



Critical success factors in digital transformation projects in the brazilian automotive industry: a qualitative study

Egon Ferreira Daxbacher¹ Silvio Romero de Lemos Meira² and Sergio Castelo Branco Soares³

¹ MSc. in Business Administration. Pontifical Catholic University of Rio de Janeiro – PUC-Rio.
Rio de Janeiro, Rio de Janeiro – Brazil. efd@cin.ufpe.edu.br

² Ph.D. in Computer Science. University of Kent. Canterbury, Kent – United Kingdom.
srlm@cin.ufpe.edu.br

³ Ph.D. in Computer Science. Federal University of Pernambuco – UFPE. Recife, Pernambuco – Brazil. scbs@cin.ufpe.edu.br

Authors' Notes

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Correspondence concerning this article should be addressed to Egon Ferreira Daxbacher:

efd@cin.ufpe.edu.br

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Abstract

Objective of the study: To clarify the critical success factors in the management of digital transformation projects in the Brazilian automotive sector, given the challenges and changes imposed by the digital economy and national economic crises.

Methodology: A qualitative study with analysis of semi-structured interviews of 12 executives from four major vehicle manufacturers in Brazil by using MAXQDA software for qualitative data analysis.

Originality/relevance: This study addresses a gap in academic research focused on critical success factors for digital transformation projects, particularly in the context of the Brazilian automotive industry (BAI), in order to provide significant insights for future research and contribute to the scientific knowledge base on digital transformation.

Main results: Identification of common critical success factors in the management of digital transformation projects in the BAI and proposal of a model enabling its implementation in future projects for increasing their chances of success in the current competitive market.

Theoretical/methodological contributions: This study contributes to the specialized literature by integrating theory and practice on digital transformation, highlighting the importance of factors such as leadership, strategy, and organizational innovation, and providing a practical model based on the results obtained for application to future initiatives.

Contributions to society: This study suggests a model for digital transformation in the BAI which can enhance the company's competitiveness and efficiency, while contributing to the economy's and society's sustainability by fostering innovation and creating specialized jobs.

Keywords: digital transformation, digitalization, critical success factors, best practices

Fatores críticos de sucesso em projetos de transformação digital na indústria automobilística brasileira: um estudo qualitativo

Resumo

Objetivo do estudo: Elucidar os fatores críticos de sucesso na gestão de projetos de Transformação Digital no setor automobilístico brasileiro, diante dos desafios e mudanças impostas pela economia digital e as crises econômicas nacionais.

Metodologia: Realização de uma pesquisa qualitativa com análise de entrevistas semiestruturadas de 12 executivos de quatro grandes montadoras de veículos no Brasil, utilizando o software MAXQDA para a análise de dados qualitativos.

Originalidade/ relevância: A pesquisa aborda uma lacuna nos estudos acadêmicos focados nos fatores críticos para o sucesso de projetos de Transformação Digital, particularmente no contexto da Indústria Automobilística Brasileira (IAB), oferecendo insights significativos para futuras pesquisas e contribuindo para o corpo de conhecimento científico sobre a Transformação Digital.

Principais resultados: os resultados apresentaram um modelo com os fatores críticos de sucesso e as melhores práticas para o gerenciamento de projetos de Transformação Digital na IAB.

Contribuições teórico/metodológicas: Identificação de fatores críticos de sucesso comuns na gestão de projetos de Transformação Digital na IAB e proposta de um modelo habilitador para implementação em projetos futuros, visando aumentar suas chances de sucesso no mercado competitivo atual.

Contribuições para a sociedade: O estudo propõe um modelo para a Transformação Digital na IAB que pode melhorar a competitividade e eficiência das empresas, enquanto contribui para a economia e sustentabilidade da sociedade, promovendo inovação e gerando empregos especializados.

Palavras-chave: transformação digital, digitalização, fatores críticos de sucesso, melhores práticas

Factores críticos de éxito en proyectos de transformación digital en la industria automotriz brasileña: un estudio cualitativo

Resumén

Objetivo del estudio: Aclarar los factores críticos de éxito en la gestión de proyectos de Transformación Digital en el sector automotriz brasileño, dados los desafíos y cambios impuestos por la economía digital y las crisis económicas nacionales.

Metodología: Realización de una investigación cualitativa con análisis de entrevistas semiestructuradas a 12 ejecutivos de cuatro grandes fabricantes de vehículos en Brasil, utilizando el software MAXQDA para el análisis de datos cualitativos.

Originalidad/relevancia: La investigación aborda una brecha en los estudios académicos enfocados en los factores críticos para el éxito de los proyectos de Transformación Digital, particularmente en el contexto de la Industria Automotriz Brasileña (IAB), proporcionando percepciones significativas para futuras investigaciones y contribuyendo a la base de conocimiento científico sobre la Transformación Digital.

Resultados principales: Identificación de factores críticos de éxito comunes en la gestión de proyectos de Transformación Digital en la IAB y propuesta de un modelo facilitador para la implementación en proyectos futuros, con el objetivo de aumentar sus posibilidades de éxito en el mercado competitivo actual.

Aportes teóricos/metodológicos: La investigación contribuye a la literatura especializada integrando teoría y práctica sobre la Transformación Digital, destacando la importancia de factores como el liderazgo, la estrategia y la innovación organizacional, y proporcionando un modelo práctico basado en los resultados obtenidos para la aplicación en iniciativas futuras.

Contribuciones a la sociedad: El estudio propone un modelo para la Transformación Digital en la IAB que puede mejorar la competitividad y la eficiencia de las empresas, al mismo tiempo que contribuye a la economía y la sostenibilidad de la sociedad, promoviendo la innovación y generando empleos especializados.

Palabras clave: transformación digital, digitalización, factores críticos de éxito, mejores prácticas

Introduction

In the past years, the digital transformation in the automotive industry has drawn attention of the academic research. This transformation process goes beyond the mere adoption of digital technologies for automotive products, as it represents a comprehensive operational review affecting everything, that is, from the manufacturing processes to commitment with the client and post-sales services.

The Brazilian automotive industry (BAI), particularly, has been facing great challenges in the past 12 years. The successive economic crises in Brazil made the vehicle plate registration not to resume that level of 2012 anymore, when 3,627,715 light vehicles were licensed (AUTOO, 2023). In addition, the change in the customer's profile has made the selling process in the sector be increasingly more digital (Mercado & Consumo, 2023). And these are only two examples evidencing how this very important industry for the country, which accounts for 2.5 percent of the gross domestic product and for 20 percent of the Brazilian industry, has been challenged by an even more difficult dynamic (ANFAVEA, 2023). The BAI has followed up the global trend of automation, digitalization, and innovation in the sector (Riasanow et al., 2017; Llopis-Albert, Rubio & Valero, 2020) and significantly invested in digital transformation projects to secure the own competitiveness (Alves, 2019).

Studies highlight how digital transformation is increasing the manufacturers' profitability and competitiveness as a result of the improvement of the customers' satisfaction with the services provided (Llopis-Albert, Rubio & Valero, 2020). The rising of connected autonomous cars illustrates the re-shaping of the customers' expectations and demands because of such new products and digital services (Verevka, Gutman, & Shmatko, 2019). However, the journey towards a digital transformation in the automotive industry is not free of challenges. Companies face the challenging task of following up the rapid technological advances, especially regarding the electrical and autonomous vehicles, which requires continuous adaptation in order to remain relevant and competitive (Simonazzi, Sanginés, & Russo, 2020). Managing and analyzing efficiently the vast volume of data generated by several digital sources, including real-time prediction of quality and development of data pipelines, are another significant challenge (Uguroglu, 2021). In addition, digital transformation requires a substantial organizational restructuring involving new business processes and structures in order to adapt to digital strategies, but which diverge significantly from the traditional automotive business models (Dremel et al., 2017).

Creating a digitally qualified workforce and changing the employees' mind-set for adapting to new tools and methods of digital work are still a significant obstacle, which often requires extensive training and development programs (Mazurchenko & Zelenka, 2021). Cyber security and data protection are great challenges as the automotive companies depend increasingly on digital technologies, meaning that they need robust security measures to protect their data and digital systems (Brandtner, Mayrboeck & Zimmermann, 2022). Adapting to changes in the customers' behaviors and expectations has been considered crucial in this digital era. Automotive companies also try to evolve their strategies with customer experience in order to

keep in line with the digital communication channels and data sources used by clients (Tanase, 2018).

The complexity of digital transformation, which goes beyond the mere adoption of new technologies and implies a re-definition of the business models for ensuring survival in the digital market, is supported in the specialized literature (Kane et al., 2015). Investigations of the factors determining the success in initiatives of digital transformation reveal the importance of elements such as leadership, strategy, and organizational innovation, as discussed in relevant academic studies (Rogers, 2016; Holotiuk & Beimborn, 2017; Sebastian et al., 2020). In addition, this study incorporates insights on the practical implementation of these projects by assessing theoretical contributions as well as those applied to the field (Gurbaxani & Dunkle, 2019), which are then complemented with data on market research demonstrating global patterns and trends (Fujitsu Future Insights, 2018).

The present study identified a gap regarding the academic research focused on critical success factors for management of digital transformation projects, particularly in the context of the Brazilian automotive industry (BAI). In view of this lack of information, one sought to find grounds from research on such critical dynamics, in which studies on automotive industry (Chaniias & Hess, 2016; Barthel & Hess, 2019; Bathia & Kumar, 2020) and particularly the BAI are highlighted, for analyses and propositions of implementation (Nagli, 2019; Rocha et al., 2021; Ribas & Teixeira, 2021; Cordeiro, 2022). This approach allowed understanding not only the critical success factors in the management of these projects, but also proposing ways to apply them in the practice. The academic relevance of the present study is emphasized as it contributes significantly to future research and broadens the scientific knowledge base on digital transformation.

In view of the current context and considering the investments made and their impacts on the Brazilian automotive industry, the following central question arises: Which are the critical success factors in the management of digital transformation projects in this sector? Therefore, this study aims to answer such a question by presenting findings of a qualitative research on critical success factors in the management of these projects in the Brazilian automotive industry.

The methodology used involved a qualitative analysis to capture, process and interpret the viewpoints of the leaders of the major four automotive manufacturers in the country, all subsidiaries of large global corporations. By using semi-structured interviews with 12 BAI executives and the MAXQDA software for qualitative data analysis, this study sought to determine which success factors are critical for initiatives of digital transformation in the BAI.

The results point to an identification of critical success factors which are common in the digital transformation projects within the industry in question. In addition, this study proposes an enabling model based on research conclusions which could be implemented in future projects to increase their odds of success. This is particularly relevant in the current environment of digital economy, where the automotive industry in Brazil must be equipped to face a new era of competitiveness in which digitalization is key for participation in the market.

Theoretical Reference

Definitions and Approaches to Digital Transformation

The term ‘digital transformation’ has become extremely popular in the recent years, but which has two distinct consequences: the first is the consolidation of the importance of the theme and the second is the vulgarization of it or even confusion on the concept (Morakanyane et al., 2017). In Table 1, one can observe that there are as many definitions for digital transformation as there are authors and researchers.

Table 1

Definitions for Digital Transformation

Authors	Definition
Liu <i>et al.</i> (2011)	It refers to the integration of digital technologies in business processes.
Bharadwaj <i>et al.</i> (2013)	It is considered an organizational strategy formulated and performed by leveraging digital resources for creation of differential values for the clients.
Fitzgerald <i>et al.</i> (2013)	It is associated with the use of digital technologies to allow for business improvement.
Lucas <i>et.al</i> (2013)	It can fundamentally alter the traditional forms of trading by redefining capabilities, processes, and relationships of business.
Mithas <i>et al.</i> (2013)	It can be understood as an extension through which an organization engages with any Information technology-related activity.
Westerman <i>et al.</i> (2014)	It is related to the use of technology to radically improve the organization's performance or outreach.
Piccinini <i>et al.</i> (2015)	It is characterized by the use of new digital technologies for significantly improving the business process.
Schuchmann & Seufert (2015)	It allows technological realignment and new business models so that the digital customers can be more efficiently involved in all points of contact within their lifecycle experience.
Chanias & Hess (2016)	It allows reflecting the reach of the changes induced by the digital technology throughout the organization.
Hess <i>et al.</i> (2016)	It refers to changes the digital technologies can bring to the company's business model, resulting in changes in products, structures, or process automation.
Henriette <i>et al.</i> (2015)	It can be considered a business model boosted by changes associated with the application of digital technology to all aspects of human society.

Source: Elaborated by the author based on Morakanyane *et al.* (2017).

The concept of digital transformation has been widely used in contemporary studies, being defined as the use of digital technologies for transforming business process and models in order to allow organizations to compete efficiently in the digital scenario (Kane *et al.*, 2015). This understanding is enriched by the perspective that digital transformation encompasses the integration of digital technology in all aspects of an organization, resulting in improved

performance and increased values for the clients (Llopis-Albert, Rubio & Valero, 2020; Gebayew et al., 2018).

Although digital transformation and digitalization can be perceived as distinct concepts, this study defines them as synonymous terms (Osmundsen et al., 2018). It would be necessary to differentiate inherently digital companies from the traditional or incumbent ones. The latter ones are now undergoing the adaptation process or are at the beginning of their digital transformation (Verevka, Gutman, & Shmatko, 2019).

Digital transformation represents a significant change of paradigm for the incumbent companies, as the adoption of digital practices opens doors for new business opportunities (Simonazzi, Sanginés, & Russo, 2020; Sebastian et al., 2020). Companies of the automotive sector, including those operating in Brazil, are examples of such transition (Uguroglu, 2021).

The use of digitalization transcends the mere implementation of technologies as it resides in the organizational ability of capitalizing new waves of change (Dremel et al., 2017; Plummer et al., 2014). The outreach of significant benefits is intrinsically related to the successful implementation of digital projects (Abylova & Salykova, 2019).

Critical Success Factors in the Digital Transformation

The present study explores critical success factors in corporate digital transformation projects. Such factors are understood as the characteristics, conditions, or variables which, if well managed, could have a significant influence on the project's success (Milosevic & Patanakul, 2005). These elements are considered important management tools for project managers as they contribute to the monitoring and communication of the project's progress (Mazurchenko & Zelenka, 2021), thus being used to increase the likelihood of success (Abylova & Salykova, 2019; Bhatia & Kumar, 2020).

The critical success factors (CSF) for digital transformation projects differ depending on the projects and sectors, which reflects the diversity of operational contexts of the organizations (Pinto & Slevin, 1989). This variation shows the importance of a careful evaluation of these factors as each project and each sector have unique characteristics affecting the success (Tanase, 2018).

In the journey towards to a digital transformation, the application of technology is only one among various components necessary for success. Digital transformation also covers the participation and qualification of personnel, development of strategic partnerships, adoption of innovative management models, customer involvement, organizational restructuring, and corporate strategy review (Brandtner, Mayrboeck, & Zimmermann, 2022; Rogers, 2016). Therefore, organizations should adopt a holistic approach considering all these aspects for an effective digital transition (Holotiuk & Beimborn, 2017).

Holotiuk and Beimborn (2017) identified 40 CSFs distributed in eight main dimensions for development of digital business models. These dimensions include culture, leadership, human competencies, vision, data, infra-structure, operations, and partnerships, all aimed at providing a framework for development of digital strategies. Additionally, analysis of already-established organizations (e.g. BAI) shows that digitalization involves the definition of digital strategies, investment in operations, creation of digital platforms and promotion of a service-oriented culture (Sebastian et al., 2020).

The traditional companies face singular challenges in the adoption of digital transformation practices because this transition is less about incorporation of new technologies and more about re-configuration of corporate and operational strategies. The Global Digital Transformation Survey Report 2018 pointed out that executives of different sectors recognize that a set of CSFs for digital transformation, including leadership, agility, business integration, robust

ecosystem and value from data, comprise the base upon which mature companies develop their digitalization strategies (Fujitsu Future Insights, 2018).

Additionally, specific analyses of the automotive sector emphasize the relevance of digitalization for keeping competitive advantages and exploring new models of business and innovations, suggesting that these projects carry a considerable strategic burden (Chanas & Hess, 2016). In digital transformation projects, a series of interlinked factors can contribute to the success of corporate initiatives. Data governance, legal conformity and a robust IT infra-structure form the technological backbone necessary to support the digital transition (Bhatia & Kumar, 2020). In addition, collaboration and organizational culture are recognized by their role in catalyzing changes and sustaining continuous innovation, whereas the definition of a clear strategic view guides the companies throughout this transformation process (Ribas & Teixeira, 2021).

Connectivity, customer involvement, process adaptation and personnel competency emerge as elements which, together with a strategic alignment, are indispensable for implementation of structural changes accompanying the demands of a volatile market (Ribas & Teixeira, 2021). These elements not only boost the implementation of digital technologies, but also facilitate the evolution of the whole organization aiming at a more agile and responsive business model.

These perspectives converge into an understanding that digital transformation requires a strategically oriented approach in which technology is only one element of a complex system which also includes personnel, processes, and organizational culture. All these elements should be aligned to support and promote an effective, long-lasting transformation.

Models and Frameworks of Implementation

The academic literature offers a series of frameworks aimed at guiding organizations throughout their journey towards digitalization, with focus on CSFs. These models highlight elements essential for executive leadership, which are key in the digital economy, such as vision of the future, adaptive culture, specialized knowledge, human talent, technological innovations, and clear strategic alignments (Gurbaxani & Dunkle, 2019; Sebastian et al., 2020).

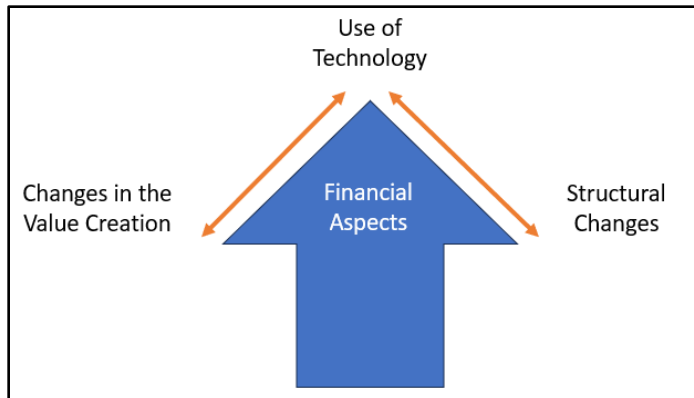
One can observe a congruence between the CSFs identified by Fujitsu Future Insights (2018) and those highlighted by several academic studies elsewhere (Holotiuk & Beimborn, 2017; Barthel & Hess, 2019; Bhatia & Kumar, 2020; Ribas & Teixeira, 2021). This concordance suggests a way for identifying critical elements which, if validated in the Brazilian context, could form the base of a model enabling digitalization in the country.

Although the current literature does not provide a specific model of CSFs for digital transformation projects in the Brazilian automotive industry (BAI), related studies offer valuable insights. For instance, a study by De Carli et al. (2010) on implementation of digital factories reveals factors such as top administration support and personnel's receptivity to changes, which are essential for a successful adoption of advanced digital technologies, as is the case of Digital Twin (Simonazzi, Sanginés & Russo, 2020; Uguroglu, 2021).

In addition, the existing models such as the 4-dimension transformation framework (Matt et al., 2015), Figure 1, and the model integrating culture, processes, personnel, and technology (Laudon & Laudon, 2014) can be adapted for development of a framework to meet specific needs of the BAI. These approaches emphasize the importance of synergy between the various organizational components and suggest that the inclusion of multiple operational and strategic facets is necessary for a successful digital transformation (Brandtner, Mayrboeck, & Zimmermann, 2022; Tanase, 2018).

Figure 1

Digital transformation framework



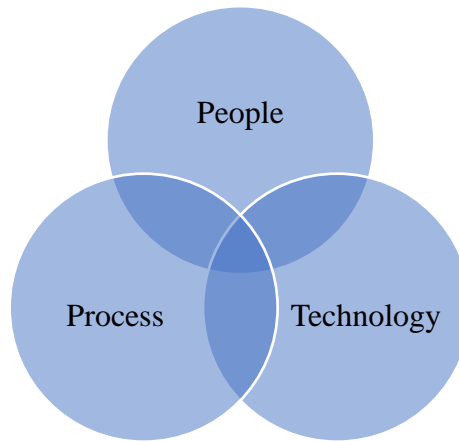
Source: Adapted from Matt et al. (2015).

In the search for a model enabling CSFs in digital transformation projects in the Brazilian automotive industry (BAI), the PPT (People, Process & Technology) framework (Leavitt, 1965) emerges as a visually clear and didactic approach in which several CSFs are condensed regarding three essential elements, namely, people, processes, and technology (Figure 2).

This choice is supported by previous studies (Verina & Titko, 2019; Nagli, 2019) and indicates that this model can be possibly used as a guiding tool for boosting digital transformation projects in the BAI. Such studies highlight how the use of the PPT framework can facilitate the understanding and implementation of CSFs in specific contexts (e.g. BAI), thus being a viable option for successfully carrying out these projects.

Figure 2

Framework PPT (People, Process & Technology)



Source: Adapted from Leavitt. (1965).

The PPT framework plays a relevant role in the success of management projects, especially in those of digital transformation, as it provides a holistic approach in which the intrinsic interconnection between three components (people, process, and technology) is recognized. In the context of people, the emphasis is on the importance of qualified personnel who are committed and aligned with the organization's strategic goals and on a leadership capable of guiding and motivating people, optimizing processes, and boosting an effective integration to ensure the success of these projects (Verina & Titko, 2019).

In the process dimension, the model highlights the importance of well-defined and effective structures to ensure that operations are performed for the search of excellence. Constant review and optimization of processes enable a continuous improvement, thus favoring operational efficiency and adaptation to changes in the organizational setting as a result of the implementation of new technologies (Leavitt, 1965).

Finally, in the context of technology, the strategic selection of digital tools and platforms plays a crucial role in facilitating operations and supporting the execution of the organization's strategic objectives. The adoption of technologies enabling digital transformation contributes to the agility and capacity to respond to the market demands, which ensures the relevance and competitiveness in the long run (Nagli, 2019). Altogether, these three elements form a comprehensive model to boost the success of digitalization initiatives in the organizations by means of synergy between human, process, and technological dimensions (Petersen, 2018), thus contributing to increasing the likelihood of a successful management of projects, specifically the digital transformation one, which is in alignment with the objective of the present study.

Method

The present study uses a qualitative approach with application of semi-structure interviews. According to Kvale (2008), a qualitative study is suitable when one intends to address social phenomena in a real workplace setting by analyzing the individuals' experiences related to professional practices. Semi-structured interviews have a flexible, accessible, and intelligible format so that the interviewees can express their views spontaneously, which facilitates the understanding of how they perceive their activities in the workplace (Qu & Dumay, 2011). For Rubin and Rubin (2011), the information resulting from semi-structured interviews helps identify a process as a discovery factor in the setting where the study was carried out. The objective of this interview is to investigate knowledge by showing the interviewees' experiences in each construct to better understand the phenomenon being investigated (Creswell, 2017). Therefore, it is presumed that the learning acquired in a typical company can be informative for others in the same industry sector.

The present study was conducted in four automotive manufacturers, all subsidiaries of large multinational corporations, and who account for one-third of the participation in the

automotive market. Due to reasons of confidentiality, these companies’ names will not be revealed nor any other information on their identification. The list of automotive manufacturers investigated in the present study is presented in Table 2.

Table 2

List of Automotive Manufacturers

Company	Description	Relationship with digital transformation
I-01	Subsidiary of a large multinational group	Investment in digital transformation is mainly focused on the commercial area.
I-02	Subsidiary of a large multinational group	Investment in digital transformation is mainly focused on the industrial area.
I-03	Subsidiary of a large multinational group	Investment in digital transformation is mainly focused on the commercial and industrial areas.
I-04	Subsidiary of a large multinational group	Investment in digital transformation is mainly focused on the commercial and industrial areas.

Source: Elaborated by the author, 2023

The companies listed in Table 2 were selected for convenience because one of this study’s authors has more than 10 years of experience in the sector and because of their predominance in the Brazilian automotive market. In addition, these companies have relevant portfolios of digital transformation implemented through roll-out projects developed in the parent company as well as locally through independent initiatives. In fact, some projects originating from Brazil are being implemented in other countries where the companies operate, thus aggregating more value to the present study.

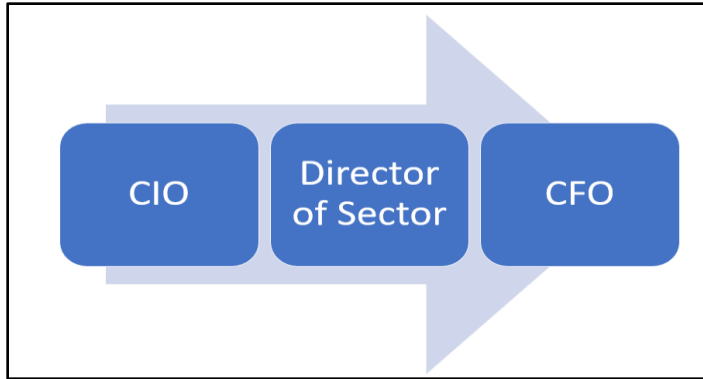
The interviews in the present study were conducted according to a systematic process guidance proposed by Kvale (2008), namely: i) formulation of objective and theme; ii) planning; iii) conduction of interviews; and iv) transcription. In this sense, theme refers to digital transformation projects in the Brazilian automotive manufacturers, including their impacts and characteristics.

Regarding the interviewees, three profiles were selected for each company as follows: chief information officer (CIO), director of digital transformation projects (the one with the most concentration of projects) and chief financial officer (CFO). This composition was designed to ensure different perspectives on the same theme by capturing different viewpoints on the object of the present study. In some cases, for reasons of availability or better knowledge on the projects, the interviewee was a senior executive who was more involved in the company's initiatives of digitalization.

The reason for choosing interviewees at an organizational strategic level in the present study arises from the fact that these executives have a broader knowledge and long-term vision. As shown in Figure 3, the rationale in the interview sequence is that CIO is the executive who better knows the company's digital transformation projects, thus being qualified to indicate which area is the most impacted by such initiatives; then, the director of digital transformation projects is the next to be interviewed, followed by the CFO, who has a better knowledge of financial issues related to the projects' outcomes.

Figure 3

Sequence of the interviews in each company



Source: Elaborated by the author.

The interviewees' profile was defined and is presented in Table 3. For reasons of confidentiality, the names of the interviewees will not be revealed nor any other information on their identification or workplace.

Table 3

Profile of the interviewees

Interviewee	Company	Position	Time in the company	Time in the industry sector	Time in executive position
E-01	I-01	CIO	> 25 yrs	> 25 yrs	> 15 yrs
E-02	I-01	Director	> 20 yrs	> 20 yrs	> 15 yrs
E-03	I-01	CFO	> 10 yrs	> 15 yrs	> 10 yrs
E-04	I-02	IT Manager	> 15 yrs	> 15 yrs	> 5 yrs
E-05	I-02	Director	> 25 yrs	> 25 yrs	> 15 yrs
E-06	I-02	Controller	> 15 yrs	> 15 yrs	> 10 yrs
E-07	I-03	IT Manager	> 15 yrs	> 15 yrs	> 10 yrs
E-08	I-03	Sr. Manager	> 25 yrs	> 25 yrs	> 15 yrs
E-09	I-03	S. Manager	> 20 yrs	> 15 yrs	> 5 yrs
E-10	I-04	IT Manager	> 10 yrs	> 10 yrs	> 5 yrs
E-11	I-04	Director	> 5 yrs	> 25 yrs	> 5 yrs
E-12	I-04	Controller	> 20 yrs	> 20 yrs	> 10 yrs

Source: Elaborated by the author, 2023.

The interview protocol was elaborated with 24 questions on the characteristics of the digital transformation projects in the companies, how the process of approval and implementation was conducted, presence or not of sponsorship, strategic alignment, main difficulties and learned lessons, including the most relevant impacts, negative points, and CSFs in the relevant projects (Table 4). Open questions were also elaborated based on the literature and interview objectives in order to stimulate discussions.

Table 4

Questions of the Interview script (protocol)

Objective: Description of the projects.	
Question	Reference
Which were the initiatives of digital transformation (needs qualification) implemented in the company in the past 10 years? In which areas? With which enabling technologies?	Chantias & Hess, 2016; Barthel & Hess, 2019; Gurbaxani & Dunkle, 2019; Bathia & Kumar, 2020
Was the scope of these projects within the company or did it involve its ecosystem?	
Which are the digital transformation projects (needs qualification) you are currently implementing in the company? In which areas? With which enabling technologies?	
Is the scope of these projects within the company or does it involve its ecosystem?	
Is there a project report summarising objectives, technologies, results, time of implementation, costs or another determining factor?	
Objective: Qualification of the Projects.	
Question	Reference
Which were the main difficulties in approving digital transformation projects?	Abylova, V., & Salykova, L. (2019); Holotiuk & Beimborn, Gurbaxani & Dunkle (2019), Barthel & Hess (2019); Bathia & Kumar (2020), Ribas & Teixeira (2021); Cordeiro, G. A. (2022).
Which were the main difficulties in implementing these projects?	
Which were the critical success factors of these projects?	
Were these projects developed locally or through roll-outs?	
How were/are these projects aligned with strategic objectives?	
Is there a roadmap, data governance, project office or specific portfolio for digital transformation projects?	
Was there any participation of external entities (i.e. consulting agencies, institutes of technology, start-ups, partners, suppliers) or was it an internal development?	
Was there any sponsor? Which one specifically? Was there involvement of collaborators from the customer areas?	
What were the lessons learned with the already-implemented projects? Are they being considered in the new projects?	
Objective: Impact of the Projects	
Question	Reference
How was the day after implementation of the projects?	Lucas, Jr., H. C., et al.. (2013); Piccinini <i>et al.</i> (2015); Riasanow,
What were the benefits for the customer area provided by the projects?	
Was there perception of the results of these projections in the areas?	
What were the changes the areas had to do to adapt to the projects?	

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Was there increase in productivity, decrease in costs, increased customer satisfaction, increment of market share, improvement in the company’s image or products, improvement in the internal processes, reduction in development time, reduction in the delivery time for input materials, pieces and parts, as well as finished products, and improvement in the distributor relationship?	T., Galic, G., & Böhm, M. (2017); Alves, M. S. (2019); Llopis-Albert, C., Rubio, F., & Valero, F. (2020); Simonazzi, A., Sanginés, J., & Russo, M. (2020). Rocha, C., et al. (2021).
What are the measurements used to assess the results of the digital transformation projects?	
Was there creation of new products, new processes, or reduction of overhead?	
Was there financial return from the projects? In which mean percentage (by project)? And at which proportion? (number of projects with positive financial return)?	
Which were the ‘champions’ (references)?	
Was there the creation of spin-offs or start-ups from these projects?	
Was there a spill-over effect as a result of these projects?	
Objective: Qualification of the Projects	
Question	Reference
What is the perception of the customer area on the results of the digital transformation projects?	Ribas, A. I., & Teixeira, L.;
What could be done differently in the portfolio management of these projects?	Verevka, T.,
What is the evaluation of these projects on the part of the directors?	Gutman, S., &
Is there any further comment?	Shmatko, A. (2019).

Source: Elaborated by the author, 2023

All the interviewees were invited by email and informed on the objective of the study, including length and theme of the interview. The interviews were conducted by using the Microsoft Teams tool after being previously scheduled with the researcher according to the availability and preference of the interviewees. Each interview lasted 1 hour, totalizing 12 hours. As asked by the participants, the interviews were not tape-recorded and had to be transcribed word by word by the researcher, who used the verbatim transcription to record the dialogues in detail, which also included non-verbal and para-verbal elements (Oliver, Serovich & Mason, 2005). Altogether, the transcription yielded 38 pages with 9,740 words written in simple space.

Data analysis was performed in three phases: i) pre-analysis, in which the transcribed material was read; ii) exploration of the collected material, which was outlined and grouped by theme; and iii) treatment of the results, inference and interpretation, with the expressed and latent content of the material being interpreted based on theoretical reference.

After the pre-analysis and exploration of the collected material, an open codification process was performed according to the guidelines described by Corbin & Strauss (2008). This strategy allows for a more detailed analysis, resulting in a more complete understanding of the participants' viewpoints.

Table 5

List of Codes

Learned lessons	Sponsorship	Strategic alignment	Critical success factors
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Source: Elaborated by the author, 2023.

Once data from the interviews were collected, they were exported to the MAXQDA software for qualitative analysis. This software has an intuitive interface which enables importing and organizing transcriptions efficiently, thus providing a more systematic and complete analysis of the collected data.

The use of this software allowed for codification and categorization of the data so that patterns could be identified for comparisons between the interviewees of the same company as well as between the companies. This, in the end, enabled us to build associations with the concepts raised in Theoretical Reference section. According to Miles & Huberman (1994), after codification, it is possible to analyze the correlation between information from the answers and

CSFs highlighted in the literature. This method allowed creating significant inferences based on the data obtained.

Presentation of the results

The results obtained from the interviews and after data treatment with MAXQDA software are listed in this section on a consolidated basis, with answers regarding all the companies. They are also grouped by the four codes used in the data treatment, namely: sponsorship, strategic alignment, learned lessons and CSF.

It is important to emphasize that some answers had to be erased or edited in order to maintain data confidentiality, mainly in terms of the participants' identity or of their companies. Nevertheless, the author sought to keep the meaning of the answer by avoiding modifying the phrase significantly, even when it was necessary to replace a given word.

Table 6 lists the answers regarding the two codified themes present in the answers of all companies, namely: sponsorship from directors and strategic alignment.

Table 6

Compilation of the answers on sponsorship and strategic alignment

Sponsorship	Strategic Alignment
<p>Yes, as a result of the alignment with the strategic planning, the sponsorship was immediate. In the case of these projects, with effective involvement of collaborators of the area.</p>	<p>100-percent aligned with the strategic planning and the company is committed to become digital.</p>
<p>Yes, the executive board meets once a month to assess the digital transformation projects.</p>	<p>100-percent aligned with the strategic planning and focused on generating value to the company.</p>
<p>Yes, from the CIO to the middle-level managers of the company.</p>	<p>100-percent aligned with the company's strategic planning according to the I-4.0 concepts</p>
<p>Fully, with the business directors assuming the leadership of the projects</p>	<p>Completely aligned, both locally (Latam) and globally.</p>
<p>Yes, mainly in the business areas, with IT playing an important role in support.</p>	<p>There is no possibility of approving such large-scale initiatives which are not aligned with the company's strategy. The company's strategy seeks complete digitalization of the processes.</p>
<p>Yes, with bi-weekly reports on the progress of the projects and already-achieved results.</p>	<p>100-percent aligned with the strategy because digital transformation is an integrating part of the company's global strategy.</p>
	<p>Fully aligned, as these projects affect the client's decision-making regarding the purchase.</p>
	<p>100-percent aligned because digital transformation is one of the company's strategic pillars.</p>

Source: Elaborated by the author, 2023.

These two elements, namely, top management sponsorship and strategic alignment were also present in the studies by Gurbaxani and Dunkle (2019) as well as by Chanias and Hess (2016), which were objects of questions on whether this premise was present in the BAI's reality, appearing in all answers given by the interviewed executives, as exemplified in the answer below:

“[...] There is no possibility of approving such large-scale initiatives which are not aligned with the company's strategy. The company's strategy seeks complete digitalization of the processes” (Respondent E004)

The other two codifications used in the present study for data treatment were the identification of learned lessons for addressing the difficulties faced in the digital transformation projects as well as the identification of the interviewee's perception of CSFs from these initiatives. A compilation of the answers on these elements are listed in Table 7.

Table 7

Compilation of the answers on learned lessons and critical success factors (CSF)

Learned Lessons	Critical Success Factors
<p>Change in mind-set, training, resistance by collaborators, customer’s adaptation and resistance to changes.</p> <p>Difficulty in orchestrating different partnership (distributors, employees, and Consulting agents).</p> <p>Evaluation of the competence and mind-set of the team involved in the initiatives.</p> <p>Selection of collaborators with better digital profiles (having the right team).</p> <p>Cultural alignment.</p> <p>Better planning by anticipating problems and better selection of members from the project team by selecting more digital profiles.</p>	<p>Focus on all organizational levels of the distributors. Ambitious objectives shared between manufacturer and distributors.</p>
<p>To increase the long-term focus and to decrease the short-term actions.</p> <p>Not to adopt outdated technologies and to seek more autonomy.</p> <p>To increment the financial results of the projects.</p>	<p>Manager’s leadership of the initiatives and top-management sponsorship. Company’s obsession with the success of the digital transformation projects</p>
<p>To reach the performance of the application as promised by the project regarding response time.</p> <p>Adaptability to digitalization by collaborators, distributors, and customers.</p> <p>High expectation of rapid productivity gains in the process.</p> <p>Involvement of more people in projects with higher aggregate value.</p> <p>Greater attention to cultural transformation.</p>	<p>Mind-set based on digital thinking. Strong culture. Planning of the user’s experience aiming at future usability of the application.</p>

Continues on the next page

<p>High level of complaints due to problems with architecture and infrastructure.</p> <p>Conflicts between distributors and project team requiring change management.</p> <p>Well-structured work methodology.</p> <p>Necessity to ensure delivery with performance (response time) of application in line with the user's expectancy.</p> <p>Prioritization of urgencies demanding much attention and generating stress in the team.</p>	<p>Technical competence of the team; organizational culture open to changes; business and IT partnerships; top management sponsorship; global support.</p>
<p>High cost of technological devices decreases investments for infrastructure.</p> <p>To demonstrate gains obtained from the adoption of digital transformation.</p> <p>Openness to opportunities emerging throughout the execution of the projects.</p> <p>Need for pilots.</p> <p>To prepare personnel in terms of qualification.</p>	<p>Team's commitment; connection with suppliers of systems and products; implementation strategy with adoption of pilots.</p>
<p>Adoption curve of innovations, generating distrust.</p> <p>Frustration with absence of immediate returns.</p>	<p>Support of the top management; financial discipline.</p>
<p>Infrastructure left with little digitalization and outdated.</p> <p>Company's mind-set, sometimes with resistance.</p> <p>Available qualified human resources.</p> <p>Business as a protagonist.</p>	<p>Synergy between the areas, top management support and financial availability.</p>

Continues on the next page

<p>The leader’s profile has to encompass knowledge (business and technical) and attitude (leadership) aligned with the company’s culture since the beginning.</p> <p>Technological devices are crucial in the digital transformation initiatives due to their specificities, high cost and lead time.</p> <p>Need to include lead time in the schedules for these devices.</p>	
<p>Data collection and delayed input in the development of projects.</p> <p>Faster implementation of projects and to reduce the delay in technology.</p>	<p>Alignment of the expectations.</p> <p>Control of anxiety among collaborators and top managers.</p> <p>Understanding that this is a journey demanding process change, mainly culturally. To-management sponsorship.</p>

Source: Elaborated by the author, 2023

Discussion

Analysis of the aggregate results of the interviews revealed the universality of two factors among the participants of all companies involved in the study, namely: top management support and strategic alignment. Support of the top management is key for successful digital transformation projects, especially due to the significant financial investment and changes in organizational processes required by such projects. This support is essential because top level executives are the ones who can make resources available and have authority necessary to overcome technical and managerial challenges inherent to these projects. An effective sponsorship facilitates overcoming obstacles and directs the resources during the implementation of initiatives (Gurbaxani & Dunkle, 2019; Chaniás & Hess, 2016; Simonazzi, Sanginés & Russo, 2020).

In addition, top management support is usually provided because these projects are considered fundamental for the company's future. Carrying out these projects paves the way towards the objectives and goals defined in the strategic planning, thus contributing to the realization of the organization's long-term vision. Therefore, strategic alignment of the digitalization initiatives allows adequate project prioritization, allocation of critical resources and continuous attention by the top management by integrating and realigning the importance of such support (Ribas & Teixeira, 2021; Uguroglu, 2021).

In this sense, it is reasonable to consider these two elements as being necessary pre-requisites for digital transformation projects in the BAI to create the base for a framework of CSFs, which should be adopted by the industry, otherwise, it would be impossible to implement such initiatives (Bathia & Kumar, 2020).

Analysis of the data collected from the several companies participating in the study identified and explored associations between the indicated CSFs, which allowed determining common patterns. This understanding facilitated the construction of a unified model of critical factors for an effective implementation of digital transformation projects potentially adoptable by the automotive industry. Analytic process also enabled inter-related elements to be grouped into unique categories, thus simplifying the comprehension and application. For instance, the concept of 'data' and 'data value' were synthesized into a single critical factor, which emphasizes the need to use efficiently the data in the digital transformation. Similarly, 'ecosystem' and 'partnership' were integrated due to their relevance combined with the development of collaborative innovation networks (Dremel et al., 2017; Mazurchenko & Zelenka, 2021).

Analysis reflects a consensus in the perceptions on the challenges faced throughout the digital transformation, as illustrated by the difficult experience shared during orchestration of different partnerships and collaborators. This synthesis not only saves interpretative efforts, but

also provides the base for a leaner and efficient model of critical factors which can be used as reference for future initiatives of digitalization in the BAI and related sectors. The similarities found in the studies by Rogers (2016), Bathia & Kumar (2020) and Holotiuk & Beimborn (2017) evidenced a convergence of factors such as ‘data’ and ‘ecosystem’, thus reinforcing the importance of collaboration and data management as being key learned lessons for a successful digital transformation.

Initial analysis points to the possibility of developing a model of better practices in which nine factors are included: culture, leadership, personnel, vision, ecosystem, data, infra-structure, operations, and agility. In reviewed studies, strategy emerges as a highlighted factor, particularly the strategic vision (Holotiuk & Beimborn, 2017) and strategic alignment, as well as strategic vision for digital transformation projects (Gurbaxani & Dunkle, 2019; Ribas & Teixeira, 2021). These concepts are also reflected in the interviewees’ answers, as exemplified by the emphasis on long-term oriented actions.

Table 8 shows a detailed representation of the correlations extracted from the four companies regarding critical success factors.

Table 8

Correlation between answers and critical success factors according to Holotiuk & Beimborn (2017), Gurbaxani & Dunkle (2019), Barthel & Hess (2019), Bathia & Kumar (2020), Ribas & Teixeira (2021) and Global Digital Transformation Survey Report da Fujitsu

Cultural	Cultural alignment. More attention to cultural transformation. Company’s mid-set, sometimes with resistance. Leader has to have a profile of knowledge (business and technical) and attitude (leadership) aligned with the company’s culture since the beginning. Change in mind-set. Mind-set adopting a digital thinking. Strong culture. Organizational culture open to changes. Synergy between the areas. Understanding that it is journey demanding process changes, mainly culturally.
Leadership	Better planning with anticipation of problems and better selection of members from the project teams based more on digital profiles. Involvement of more people in projects with more aggregate value. Conflicts between distributors and project team requiring change management. Prioritization of urgencies demanding much attention and generating stress in the team. Openness to opportunities emerging throughout the execution of the projects. The leader’s profile has to encompass knowledge (business and technical) and attitude (leadership) aligned with the company’s culture since the beginning. Managers’ leadership of the initiatives and top management sponsorship. Top management support. Alignment with expectations. Control of anxiety among collaborators and top managers.
Personnel	Training, resistance by collaborators, and resistance to changes. Time evaluation regarding the competence and mid-set of the team involved in the initiatives. Selection of collaborators with more digital profiles (the right time). To prepare personnel based on competence. Available qualified human resources. Technical competence of the team. Team’s commitment.
Vision	To increase the long-term focus and to decrease the short-term actions. High expectation of rapid productivity gains in the process. To demonstrate gains obtained from the adoption of digital transformation. Need for pilots. Adoption curve of innovations, generating distrust. Frustration with absence of immediate returns. Business as a protagonist. Company’s obsession with the success of the digital transformation projects 1. Global support. Implementation strategy with adoption of pilots
Data	Data collection and delayed input in the development of projects.

Continues on the next page

<p>Infra-structure</p>	<p>High level of complaints due to problems with architecture and infra-structure. Not to adopt outdated technologies and to seek more autonomy.</p> <p>To reach the performance of the application as promised by the project regarding response time. Necessity to ensure delivery with performance (response time) of application in line with the user’s expectancy. High cost of technological devices decreases investments for infra-structure.</p> <p>Infra-structure left with little digitalization and outdated. Technological devices are crucial in the digital transformation initiatives due to their specificities (different technologies and jobs), high cost and lead time, Connection with suppliers of systems and products.</p>
<p>Operations</p>	<p>To increment the financial results of the projects. Change in the processes. Need to include lead time in the schedules for these devices. Well-structured work methodology. Planning of the user’s experience aiming at future usability of the application. Business and IT partnerships. Financial discipline. Financial availability.</p>
<p>Agility</p>	<p>Faster implementation of projects and to reduce the delay in technology.</p>
<p>Ecosystem</p>	<p>Difficulty in orchestrating different partnership (distributors, employees and Consulting agents). Adaptability to digitalization by collaborators, distributors and customers. Client’s adaptation. Focus on all organizational levels of the distributors. Ambitious objectives shared between manufacturer and distributors.</p>

Source: Elaborated by the author, 2023

In Table 8, one can observe that the participant’s answers are aligned with the nine CSFs common to the digital transformation projects in the Brazilian automotive industry (BAI). In order to promote adoption and simplification, it is proposed a conceptual model in which these CSFs can be grouped rather than eliminated.

The initial question raised in the present article (Which are the critical success factors in the management of digital transformation projects in the BAI?) is answered based on the results and correlations with factors identified in the Theoretical Reference section. The congruence between the interviewees’ answers and the observations of these authors contributed to the formulation of a framework covering the nine previously cited critical factors. This framework

also recognizes the top management sponsorship and strategic alignment as key components for carrying out these projects, given their consistent presence in all cases studied.

However, a model aimed at serving as a reference for an industry needs to be accessible and of easy implementation. A framework with nine axes can be perceived as complex. Therefore, based on the PPT (people, process & technology) model (Leavitt, 1965), which was addressed in the Theoretical Reference section, is proposed to be an alternative model for simplifying visualization and facilitating comprehension, thus effectively integrating the nine critical factors identified.

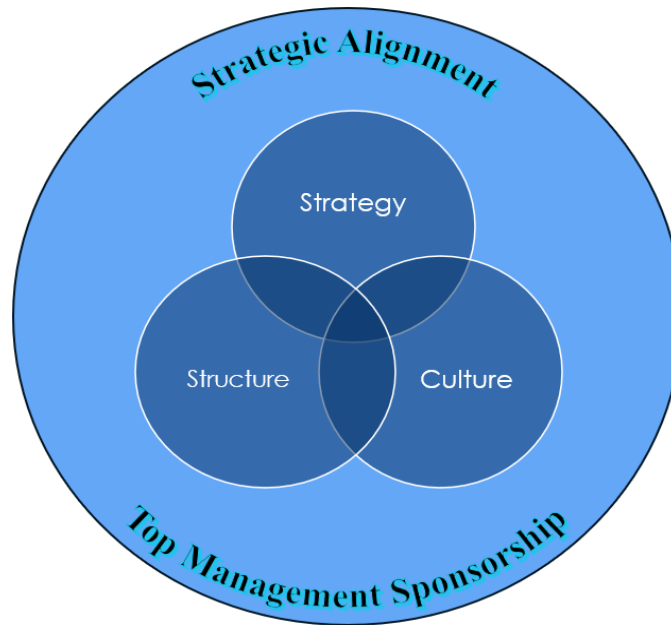
Considering that such a strategy involves planning and coordination of actions to meet the long-term objectives, the organization's operational environment should also be taken into account. It is also suggested that the fusion of culture, leadership and personnel into a single category termed as 'culture' (organizational), thus reflecting the idea that culture is expressed through people, particularly, in the leadership.

Additionally, this model groups the factors 'infra-structure', 'data', 'operations' and 'agility' under the denomination of 'structure' based on the understanding that these elements are intrinsically linked to the organizational configuration and its effective operability.

Therefore, the present study of multiple cases in the Brazilian automotive industry allows deriving a model of CSFs for digital transformation projects based on three main pillars: strategy, structure, and culture (organizational). This model is reinforced by strategic alignment and top management sponsorship, as illustrated in Figure 2.

Figure 4

Framework of critical success factors in the management of digital transformation projects in the Brazilian automotive industry



Source: Elaborated by the author, 2023.

This article has contributed to the academic literature by elucidating the universality of two critical success factors, namely, top management support and strategic alignment, in digital transformation projects in the Brazilian automotive industry (BAI) (Gurbaxani & Dunkle, 2019; Chanias & Hess, 2016; Simonazzi, Sanginés & Russo, 2020). At the same time, it extends the theoretical framework by applying these factors to the Brazilian context, thus providing valuable insights for application in other industrial contexts.

Moreover, the development of a unified model of critical success factors synthesizing concepts such as ‘data’ and ‘data value’ as well as ‘ecosystem’ and ‘partners’ not only simplifies the complexity inherent to the digital transformation process, but also provides a theoretical

framework for future research. This model reflects the inter-relationship and the importance of these concepts for an effective digital change management (Dremel et al., 2017; Mazurchenko & Zelenka, 2021).

The proposition of a simplified alternative model integrating strategy, structure, and culture (organizational) incorporates the essence of the theoretical discussions established by Chandler (1962) and Shein (2010), in addition to reflecting the contemporaneous views on the dynamics between culture and strategy (Neves & Meira, 2020). This theoretical approach not only facilitates the adoption of digital transformation by the Brazilian automotive companies, but also can enable a more efficient and less intimidating implementation.

In the practice, the proposed model can serve as a guide for companies, in which factors such as ‘culture’, ‘leadership’ and ‘people’ are fused into a single category, which reflects a practical approach aimed at an organizational transformation. Such practical aspect of the model is in line with the needs of companies who seek more accessible and achievable strategies for digitalization, which corresponds to the principles of the PPT model (Leavitt, 1965).

Lastly, the social contributions of the present study can make digital transformation easier in the BAI, in which the proposed model can play a key role in the maintenance of competitiveness of the Brazilian automotive industry. This, in turn, can have a positive economic impact and boost productivity and innovation within the sector. Additionally, by highlighting the importance of a digitally competent workforce, the present study emphasizes the need for an initiative of development of digital skills, which can influence future educational and professional policies.

This article presents a detailed analysis of the digital transformation in the Brazilian automotive industry, and although it is concentrated on large automotive manufacturers in the specific Brazilian context, principles and critical success factors were found to have potential to

inform similar strategies in other segments of the automotive sector. However, the application of these insights in a wider context should be carefully addressed. The relevance and efficacy of these factors in different operational, cultural, and economic settings require further validation. In this sense, new studies are suggested for exploring how these findings are translated into different sub-sectors of the automotive industry, considering variables such as company size, market activity and technological capacity.

The rapid technological changes and the emerging business models in the automotive sector suggest that the identified success factors can require continuous updating in order to maintain their relevance. Longitudinal studies would allow following up the evolution of these factors over time, thus providing a more dynamic understanding of how organizations can adapt and grow within a constantly changing digital environment.

In addition, the development of research instruments or the search for broader databases could facilitate the conduction of a quantitative confirmatory study. Collection and analysis of quantitative data would enable not only confirming qualitative findings of the present study, but also exploring the possibility of wider generalizations, thus providing a statistical base for application of the suggested strategies to a variety of contexts in the automotive sector.

Final Considerations

Digital transformation represents significant challenge and opportunities for the Brazilian automotive industry (BAI). The present study has deepened the analysis of critical success factors for digital transformation projects in the BAI by identifying elements such as top management support and strategic alignment as key for the success. Although the results of this study provide valuable insights for Brazilian automotive manufacturers, it is important to recognize that these factors can be possibly applied to broader contexts of the automotive industry, thus requiring further validation.

In addition, the dynamic nature of the digital environment requires a continuous and adaptive approach to digital transformation. The rapid technological evolution and changes in the business models highlight the need for longitudinal studies in order to follow up the relevance of the identified factors over time. The search for research instruments and quantitative data can further enrich our understanding, thus allowing for statistical confirmation of qualitative findings and broaden generalizations. Ultimately, digital transformations in the automotive industry are a continuous journey and the present study offers a solid base for further research and practical initiatives aimed at boosting the success in this constantly changing digital era.

AUTHORS' CONTRIBUTIONS

Contribution	Daxbacher, E. F.	Meira, S. R. L.	Soares, S. C. B.
Conceptualization	X	X	X
Methodology	X	----	X
Software	----	----	----
Validation	X	X	X
Formal analysis	X	X	X
Investigation	X	-----	X
Resources	X	-----	----
Data curation	-----	-----	-----
Writing – original draft	X	X	X
Writing – review & editing	X	X	X
Visualization	X	X	X
Supervision	X	-----	X
Project administration	X	X	----
Funding acquisition	-----	-----	-----

References

Abylova, V., & Salykova, L. (2019). Critical success factors in project management: a comprehensive Review1, 2. *PM World Journal*, 8, 1-13.

Alves, M. S. (2019). Indústria 4.0: o lastro da transformação digital da indústria automobilística nos contextos global e brasileiro. Repositorio.ufba.br.
<http://repositorio.ufba.br/ri/handle/ri/30385>

- ANFAVEA. Anuário da Indústria Automobilística Brasileira (2023). Retrieved from <https://anfavea.com.br/site/anuarios/>
- AUTOO - Emplacamentos de veículos e marcas no Brasil (2023). Retrieved from <https://www.autoo.com.br/emplacamentos/>
- Barthel, P., & Hess, T. (2019, July). Are digital transformation projects special? *In PACIS* (p. 30).
- Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. V. (2013). Digital business strategy: toward a next generation of insights. *MIS quarterly*, 471-482.
- Bhatia, M. S., & Kumar, S. (2020). Critical success factors of industry 4.0 in automotive manufacturing industry. *IEEE Transactions on Engineering Management*, 69(5), 2439-2453.
- Brandtner, P., Mayrboeck, R., & Zimmermann, R. (2022). Data-Driven Digital Services in the Automotive Industry: Implementation in Practice, Success Factors, and Future Potential. *2022 13th International Conference on E-business, Management and Economics*. <https://doi.org/10.1145/3556089.3556115>.
- Chanias, S., & Hess, T. (2016). "Understanding Digital Transformation Strategy Formation: Insights from Europe's Automotive Industry," *in Proceedings of PACIS*, Chiayi, Taiwan, pp. 1-15
- Chandler, A. D. (1962). *By Alfred D. Chandler Strategy and Structure: Chapters in the History of the American Industrial Enterprise*. MIT Press.
- Corbin, J., & Strauss, A. (2008). Qualitative research. *Techniques and procedures for developing grounded theory*, 3.
- Cordeiro, G. A. (2022). Proposta de método para implantação de projetos de transformação

- digital (Doctoral dissertation, [sn]).
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approach*. Sage publications.
- De Carli, P. C., Delamaro, M. C., & Salomon, V. A. P. (2010). Identificação e priorização dos fatores críticos de sucesso na implantação de fábrica digital. *Production*, 20, 549-564.
- Dremel, C., Herterich, M., Wulf, J., Waizmann, J., & Brenner, W. (2017). How AUDI AG Established Big Data Analytics in Its Digital Transformation. *MIS Q. Executive*, 16.
- Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2013). Embracing digital technology: A new strategic imperative. *MIT Sloan Management Review*, 55(2), 1.
- Gebayew, C., Hardini, I. R., Panjaitan, G. H. A., Kurniawan, N. B., & Suhardi. (2018). A Systematic Literature Review on Digital Transformation. In *2018 International Conference on Information Technology Systems and Innovation (ICITSI)*. IEEE. <https://doi.org/10.1109/icitsi.2018.8695912>
- Global Digital Transformation Survey Report (2018). Fujitsu Limited. Retrieved from https://www.fujitsu.com/downloads/GLOBAL/vision/2018/download-center/FTSV2018_Survey_EN-1.pdf
- Gurbaxani, V., & Dunkle, D. (2019). Gearing Up For Successful Digital Transformation. *MIS Quarterly Executive*, 18(3), 209–220. <https://doi.org/10.17705/2msqe.00017>
- Henriette, E., Feki, M., & Boughzala, I. (2015). The shape of digital transformation: A systematic literature review. *MCIS 2015 proceedings*, 10, 431–443.
- Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016). Options for formulating a digital transformation strategy. *MIS Quarterly Executive*, 15(2).
- Holotiuk, F., & Beimborn, D. (2017). Critical success factors of digital business strategy. Retrieved from <https://core.ac.uk/download/pdf/301370708.pdf>

- Huberman, A. M., & Miles, M. B. (1994). Data management and analysis methods.
- Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). Strategy, not technology, drives digital transformation. *MIT Sloan Management Review and Deloitte University Press*, 14(1–25).
- Kvale, S. (2008). *Doing Interviews*. USA: SAGE Publications Inc.
- Leavitt, H. J. (1965). Applied Organization Change in Industry. Structural, Technical and Human Approaches, [in:] JG March (ed.), *Handbook of Organization*.
- Liu, D., Chen, S., & Chou, T. (2011). Resource fit in digital transformation. *Management Decision*, 49(10), 1728–1742. <https://doi.org/10.1108/00251741111183852>
- Llopis-Albert, C., Rubio, F., & Valero, F. (2020). Impact of digital transformation on the automotive industry. *Technological Forecasting and Social Change*, 162, 120343 - 120343. <https://doi.org/10.1016/j.techfore.2020.120343>
- Luadon, K. C., & Laudon, J. P. (2014). *Sistemas de informação gerenciais*. Tradução Célia Taniwaki.
- Lucas, Jr., H. C., Agarwal, R., Clemons, E. K., El Sawy, O. A., & Weber, B. (2013). Impactful Research on Transformational Information Technology: An Opportunity to Inform New Audiences. *MIS Quarterly*, 37(2), 371–382. <https://doi.org/10.25300/misq/2013/37.2.03>
- Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. *Business & information systems engineering*, 57, 339-343.
- Mazurchenko, A., & Zelenka, M. (2021). Employees' Digital Competency Development in the Construction and Automotive Industrial Sectors. *Central European Business Review*. <https://doi.org/10.18267/j.cebr.284>.
- Meira, S. & Neves, A. (2021). *A cultura não come a estratégia*. (s.d.). MIT Sloan Review

- Brasil. <https://www.mitsloanreview.com.br/post/a-cultura-nao-come-a-estrategia>
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.
- Morakanyane, R., Grace, A.A., & O'Reilly, P. (2017). Conceptualizing Digital Transformation in Business Organizations: A Systematic Review of Literature. *Bled eConference*. Retrieved from https://www.researchgate.net/publication/321805933_Conceptualizing_Digital_Transformation_in_Business_Organizations_A_Systematic_Review_of_Literature/link/5a32a9a40f7e9b2a288d7ee9/download
- Milosevic, D., & Patanakul, P. (2005). Standardized project management may increase development projects success. *International Journal of Project Management*, 23(3), 181–192. <https://doi:10.1016/j.ijproman.2004.11.00>
- Mithas, S., Tafti, A., & Mitchell, W. (2013). How a Firm's Competitive Environment and Digital Strategic Posture Influence Digital Business Strategy. *MIS Quarterly*, 37(2), 511–536. <https://doi.org/10.25300/misq/2013/37.2.09>
- Nagli, L. S. D. (2019). *Projetos de transformação digital implementados com a participação de startups: um estudo sobre os fatores críticos de sucesso e sua gestão* (Doctoral dissertation).
- Oliver, D. G., Serovich, J. M., & Mason, T. L. (2005). Constraints and opportunities with interview transcription: Towards reflection in qualitative research. *Social Forces*, 84(2), 1273–1289. <https://doi.org/10.1353/sof.2006.0023>
- Osmundsen, K., Iden, J., & Bygstad, B. (2018). Digital transformation: Drivers, success factors, and implications.
- Petersen, S. (2018). Dell practices what it preaches about digital transformation. *eWeek* 5/2/2018

- (p. 4-4). Retrieved from <http://www.eweek.com/enterprise-apps/dell-practices-what-it-preaches-about-digital-transformation>
- Piccinini, E., Hanelt, A., Gregory, R., & Kolbe, L. (2015). Transforming industrial business: the impact of digital transformation on automotive organizations. Retrieved from https://web.archive.org/web/20200323000530id_/https://aisel.aisnet.org/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1424&context=icis2015
- Pinto, J. K., & Slevin, D. P. (1989). Critical success factors in R&D projects. *Research-technology management*, 32(1), 31-35.
- Plummer, D *et al.* (2014). Top 10 Strategic Predictions for 2015 and Beyond: Digital Business Is Driving “Big Change.” Gartner. Retrieved from <https://www.gartner.com/doc/2864817/top--strategic-predictions-digital>
- Qu, S. Q., & Dumay, J. (2011). The qualitative research interview. *Qualitative Research in Accounting and Management*, 8(3), 238–264.
<https://doi.org/10.1108/11766091111162070>
- Redação. (2023, March 8). Digital chega com tudo e aquece mercado automotivo. Mercado&Consumo. <https://mercadoeconsumo.com.br/08/03/2023/tecnologia/digital-chega-com-tudo-e-aquece-mercado-automotivo/>
- Riasanow, T., Galic, G., & Böhm, M. (2017). Digital transformation in the automotive industry: towards a generic value network.
- Ribas, A. I., & Teixeira, L. Information Systems in Digital Transformation: Practical Case in an Automotive Industry Company and Critical Success Factors.
- Rocha, C., Quandt, C., Deschamps, F., Philbin, S., & Cruzara, G. (2021). Collaborations for digital transformation: Case studies of industry 4.0 in Brazil. *IEEE Transactions on Engineering Management*.

- Rogers, D. L. (2016). *The digital transformation playbook: Rethink your business for the digital age*. Columbia University Press.
- Rubin, H. J. & Rubin, I. S. (2011). *Qualitative interviewing: The art of hearing data*, Sage
- Sebastian, I. M., Ross, J. W., Beath, C., Mocker, M., Moloney, K. G., & Fonstad, N. O. (2020). How big old companies navigate digital transformation. In *Strategic information management* (pp. 133-150). Routledge. Retrieved from <https://publikationen.reutlingen-university.de/frontdoor/deliver/index/docId/1501/file/1501.pdf>
- Simonazzi, A., Sanginés, J., & Russo, M. (2020). *The Future of the Automotive Industry: Dangerous Challenges or New Life for a Saturated Market? Institute for New Economic Thinking Working Paper Series*. <https://doi.org/10.36687/inetwp141>.
- Schein, E. H. (2010). *Organizational culture and leadership* (Vol. 2). John Wiley & Sons.
- Schuchmann, D., & Seufert, S. (2015). Corporate Learning in Times of Digital Transformation: A Conceptual Framework and Service Portfolio for the Learning Function in Banking Organisations. *International Journal of Advanced Corporate Learning (iJAC)*, 8(1), 31. <https://doi.org/10.3991/ijac.v8i1.4440>
- Tanase, G. C. (2018). Artificial intelligence: optimizing the experience of digital marketing. *Romanian Distribution Committee Magazine*, 9(1), 24-28.
- Uguroglu, E. (2021). Near-Real Time Quality Prediction in a Plastic Injection Molding Process Using Apache Spark. 2021 *International Symposium on Computer Science and Intelligent Controls (ISCSIC)*, 284-290. <https://doi.org/10.1109/ISCSIC54682.2021.00059>.
- Verevka, T., Gutman, S., & Shmatko, A. (2019). Prospects for Innovative Development of World Automotive Market in Digital Economy. *Proceedings of the 2019 International SPBPU Scientific Conference on Innovations in Digital Economy*. <https://doi.org/10.1145/3372177.3373320>.

- Verina, N., & Titko, J. (2019, May). Digital transformation: conceptual framework. In *Proc. of the Int. Scientific Conference “Contemporary Issues in Business, Management and Economics Engineering* (pp. 9-10). <https://doi.org/10.3846/cibmee.2019.073>
- Westerman, G., Bonnet, D., & McAfee, A. (2014). *Leading Digital: Turning Technology into Business Transformation*. Harvard Business Review Press.