Information Systems in Digital Transformation: Practical Case in an Automotive Industry Company and Critical Success Factors

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Abstract

Nowadays, organizations face an industrial revolution, also known as Industry 4.0. Since it is a fairly recent phenomenon, many companies wonder how to embark on these digital transformation initiatives and do it successfully. Information Systems (IS), already present in the vast majority of companies, are shown to be one of the most important pillars within the digital transformation. This work aims to explore the Critical Success Factors that may contribute to a successful implementation of IS within a digital transformation initiative, based on a practical case carried out in an automotive industry company, where a digital transformation initiative was followed. The results point to the existence of some key factors for the success of IS implementation within this type of initiatives, such as: the existence of reliable connectivity between devices, the involvement of users in each phase of the systems' development, the analysis of the existing processes, a good relationship with business partners that provide technological solutions and support them, and, also, the definition of strategic plans and roadmaps.

Keywords
Digital Transformation, Industry 4.0, Information Systems, Practical Case, Critical Success Factor.

1. Introduction
Nowadays, our world faces a shift in the industrial context, to an era known as "Industry 4.0". This transition comes with its challenges and, as it can cause a major transformation in organizations, there are some points to be taken into consideration upon company changes. Organizations need to continuously evolve and innovate in order to keep a competitive advantage, retain customers and increase their profitability (Kir & Erdogan, 2021; Marques et al., 2020). Like so, in the current manufacturing setting, marked by digitalization (Doyle-Kent & Kopacek, 2020), it is crucial to take advantage of new technologies along with existing and well-known organizational practices. One of those relevant business components are Information Systems (IS), essential in enterprises wanting to go digital (Salvadorinho & Teixeira, 2020). Companies capabilities are becoming more dependent of its Information Systems (Laudon & Laudon, 2018). At the same time, enterprises are investing in new technological solutions that comply with the concept of Industry 4.0, making the work environment more flexible. Also machines are expected to become more autonomous and connected with each other (Oztemel & Gursev, 2020).

Although a digital transformation (DT) is imperative for companies that want to stand out in this time, many are still struggling with how to do it effectively (Barthel & Hess, 2019).

To contribute to a higher success rate of DT initiatives, the experiences and results from a case study in an automotive industry organization, currently facing a transition to a world more digital will be acknowledged in this paper. From its findings, it is expected a better understanding of what might be the Critical Success Factors (CSF) to implement ISs in a DT project. With that knowledge and with similar ones from the literature, companies can be better prepared for their digital future.

To explore the CSF inherent from the implementation of ISs in the context of a DT towards I4.0, first, a literature review was led to elucidate on the main concepts in study and explore the relationship between information systems and a digital transformation. Later, a practical case was conducted and, through its experiences and results, the CSF were exposed.

This paper is organized as follows: first, in chapter 2, the literature review is presented with an overview of the main topics in study, namely, digital transformation and ISs in Industry 4.0. Then, the practical case is detailed in chapter 3, followed by its results in chapter 4. Lastly, some conclusions and future work are highlighted in chapter 5.

2. Literature Review

2.1 Considerations about Digital Transformation

For companies to develop and remain competitive in today's world, it is essential the investment in digital technologies, as well as in the incorporation of the digital capabilities in processes. These challenges are usually inserted in an area called Digital Transformation (Butt, 2020; Castro & Teixeira, 2021).

Digital transformation (DT), despite being an increasingly relevant topic among businesses and society in general, it still lacks a well-accepted definition in the research field (Feroz et al., 2021; Gong & Ribiere, 2021; van Veldhoven & Vanthienen, 2020). In accordance with Gong and Ribiere (2021), a DT can be defined as an organization-wide transformation, enabled by the use of new digital technologies and the strategic use of the enterprise's resources and capabilities, with the hopes of improving the existing business processes and redefining the company's value proposition. DT initiatives are expected to bring multiple benefits to enterprises such as an increased efficiency, a better use of the enterprise's resources, a higher flexibility and an enhanced response rate to challenges faced (Patsavellas & Salonitis, 2019).

This shift will have wide consequences (Gobble, 2018) and given the essential need for companies to digitally transform, many are left wondering how to do it and to do it successfully. Nonetheless, this change is typically embraced by the means of a project, that, should be noted, differs from the traditional Information Technologies (IT) projects. This difference is justified by the higher importance given to business change, integrating IT and business and fostering enterprise's change (Barthel & Hess, 2019).

In terms of its accomplishment, a digital transformation can only be successful if it's "built in the right kind of organization" (Brkić et al., 2020, p. 1109). It's vital to select a proper strategy and technologies, whilst considering the enterprise's restrictions (Brkić et al., 2020).

2.2 Information Systems in Industry 4.0

In compliance with Carvalho (2020) as cited in Barata and Rupino Da Cunha (2013), "any definition of information system is inevitably a general statement that can fit different instances" (p. 3). Thus, the conceptualization of any IS is, in fact, quite complex, since ISs can be seen, comprehended and researched bearing in mind different views (Barata & Rupino Da Cunha, 2013; Boell & Cecez-Kecmanovic, 2015). For example, some studies view ISs with a technical perspective, where the focus is on the IT while others, focus on the social nature of ISs, being viewed with a social perspective. Besides these viewpoints, others can also see ISs in a socio-technical or process view. Regardless, these views are based in the undoubted conjecture around the individual existence of human or social aspects of ISs and the material/technological. However, these views become more difficult to embrace with the digital developments of the recent years such as the Internet and digitization endeavors. Since humans and their practices have become remarkably intertwined with various technology solutions, it has become progressively tough to support their individual existence (Boell & Cecez-Kecmanovic, 2015). Therefore, Boell and Cecez-Kecmanovic (2015) suggest an alternative view, sociomaterial, that puts to rest the issue reported before. Along the same lines, Barata and Rupino Da Cunha (2013), although recognizing some key dimensions of ISs and the appeal to studying each separately, they defend that an IS requires to be holistically comprehended. Thus, in this work, a holistic approach to ISs is adopted.

Nowadays, Information Systems have become a critical activity for the delivery of value to customers, in the competitive market setting established (Ribeiro, 2021). Additionally, they are systems designed with the goal of providing business solutions to one or multiple organizational problems (Laudon & Laudon, 2018). Given that DT implies new business needs, new problems, ISs need to be developed for or adapted to the new manufacturing paradigm (Cocca et al., 2018). ISs are essential for businesses and demand to be seen as crucial pieces for organizations' daily activities. Companies should investigate the relationship between its people, processes and technology to guarantee a competitive advantage in the present and future (Ribeiro, 2021). Considering a deep analysis of the literature, the main matters concerning this digital transformation for ISs are summarized in table 1, next.

Table 1. DT main matters concerning ISs

Main Aspect	Description
System's Integration and Development	Organizations should assess their current ISs and evaluate their readiness to incorporate new technologies and needs of I4.0 (Cocca et al., 2018). The Systems need to be adapted or developed with those necessities in mind (da Costa Dias et al., 2021). One of those being interoperability (Oliveira & Afonso, 2019). The use of automation architectures designed especially for this new era and new systems development strategies could be helpful (Helmann et al., 2020; Laudon & Laudon, 2018).
Data	Data is a valuable asset for I4.0 and should be properly explored. ISs should be capable of supporting the growing volume of data, and of managing and exchanging that data (Klingenberg et al., 2019; Marques et al., 2020; Salvadorinho et al., 2020). Additionally, organizations should have both I4.0 enabling technologies and value creating technologies. It is also crucial that the data retrieved and processed by the systems is accurate to guarantee the best and realest outcome (Klingenberg et al., 2019).
Cybersecurity	With all the novel technologies, more and more devices can be connected and integrated (Lowry et al., 2017). Also data has been gaining an increasing importance (Klingenberg et al., 2019). Companies should invest in the security and assuring the privacy of its systems and data (Lowry et al., 2017).
People	People should not fear technological investments in organizations but should be ready for a shift in the labor market. Enterprises but also society should train its workers for company's changing necessities (Cunha et al., 2020; Vestin et al., 2020).

3. Practical Case: Report on DT, status and implementation challenges

The case study concerns a facility of a multinational company, one of the major suppliers of the automotive industry. In order to be competitive today, the organization started to invest in new digital tools, which promise to improve the current practices.

The company had already multiple technologies running such as digital Kanban cards [1] and AGVs. Also, it had several solutions provided by an external software supplier, namely, SAP SE. SAP SE is a company which offers business software solutions, founded with the objective of developing "standard enterprise software for real-time integration of all business processes" (Cocca et al., 2018, p. 1202). The organization also has an ERP, based on SAP ECC. This type of system is considered by Cocca et al. (2018) as "the backbone for the Industry 4.0" (p. 1203). Also, it utilizes other third-party solutions by SAP SE, such as SAP Manufacturing Execution (SAP ME) and SAP Manufacturing Integration and Intelligence (SAP MII), to help manage the flow of information and materials, and activities on the shop floor. These SAP solutions, more specifically, SAP ME and SAP ERP, can be reflected as one of the best market solutions in terms of I4.0 readiness (Telukdarie & Sishi, 2019).

[1] "A Kanban card is a signal that provides the authorization to order or produce parts such as to replenish those which have been consumed from the supermarket" (Powell, 2018, p. 140). In turn, a supermarket is a place mid production processes used to store a pre-defined inventory. This inventory is used to continuously supply the downstream processes, in spite of possible production fluctuations (Kovács, 2012).

Directly on the shop floor, there can be found other technologies of Industry 4.0. Concerning the production cells, most work is done in an sequential collaboration (Butt, 2020) between human operators and robots. While the robot is working, the operator uses the time to do other needed activities, such as, to go collect materials to feed the robot after its work cycle or work on the pieces that came from the machine. Also, in every production line, there is one computer with a barcode reader, which enables the worker to scan every finished product, declare completed containers and also to assist the initialization of production lots, these last two with the use of physical Kanban cards. Furthermore, the team leader of each production team, uses SAP MII to support some routine activities like the input of scrap information of the correspondent shift, in the nearest registration point or to send maintenance request tickets when needed.

3.1 Contextualization: New Digital Tools

The tools to be implemented aim to improve the daily management, reactivity, reliability and handling of information, which until the DT initiative was performed manually. Also, they allow the analysis and treatment of data in a timely manner, ensuring that the production indicators (e.g. scrap, internal part per million defects, production performance, production compliance) are evaluated on time. By having the information in real time an immediate reaction by the teams is also enabled, ensuring the least possible deviation to the factory's KPIs. With an enhanced method, reaction times to problems could be reduced, quality issues could be uncovered and subsequently solved, among other welfares, contributing to a higher performance. The new digital tools are briefly summarized next.

- <u>Production Management Tool</u>: It's a solution based on SAP MII and projected to help operators, team leaders and supervisors in their day-to-day activities: production tracking, scrap and reworks' registration, losses of production performance declarations and alerts' management.
- <u>WEBI</u>: Web Intelligence (WEBI) is a Business Intelligence (BI) application, within SAP BI. Linked with the other SAP solutions present in the company, it enables the creation of reports, with little effort. These reports can then be viewed on a daily basis, and help the decision-making process.
- <u>Preactor</u>: the production scheduling tool.
- <u>Digital Pull System Tool</u>: based on SAP MII and ME, allows the digitalization of the pull system. With the goal of removing the current physical Kanban cards, at the same time keeping a Lean approach and potentially reducing the intermediate stock.
- <u>Shift Management Tool</u>: app with all the important information for each production team, that can be accessed when needed. Used by the team leader to also manage the necessary documents for the shift. This solution provides a digital KPIs' board, where every team can track their indicators and follow them up.

These tools are expected to work together, aiding and complementing each other. The Production Management Tool, present in every production line will be used with two screens, displaying in every production line both the app's main menu and the production control board of the respective production line. Every week, the orders for each day are planned. The orders are then scheduled daily using Preactor and the schedule made available to the shop-floor operators. Regularly, operators will check the orders in a pick monitoring screen and the picking and production of orders is managed using the digital pull system. The operators in every production line can launch and manage production orders and register eventual non-planned stoppages in the Production Management Tool. Additionally, the team leader can manage its day-to-day activities such as the filling of the daily minutes, of the indicators in the Shift Management Tool app and register the reworks and scraps of the shift. These are some of the functionalities that will be running when the tools being explored are fully deployed.

3.2 DT Tools and maturity level on SDLC

Not all digital tools to be deployed are in the same phase regarding the system development life cycle (SDLC) nor do they always develop at the same pace. For example, the tools do not all have the same complexity - it is expected that the higher the complexity, more time will be needed to study the system and deploy it. The same goes for the project where the tool will be implemented – the more complex the project (e.g., more production lines and product references), more time it takes to parametrize the system. Based on the SDLC by Valacich & George (2017) (see Figure 1), the tools can be positioned in those SDLC activities. This classification can be visible in table 2.

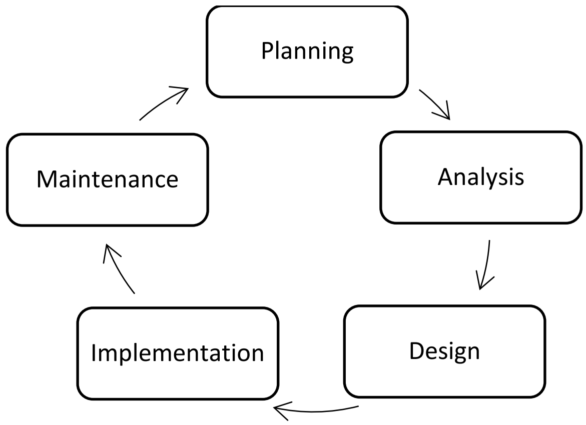

Figure 1. System development life cycle (Valacich & George, 2017)

Table 2 presents the different tools according to their phase in the SDLC. Though, within the implementation step, they do not all are in the same situation. The Production Management Tool, after trials in a test environment, is ready to be deployed. The same goes for the Digital Pull System Tool, with one major difference – the Digital Pull System can only be deployed after the Production Management Tool. Preactor is ready for implementation and at last, Shift Management Tool can be positioned in two phases – maintenance and implementation. Maintenance because the system is already running in many projects and implementation due to the fact that the plant wants to add the system to more projects.

Table 2. Digital Tools and SDLC phase

Digital Tool	**SDLC phase**	**Details**
Production Management	Implementation	Test environment simulations and deployment
WEBI	Implementation	Test solution and deployment
Preactor	Implementation	-
Digital Pull System	Implementation	Test environment simulations and deployment after DMC
Shift Management	Maintenance and Implementation	-

Before the implementation step, it is worth examining the design method chosen, that is, if the tools are developed in-house, the development is outsourced or if the systems are a bought package software. Since the company already has SAP solutions running, some of the to-be deployed tools are bought or developed from this same software provider such as WEBI and the Production Management and Digital Pull System tools. As for Preactor, it is provided by SIEMENS while the Shift Management Tool is developed in-plant. In table 3, the development strategies are detailed for each tool.

Table 3. DT Tools Development Strategy

Digital Tool	**Development Strategy**	**Provider**
Production Management Tool / Digital Pull System Tool	Built in SAP MII	SAP SE / The company's IS department
WEBI	Software License bought	SAP SE
Preactor	Software License bought	SIEMENS
Shift Management Tool	In-plant	-

Moving forward to the implementation step, another point to be addressed is the implementation strategy. That is, how the company chose to move from the old system to the new. This can be referred to as the "Conversion" process or "Installation" process (Laudon & Laudon, 2018; Valacich & George, 2017). In the literature, there are four strategies reviewed - (i) parallel, (ii) direct, (iii) pilot-study / single location, and (iv) phased approach – each with its benefits and weaknesses. The parallel strategy encompasses the use of both the old and new systems, until there's confidence that the new one is functioning properly. Despite this being the safest approach, it can be very expensive to manage the running of both systems. The direct approach, in turn, consists of removing the old system and relying only on the new system, which can be quite risky. The pilot-study comprises the implementation of the system in a single location and, when running with no hiccups, the deployment in the rest of the organization. Finally, the phased approach, implies the deployment of the system in phases, for instance, function by function, until the whole system is deployed (Laudon & Laudon, 2018; Valacich & George, 2017). Out of all strategies, the company chose a hybrid approach, a mix of approaches. These can be seen in table 4.

Table 4. DT Tools Implementation Strategy
Note: *Old procedure available in case a backup solution is needed.

Digital Tool	**Implementation Strategy**			
	Parallel	**Direct**	**Pilot Study**	**Phased Approach**
Production Management Tool	x		x	x
WEBI		x		
Preactor		x*	x	
Digital Pull System			x	
Shift Management Tool		x*		

When implementing a new functionality, it is crucial to guarantee that the new procedures are working correctly. Thus, initially, especially in the procedures where a digitization occurs, is important to guarantee that the data and information gathered is correct and that the old procedure can be completely removed. Like so, firstly, particularly for the Production Management Tool, the users need to perform both routines – the old and the new. Then, the data needs to be cross-checked to see if there are any errors or things to further investigate. Only after a period where the team feels a sense of security that the new routine is functioning correctly, the old way is gone. Therefore, for the Production Management Tool, a parallel strategy was chosen to guarantee that the system is working well.
A direct strategy was selected for the deployment WEBI, Preactor and the Shift Management Tool. However, for Preactor and the Shift Management Tool, the old system is still available in case a backup solution is needed.
Lastly, for the Production Management Tool, Preactor and the digital pull system, pilot studies were scheduled and the tools implemented project by project. In accordance, after the implementation of a tool in a project, the system should and starts to be maintained. Particularly for the Production Management Tool, it is also implemented in a phased approach, function by function.

Since all tools can be classified as in the implementation phase of the SDLC (see table 2), this step will be assessed in more detail next.

3.3 Tools Implementation

In the implementation of the digital tools, it's essential to primarily validate the project scope and budget. Costs need to be addressed in the deployment of these digital initiatives. Those can be associated to the necessary licensing of the software, the needed hardware and servers' specificities, the costs of all the software and hardware developments.

The deployment of these digital tools will impact the current processes. Like so, it is of extreme importance that the implementation of these tools follows a business process management (BPM) approach in terms of streamlining other business processes. In line with Butt (2020), it is important to analyze in the implementation of each and every tool, the impact not only in the direct processes where the tool will be used but also in the surrounding processes. That way, the processes and systems can be better understood, the functioning of those processes can be protected, and the tools can be better adjusted to the existing practices. Also, the possible changes can be anticipated, when the time of the implementation of each tool comes. This analysis will further facilitate the definition of the processes to later review, improve and compare with the initial situation. Besides this, a process analysis is also helpful to standardize data such as product references and work centers, to name a few. This standardization is also included in the DT plan.

Additionally, to guarantee the success of the deployment of the tools, it is important to ensure the elaboration of work standards and end-user training. These will guarantee the workers learn the new procedures, express their doubts and suggestions and that everyone receives the same level of information, while fostering engagement.
The tools are implemented by project, which allows them to be progressively applied, and enabling other benefits. For instance, although the projects are somewhat different, some have similarities. By doing the deployment by project, the implementation process could be continuously enhanced, based on the lessons learned within each project and feedback received. Nevertheless, every project is different in their own way. Even the people involved can change the approach used when implementing. To meet each project needs, the implemented tools are adapted to a certain extent, with the input given by the production unit's responsible, supervisors and support functions and operators, with the users that will work directly with them. For instance, if a supervisor, used to work in the field, directly with the operators, senses that a specific process is too complex or difficult to be implemented in one step for that specific group of workers, the plan is rearranged. A deployment methodology was developed for each DT tool, to be followed in each project. To be noted that the methodology is flexible and can be adapted to the requirements of every project.

The implementation of these new digital tools is not a simple process, especially for the digital pull system. To help in the deployment, the team has close support from the software providers and developers. In case of any doubt or problem regarding the tools, it is possible to communicate with the tool's support contacts but also, generally, with the company's global IT support (if local IT support isn't able to resolve the issue). There are also weekly meetings with everyone to understand the state of the project. For the case of the digital pull system, simulation sessions are also provided in a test environment, where different functionalities are tested and in different production scenarios.
To aid the configuration process of the tools, multiple documents related to the tools can be seen and downloaded from the intranet. The documents can range from technical, configuration documents of specific tools or tools' functionalities, as well as training presentations, developed and used in other plants of the group.
After the implementation, a follow-up must be done, as well as an analysis of the obtained data and real gains with the use of these new tools. Moreover, the systems need to be continuously maintained and improved.

4. Results and Discussion

4.1 Critical Success Factors identified

It should be noted that for the development of this research, all tools were implemented in one production unit. Therefore, although the DT initiative is not yet completed, several conclusions can already be acknowledged in this phase of the project. Thus, with the findings from the practical case, the key factors to successfully deploy ISs in digitally transforming initiatives can be explored, and are summarized in table 5.

The first CSF identified is (a) Connectivity. Without connectivity between devices, without a network established, no data can be exchanged and further processed. Also, without reliable data, any subsequent information, knowledge, wisdom cannot be trusted as it may badly reflect the actual and real situation. Therefore, connectivity is a crucial factor for ISs implementation. Regarding (b) User Involvement and Change Management, this is also key as the users need to feel involved in the initiative so they can better accept the on-going changes and keep performing the new procedures. They need to see that the new system brings value. This can be seen as change management and is the most challenging aspects according to Dennis et al. (2015). It is important that the user feels heard, part of the project so they can feel more motivated for the upcoming alterations and also more moved to give feedback in the future. User involvement in the development process of the systems, as affirmed by Valacich & George (2017), is one of the necessary conditions for a successful implementation. Regarding (c) Process Analysis and Adaptable Solutions, a process analysis is important, as it can better help define the processes, see possible redundancies and standardize procedures before and after the technological modifications. With this, processes can ultimately be improved. The technological solutions are also guaranteed to be capable of being inserted to the already existing processes. Furthermore, a good relationship with (d) Partners and Support Teams turned out to be fundamental as well. It is essential as the processes can become highly dependent on the offered solutions and how they function, so it is relevant to maintain a good relationship with the solutions developers and providers. Not only in the adaptation / implementation of the systems is this key. This is also important in the maintenance and improvement of those systems. Lastly, the definition of (e) Strategic Plan and Roadmaps, it is also important. These can help keeping up with the initial expectations, and to be more aware of the future prospects for the areas that those plans cover and what the organization is expected to do during each time frame of the project. Additionally, helps to plan for eventual setbacks in the project.

Table 5. CSF identified

CSF	Brief description
Connectivity (a)	Ensure that there are no connectivity issues between the machines and the IT systems used. Guarantee that the data shared is reliable, correct.
User Involvement and Change Management (b)	Involve the users since the beginning. Develop the systems with the user input if possible. After the systems' implementation/changes, keep communicating with the users to ensure that everything is working finely and changes can be done, the system maintained by means of the constant feedback received.
Process Analysis and Adaptable Solutions (c)	The processes should be analyzed prior to the changes. The new technological solutions or changes in the existing ones need to be able of being integrated to the existing and running systems and processes.
Partners and Support Teams (d)	Work to have a good relationship with the software (and hardware) providers and support teams. A constant communication should be enabled.
Strategic Plan and Roadmaps (e)	Definition of detailed strategic plans and roadmaps. Those should encompass possible risks and ways to mitigate them, investment costs, expected payback, hardware and software necessities, among other aspects of relevance to the organization.

Along the DT initiative, these were the factors reflected as key. Regardless of their classification as major influential aspects, some limitations should be acknowledged. First, the findings are highly dependent on the flow and stage of the project and its characteristics, even though some literature findings were also highlighted for some of the factors detailed. Additionally, some of the key factors identified, could have not been found if the project ran smoothly for those factors. And, with an initiative running with no hiccups, those and other aspects could have been hidden. Also, the factors identified, although of notice, could, in fact, be hiding the real aspect for the success of ISs. On the contrary, some of the key factors identified could have also only been recognized because proven as challenging to overcome by this organization in particular.

Furthermore, by recognizing and paying attention to those key factors in a digital initiative, it does not guarantee its success. A digital transformation is much more than its information systems. The Fourth Industrial Revolution entails the redefining of the organization's business needs with the desire to upgrade the existing technologies and processes and implementation of other digital tools. And with these business changes, other challenges can occur. Not only that but each project, organization and its people, processes and technologies are all different and, accordingly, the critical aspects may vary. Regardless, the key factors presented can be helpful for other organizations in a similar situation but also enrich the existing literature around the subject.

4.2 Discussion of the results

Although the disclosed key factors are explicitly associated with a successful implementation of ISs in a DT, they can also be linked with the overall success of ISs adoption.
The study of success factors for ISs is not a new subject. There are currently many findings in the literature around it (Duan et al., 2017). Moreover, there are also models developed for a successful IS. An example of that is the DeLone and McLean (D&M) model. Developed in 1992 and with later suggested improvements, it gained popularity over the years and contributed to related studies around the success of ISs (Petter et al., 2017).
Accordingly, the results obtained from the presented practical case can and should be compared with the ones already revealed and studied by other scholars. For instance, in the work of Duan et al. (2017), 15 critical success factors (CSF) for ISs are identified, through the review of 42 papers. Those CSF are (i) Top management support; (ii) (User)Training and education; (iii) Change management; (iv) Project management; (v) Business process reengineering; (vi) Project team competence/capability; (vii) Communications; (viii) Project champion; (ix) User

involvement; (x) Business plan and vision; (xi) Testing and troubleshooting; (xii) Clear goals and objectives; (xiii) Vendor support; (xiv) Careful package selection; (xv) Use of consultants.
Comparing the practical case findings with the CSF previously listed, some similarities can be pointed out, as seen in table 6.

Table 6. CSF identified in practical case vs Duan et al. (2017)' CSFs

CSF identified	Similar Duan et al. (2017)' CSF
(a) Connectivity	-
(b) User Involvement and Change management	(ix) User involvement; (iii) Change Management
(c) Process Analysis and Adaptable Solutions	(v) Business process reengineering
(d) Partners and Support Teams	(vii) Communications; (xiii) Vendor support
(e) Strategic Plan and Roadmaps	(x) Business plan and vision; (xii) Clear goals and objectives

Such as in the practical case findings, the "User Involvement" and "Change Management" are considered CSFs in Duan et al. (2017) as CSFs (ix) and (iii), respectively. Not only that, the other key factors from the DT initiative can be compared to the Duan et al. (2017) ones. The (c) Process Analysis and Adaptable Solutions can be linked with a (v) Business process reengineering. Likewise, the (d) Partners and Support Teams can be associated with both (vii) Communications and (xiii) Vendor Support. As for (e) Strategic Plan and Roadmaps, can be connected with a (x) Business plan and vision and (xii) Clear goals and objectives. However, for (a) Connectivity, no explicit relation can be identified. Though, it can be implicitly associated with the (vi) Project team competence/capability, for example. If the team involved has strong capabilities, many connectivity problems may not appear. Therefore, the connectivity key factor, could not have been identified, if the team involved was proven to be of expertise in the area. Nevertheless, with a capable team, connectivity problems may still arise. In line with that, it is also still essential to have the machines rightly connected and capturing the right data, regardless of the competence of those involved in the project. Therefore, from the comparison between the practical case and the Duan et al. (2017) CSFs, it is possible to conclude that the practical case findings are somewhat alike the ones already in the literature, reinforcing some of the success factors for the implementation of ISs.

In line with Brkić et al. (2020); Butt (2020) and Cocca et al. (2018) and taking into account the practical exercise conducted in this study, it was also possible to conclude that, although the digital transformation in Industry 4.0 era can be considered challenging, it is also a huge opportunity for companies to rethink their business processes and change their mindset and ways of working.

A proper implementation can bring rewards such as an enhanced productivity and efficiency, reduced costs, an improved and collaborative working environment, while also improving the enterprise's competitive position (Butt, 2020; Cocca et al., 2018). At the same time, the systems become more agile and flexible, and the customer's experience is improved, contributing to an increased profit (Butt, 2020). Some sustainability improvement can also be attained (Queiroz et al., 2020). Thus, it is vital to understand these new tools and develop strategies for a digital transformation across the entire organization to guarantee the best possible outcome (Butt, 2020; Queiroz et al., 2020).

Information Systems are created with the goal of providing business solutions to one or multiple organizational problems, being a vital parts of enterprises (Laudon & Laudon, 2018). Therefore, they should be adjusted to an I4.0 setting (Cocca et al., 2018).

5. Conclusion and future work

This paper explored the relationship between IS and a DT. A practical case, where a DT initiative was led was detailed, with the solutions already running and to be implemented presented. The new tools' maturity level in the SDLC was also recognized to further characterize the solutions. Through the involvement, the experiences and results from the initiative, a set of critical success factors to successfully deploy ISs in digitally transforming initiatives was identified. The factors highlighted are a successful connectivity between the devices, the assurance that the collected data is reliable. The user involvement in the development, implementation and maintenance of the systems is essential. Along with it, it should be emphasized the value of the new procedures, so the users are more prone to the changes. A process analysis prior and after the technological changes is also essential, as the integration and adaptation of the new systems in the already existing processes. Business partners and support for the technological solutions turned out to also be key for the practical case along with the definition of strategic plans, roadmaps.

With the research findings, the literature around the success factors of IS can be strengthen and, ultimately, organizations can be more prepared for their digital transformations and with higher success rates. Though some limitations should also be acknowledged. First, for the classification of the key aspects as CSF, no framework or guidelines were followed. Therefore, the identification of the factors as CSF highly depends on the experience in the practical case and what was found as critical (either in a positive or negative perspective) for the flow of the project. Not only that, but other related limitations were also recognized previously regarding the CSFs. One other limiting point is the fact that the results presented solely reflect the findings from a DT in one organization only, which already possesses a greater digital maturity level than the vast majority. Therefore, the results may not be representative of every company. Additional studies in other organizations could be interesting to close this gap.

Other future work can also be highlighted. It could be interesting to study in more detail some of the key factors uncovered. Also, the geographic setting, culture of organizations' workers would as well be an attractive subject to research as it can impact the way that the enterprise works and what it is given more attention to or not. It could also be appealing to do a deeper study around the success factors reached and the ones already present in the literature such as the example exposed. Lastly, a proper definition for what constitutes a critical success factor and/or key factor from the research findings should be reached. This can help define if aspects from different studies were found as key using the same criteria or not, to, ultimately, help in the definition of additional models around the subject.

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