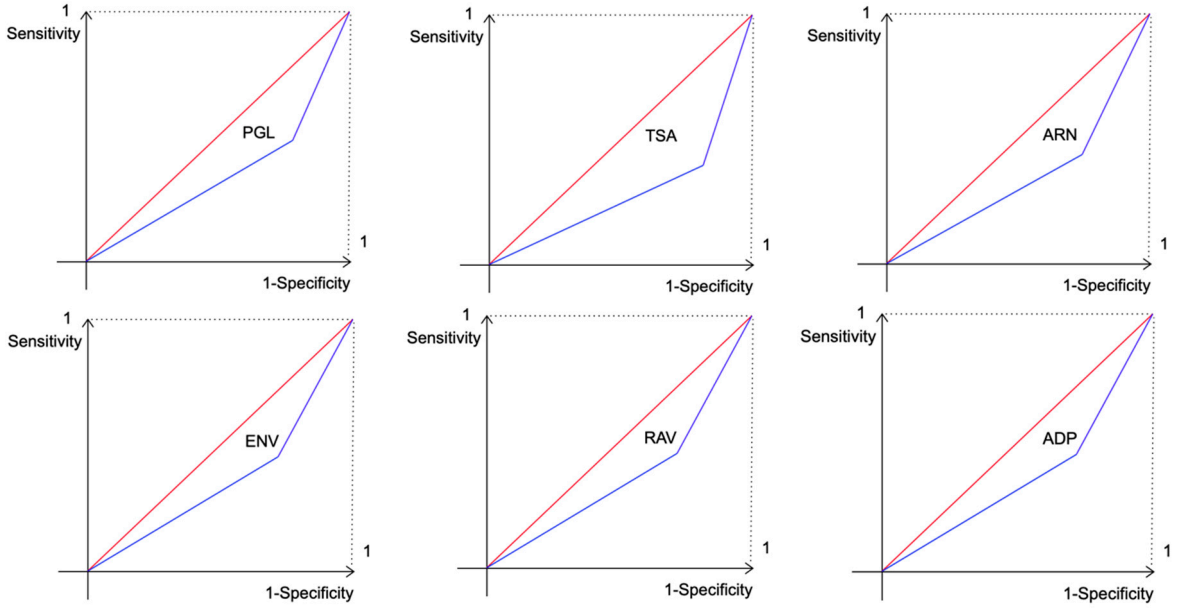

Figure A1. The AUCs of the different digital determinants associated with CSR success.

In Figure A1, the red and blue lines represent the performance of the numerical determinants in the ROC (Receiver Operating Characteristic) analysis to predict the success of CSR (Corporate Social Responsibility) in the sector of car insurance. The red line corresponds to the reference line with an AUC (Area Under Curve) of 0.5, which represents the performance threshold of a random model, that is to say without discrimination capacity. This line is used as a reference point to evaluate the predictive performance of the models. The blue line shows the actual performance of each numerical determinant tested. If the blue curve is to the right of the red line, it means that the numerical determinant has significant predictive ability, with an AUC above 0.5, indicating that it effectively contributes to predicting CSR success. The further the blue curve extends beyond the red line, the stronger the predictive capacity of the determinant. In summary, Figure A1 illustrates that all the numerical determinants tested exceed the threshold of 0.5 for the AUC, thus demonstrating a significant contribution of each of them to the prediction of CSR success.

According to the chi-square test, the connection between digital determinants, online claims management platforms and customer portals, digital roadside assistance, digital vehicle assessment and inspection, advanced safety technologies, data analysis for personalization, augmented reality (AR) and virtual reality (VR), and the response variable "the success of the concept of CSR" in the automobile insurance industry is highly significant, with an asymptotic significance (two-sided) of $p = 0.000 < 0.05$. These results led the research team to reject the null hypothesis H_0. The explanatory determinants chosen in this study had a largely significant link with the response variable, i.e., a significant influence

on the success of CSR in the automobile insurance branches and the consolidation of the insured–insurer relationship.

Regression coefficients/equation variables: the results suggest that all the predictor variables and digital determinants have a highly significant effect on the response variable "the success of CSR" in the automobile insurance branch with regard to policyholders.

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