Supplier connectivity: a study on how to gain supplier acceptance for the integration of digital supply chain systems

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Abstract

Purpose – This paper aims to explore factors influencing suppliers' acceptance, integration challenges, expected benefits and support from customers when implementing a customer-introduced digital supply chain system.

Design/methodology/approach – The study investigates the perspective of suppliers using a mixed methodology approach that combines qualitative interviews with a large-scale quantitative survey conducted among 220 internationally located suppliers of an automotive-industrial firm.

Findings – As a result, the authors identified 11 factors that drive suppliers' acceptance of customer-introduced digital supply chain systems. These factors have been ranked based on their importance. The top three important factors identified were the digital system being provided at no cost to the suppliers, the system's ability to save time and the system offering benefits to the suppliers.

Research limitations/implications – Further research can be conducted to validate the perspective of suppliers in other industries. Additionally, future studies can investigate the effectiveness of fulfilling these acceptance factors within an actual digital integration setup.

Practical implications – Companies can leverage these insights to accelerate their digital supply chain integration efforts. The insights on acceptance factors, challenges, benefits and support expected by suppliers can serve as a valuable guide for policy and decision makers within the industry.

Originality/value – To the best of the authors' knowledge, this study is among the first to investigate the perspective of suppliers in the integration of a customer's digital supply chain. By including the supplier's perspective, this study makes a significant contribution to the academic literature about supply chain digitalisation.

Keywords Supply-chain management, Supplier involvement, Systems integration, Supplier relationships

Paper type Research paper

Introduction: gaining supplier acceptance to drive supply chain digitalisation

The current era of digitalisation has witnessed introduction of numerous digital supply chain systems, all designed with the intention to enhance operational efficiency and supply chain performance (Choi *et al.*, 2018; Ivanov *et al.*, 2021). Transcending all industries, digitalisation has been shown to enable companies gain better visibility and foster collaboration along their entire value chain (Lee, 2021), ultimately helping firms adapt to market volatility and increase business value (Parker, 2020). As companies become more reliant on partners in supply chain, the absence of a digital platform for communicating and collaborating with these partners has highlighted the inadequacies of conventional collaboration methods (Tham, 2021). Maintaining the process of conventional supply chain integration is becoming difficult due to the transformation into digital supply chain and supplier

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The interview questionnaire and survey questions can be accessed by the readers on request to the corresponding author.

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integration (Parker, 2020). The resulting pressure of transforming the conventional supply chain has thus driven many companies to implement new digital systems at an increased rate (Gupta *et al.*, 2021). Companies increasingly use technologies such as block chain, cloud computing, big data analytics (Enrique *et al.*, 2022; Büyüközkan and Göçer, 2018) to enable the transparent flow and end-to-end visibility of information, goods or money exchange between the partners in the supply chain (Xue *et al.*, 2013).

Unlike a firm's internal digitalisation activities, supply chain digitalisation aims at improving real-time data exchange and thus contribute towards better communication and transparency with external partners ranging from suppliers over logistics service providers to customers. According to a survey report by McKinsey (LaBerge and O'Toole, 2020) and following the event of the COVID-19 supply chain crisis, globally there has been a 20% increase in companies adopting such digital supply chain systems. The digital supply chain requires a multi-stakeholder collaboration in which the larger entity oftentimes takes the initiative and drives the integration (Korpela *et al.*, 2017). The concept of integrating external partners into the digital supply chain in practice is still in the evolving state (Parker, 2020). According to Ghadimi *et al.* (2022), all members of a firm's supply chain should be interconnected through digital supply chain networks, no matter their size. Research by Marie-Christin *et al.* (2019), however, emphasize that the inclusion of all partners is in fact the largest challenge in implementation of any digital supply chain system.

Especially suppliers serving multiple customers might find it difficult to integrate with the many different digital supply chain systems of their many different customers. Digital supplier integration faces challenges like lack of trust, strategic alignment, expertise and willingness to collaborate (Schniederjans *et al.*, 2020; Delligatti, 2019; Weerabahu *et al.*, 2022; Patsavellas *et al.*, 2021; Weerabahu *et al.*, 2022; Patsavellas *et al.*, 2021; Mathivathanan *et al.*, 2021). Understanding suppliers' perspective in adoption of digital supply chain system is crucial as it strategically enhances supplier-oriented performance (Huo, 2012). The adoption of Radio Frequency Identification (RFID) technology in Walmart provides a compelling case of digital technology integration in supply chain management that failed: it took approximately four years to onboard almost 600 suppliers out of a pool of approximately 600,000 (Duvall, 2007). This example highlights the complexity of large-scale digital adoption in supply chain management and underscores the importance for understanding the factors driving acceptance on the side of external partners such as suppliers.

Despite the need for more insights on suppliers' perspective with respect to adopting customer-introduced supply chain systems (Zhou *et al.*, 2016), currently only few publications explore the supplier's perspectives in adopting a customer digital supply chain system. Extant research covers different application of digital customer initiatives, points out their benefits as well as outcomes relating to firm performance but rarely considers the potential risks and challenges associated with their adoption (Kessler *et al.*, 2022). We follow Yang *et al.*'s (2021) call for research on identifying the success factors in the adoption of digital supply chain systems and set out to investigate how firms can develop digital supply chain system adoption strategies in collaboration with their supply chain partners, specifically suppliers. This paper thus aims to fill a research gap by examining the suppliers' perspective in adopting a digital supply chain system. The findings of this study are intended to help companies improve preparation and implementation of digital supply chain systems due to better alignment with suppliers' expectations. By addressing this research gap, the study contributes to a more comprehensive understanding of digital supply chain systems and their impact on supplier dynamics.

The data for this research were collected from suppliers of a large automotive and industrial supplier, headquartered in Germany. Even though the study focuses on the relationship between a customer and its suppliers, the results of the findings extend to dyads between other partners of the supply chain such as manufacturers, logistic service providers, distributors or any other network entity that provides products or service to a customer introducing a digital supply chain platform. Analyses of collected data will reveal the ranking of identified acceptance factors that the customers should consider for the effective integration of suppliers into any of their digital supply chain systems. The findings will be useful for companies to collaborate with their partners more easily in digitalising supply chain by means of better accommodating for their partners' expectations. As suppliers typically represent a fundamental element of any supply chain, the results can have universal relevance for other industries seeking to integrate digitally with their supply chain partners. The findings of this research will not only provide valuable insights into the perspectives of suppliers and the adoption of digital supply chain systems but also shed light on the role of buyer–supplier relationship in this process (Zhou *et al.*, 2016). These insights are essential in advancing the theoretical underpinnings of digital supply chain integration and collaboration. Moreover, this knowledge will be crucial in developing frameworks and models that managers can employ when designing, implementing and evaluating digital supply chain systems. By understanding the barriers that suppliers face when accepting customer-introduced digital supply chain systems, managers can develop strategies that encourage their adoption. This knowledge would create opportunities to improve collaboration, streamline processes, reduce costs and increase supplier satisfaction, ultimately leading to a competitive edge in the market (Pulles *et al.*, 2016; Corsten and Felde, 2005).

This study thus addresses the question how companies can accelerate or promote digitalisation of supply chain by understanding the perspective of their partners (suppliers) in adopting these digital supply chain systems.

Theoretical background: a glimpse into extant literature

Firstly, to explore the factors that drive supplier acceptance of digital supply chain integration, this study draws on existing literature on technology adoption theories. Secondly, a clear conceptualization of digital supply chain systems is provided to gain a full understanding of how they function and operate. Thirdly, considering the intricacies of supply chain collaboration, this study emphasizes the crucial role of

collaboration in promoting supplier integration for digital supply chain systems. In essence, digital supply chain integration cannot be realized without supply chain collaboration, which is essential for enabling integration with suppliers. Therefore, the study aims to investigate how companies can gain acceptance from their suppliers to successfully integrate digital supply chain systems. It does so by examining the theoretical perspectives on technology adoption, as well as by clarifying the conceptualization of digital supply chain systems and the significance of supply chain collaboration in facilitating supplier integration.

Technology adoption theories

Various technology adoption models and studies have evolved in the past. These models include Diffusion of Innovation (DOI) by Rogers (Rogers, 1962), Technology Organization Environment (TOE) by Tornatzky *et al.* (1990), Technology Acceptance Model (TAM) by Davis (Davis, 1989), Interorganisational Information System (IOIS) adoption theory by Kurnia and Johnston (2000) and many more. The DOI theory used study the trend of spreading a technology among the population, and it shows that the adoption of the technology is mostly affected by its characteristics (Macvaugh and Schiavone, 2010). The IOIS adoption theory refers to three different variables of influence, organisational capabilities, interorganisational environment, perceived benefits (Kurnia and Johnston, 2000). Another framework, TAM has shown two major categories of influencing factors, namely, perceived ease of use and usefulness (Charness and Boot, 2016). The TAM model focuses on individual users and was even extended multiple times later to include further factors due to the continuous change in technologies (Benbasat and Barki, 2007).

The TOE framework, on the other hand, is a generic model including factors relating to the technology itself (e.g. functionality, complexity, compatibility), the organisational context in which it is deployed (e.g. size, structure, culture) and the environment in which the organization operates (e.g. market conditions, regulatory requirements) without any further specified subdimensions (Zeng *et al.*, 2021). While the original TOE Framework focuses on how companies adopt new technologies, this study aims to develop an understanding of the external partner, specifically suppliers' point of view with respect to technology adoption. However, the framework's generic nature enables an application to various research contexts (Wang *et al.*, 2010; Gangwar *et al.*, 2015; Zhu, 2004; Lei, 2022). According to Yang *et al.*'s (2021), there is a lack of technology adoption studies conducted in an interorganisational setting. The Technology Organization and Environment (TOE) framework thus provides a suitable lens for adding the nuance of how the technology itself and the organisational as well as environmental context influence suppliers' adoption of new supply chain technologies. In this study we focus on adoption of digital supply chain systems and digital initiatives on a general level in an interorganisational (customer–supplier) setup rather than on one specific technology. Although, new technology emerges frequently, studying its adoption from a supplier perspective in general is important to understand the fundamental acceptance factors driving a system's adoption and therefore digital supply chain integration efforts. This study was conducted inductively, with grounded theory approach using mixed methodologies of qualitative interviews and quantitative survey.

Digital supply chain systems

Digital supply chain systems are hardware, software, platforms or communication networks supporting digital information exchange about activities between globally distributed partners in the supply chain (Bhargava *et al.*, 2013). These are technologies or platforms used to digitalise the flow of information about production, delivery of goods, or money exchange between the partners facilitating speed, flexibility, intelligence, connectivity, real-time inventory and transparency (Büyüközkan and Göçer, 2018). Digital supply chain systems use technologies such as artificial intelligence, cloud computing, IoT, big data, blockchain technology and more. Digitalisation initiatives brought by customers suffer uncertainties such as the unwillingness of supply chain partners to invest and use or plain resistance from end-users (Zeng *et al.*, 2021). Table 1 summarises studies conducted on digital supply chain integration in recent years, including the type of methodology used and the focus of each study. Many studies have been conducted to understand the perspective of users in general, but no research has empirically explored the impact of digital supply chain integration from the partner's perspective. In that context, taking into account suppliers' previous

Table 1 Literature position of this study

Paper	Type	Topic	Internal perspective	External perspective
Yang *et al.* (2021)	Systematic literature review	Drivers of adoption	✓	
Bienhaus and Haddud (2018)	Quantitative survey	Barriers of digital adoption	✓	
Weerabahu *et al.* (2022)	Systematic literature review	Enablers and challenges	✓	✓
Luthra and Mangla (2018)	Survey	Challenges	✓	
Wong *et al.* (2020)	Survey	Drivers of adoption	✓	
Mitra *et al.* (2022)	Survey	Drivers of adoption	✓	
Samaranayake *et al.* (2022)	Literature review + AHP	Drivers of adoption	✓	
Mthimkhulu and Jokonya (2022)	Literature review	Challenges of adoption	✓	
This study	Qualitative + quantitative	Challenges, benefits, and drivers of adoption		✓

Source: Authors' own work

experience with digital supply chain systems as suggested by Banerjee *et al.* (2021) provides a first starting point to shed light on factors and contingencies beneficial for digital supply chain system integration.

Supply chain collaboration

Collaboration with supply chain partners is vital for the successful implementation of digital supply chain systems (Kayikci *et al.*, 2022). Partners within the supply chain collaborate to update each other about development, production, delivery and other activities in traditional supply chains (Alicke *et al.*, 2016). For digital supply chain systems to work, partners in the supply chain must agree to use the same system (Hadaya and Pellerin, 2010). Generally, the customer in the supply chain introduces the digital supply chain system such that external partner, and suppliers in particular, will have to adopt the system (Jenkins, 2022). The adoption works through the process of supplier integration and requires resources (Liu *et al.*, 2011). Similarly, for supplier side integration, suppliers need to allocate enough time and resources towards customers' digital integration. A study by Pulles *et al.* (2016) reveals that suppliers allocate resources to their preferred customer. This means that suppliers give high preference to the integration request from their preferred customer and allocates time for them. Further, preferred customer status is awarded by suppliers to those customers who satisfy their business needs (Pulles *et al.*, 2016). Customers thus compete against one another for attaining preferential status and receiving preferential treatment in form of collaboration in digital integration efforts, all with the aim to gain a competitive advantage for themselves. A study by Banerjee *et al.* (2021) claims that customer's reputation or status has an influence on the adoption of digital systems by suppliers. Along these lines, when customers know about relevant benefits and requirements from the supplier point of view in relation to digital systems, adoption will be able to facilitate the supplier integration process and ultimately gain a competitive edge over customers who disregard the supplier perspective.

Supplier integration

Flynn *et al.* (2010) define supply chain integration as:

> The degree to which a firm can strategically collaborate with its supply chain partners and cooperatively manage intra- and inter-organizational processes to achieve effective and efficient flows of products, services, information, money and decisions, with the objective of providing maximum value to its customer at low cost and high speed (2010, p. 59).

Supply chain integration is classified into internal integration and external integration. Stank *et al.* (2001) define supplier integration – also known as external integration – as the process of synchronisation of strategies, processes and practices between a manufacturer and its external partners. Their research also points out that partners must be willing to collaborate – at the same time investments and resources sharing between both parties is also vital. The studies by Kamaruddin and Zulkifli Mohamed (2009) in the Malaysian automotive industry and Tasnim *et al.* (2023) demonstrate supply chain partner pressure (channel pressure) to have an influence on digital supply chain adoption among partners. Peer pressure and competition in market is one of the challenges in digital adoption and coercion of power to adopting technology may not always achieve the desired outcomes (Nguyen *et al.*, 2022; Zhou *et al.*, 2016). While digital systems may be adopted as a consequence of pressure exerted by partners, the effective and sustainable use of these remain questionable. In addition, Ageron *et al.* (2020) point to several technological, organisational and strategical challenges that firms face in digital supply chain integration. The authors call for studies on understanding the supplier integration and theory adoption of digital supply chain through mixed methodology approach to support managerial efforts to implement digital supply chain systems.

Research methodology: description of collection and analysis of data

In this study, a mixed method approach is used to explore the supplier perspective and answer the question of "what drives them to accept digital supply chain systems?". The mixed method approach uses both qualitative and quantitative types of methodologies (Johnson *et al.*, 2007). The use of this approach can overcome the weaknesses of qualitative and quantitative methods and can be complementary to each other to produce more valid results (Kelle, 2006; Lund, 2012). Using mixed methodology approaches also serves as methodological triangulation for validation of the results (Denzin, 2017). Firstly, interviews were conducted among suppliers of the focal firm to collect qualitative data followed by quantitative data collection by means of a large-scale survey. The findings from the interviews were then used to draft the survey for the second stage of data collection. The different steps involved in the research method are explained below.

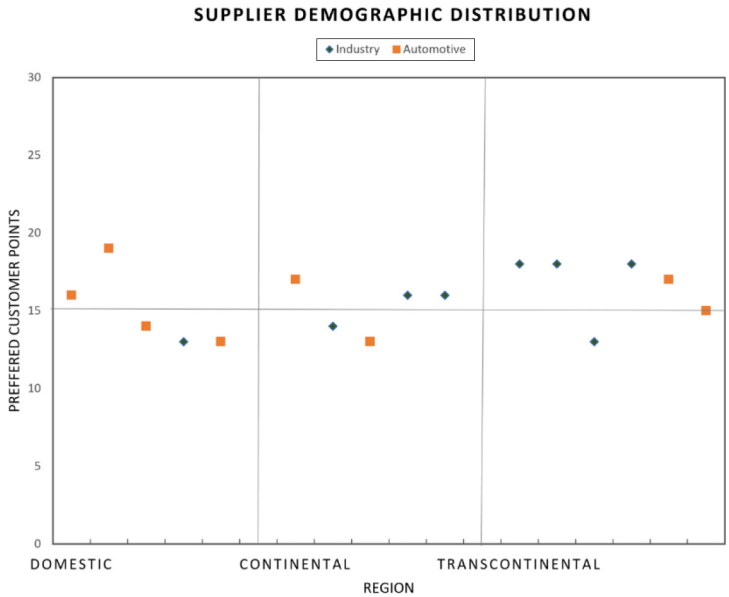
Exploratory phase – qualitative data

Sample selection and description

Research by Nielsen and Landauer (1993) showed that any sample size above 12 uncovers 90% of the issues. According to Guest *et al.* (2006), a minimum of 6 interview partners is recommended and deemed sufficient for delivering reliable and generalisable results. Based on that a sample of 16 suppliers of the focal firm were interviewed as part of the exploratory phase to identify the expected benefits, challenges, support and acceptance factors. The suppliers for the interviews were selected based on the following three criteria:

1. Suppliers from different international regions were included and were categorised as domestic – suppliers from Germany; continental – suppliers from Europe; transcontinental – suppliers from outside of Europe (see *x*-axis of Figure 1) based on their location.
2. Suppliers from different E-classes under automotive and manufacturing industries were included (Figure 3).
3. To avoid any bias with respect to the focal firm being an attractive customer for the suppliers, preferential customer status was taken into consideration. Suppliers who treated the focal firm as a highly preferred customer and those who did not do the same were both chosen. The preferential treatment level was measured based on an adapted dimensions defined in studies by Schumacher *et al.* (2008) and Schiele (2012). The dimensions included past preferential treatment, cultural

Figure 1 Supplier demographic distribution – qualitative data collection



Source: Author's own work

fit, technological importance, commercial importance and key account status of the suppliers. Suppliers' respective lead buyers or commodity managers at the focal firm were interviewed to assess the suppliers on all dimensions. Figure 1 shows the distribution of suppliers in aggregated form on the *y*-axis. Suppliers with an aggregate score above 15 treat the focal firm as a preferred customer – suppliers with a score below 15 treat the focal firm as a non-preferential customer (Schumacher *et al.*, 2008).

Data collection

After the selection of the 16 suppliers, they were individually interviewed based on the questionnaire. The interview instrument covered demographic questions, 14 questions inquiring about their expected benefits, challenges in implementation, support needed from the customer and acceptance factors for the integration and use of digital supply chain systems. The open-ended qualitative questions in the interview helped this study to gain new insights through suppliers' perspective. The interviews were conducted virtually. After obtaining consent from the participants the interviews were recorded for transcription and data analysis.

Data analysis

The data transcription was done using the software Amberscript and a manual check of the transcription was performed to avoid any errors. One of the widely used method of data validation is reviewing the data by the participants themselves (Soiferman, 2010). The transcribed records were sent to the respective participants for validation and to ensure accuracy. After data validation, the data were analysed using an inductive approach by deriving themes and coding them using Atlas.TI software (2022). Data analysis involves open coding, categorisation, and abstraction (Kuckartz, 2019; Saldana, 2012). The transcription records were read multiple times for assigning proper codes that fell under each theme of the following themes, expected benefits, challenges, support and acceptance factors. Once the data was analysed, the themes and codes were then categorized and can be found in Figure A1 in the appendix. The findings from the qualitative data analysis were incorporated and validated using a large-scale quantitative survey. The suppliers were asked to rank the acceptance factors based on their importance. The questionnaire for the survey also consisted of demographic questions.

Empirical phase – quantitative data

Sample selection and description

The candidates for this phase were the suppliers of the focal customer firm. The invitations for the survey were sent out via email to 2,689 suppliers of the focal firm. The suppliers were from a global scale, different E-classes and supply to multiple business divisions of the focal firm. In this phase, all suppliers of the focal firm were invited to participate regardless of their preferential status given to the focal firm. Ranking scales were used in the survey to collect respondents' ratings on importance of each acceptance factors.

Data collection

The survey was open for a period of 30 days for suppliers to answer. In total 326 supplier companies engaged in the survey, only 220 suppliers provided full complete responses without missing information. These 220 responses were used in the study. The share of respondents from various regions, supplied divisions, digital experience, preferred customer status and company size can be found in Table 2. The distribution of participants across different countries and E-class can be seen below in Figures 2 and 3.

Based on the demographics the suppliers were classified in to four groups for further analysis. The groups consisted of combinations of types of suppliers with or without digital supply

Table 2 Demographics of participants in counts and percentage

Variable	Values	$n = 220$	%
Region	Domestic (Germany)	54	24.55
	Continental (Europe)	52	23.64
	Transcontinental (outside Europe)	114	51.82
Division*	Automotive	169	76.81
	Industrial	91	41.36
	Automotive aftermarket	26	11.81
Digital supply chain system experience	Suppliers with DSCS experience	172	78.18
	Suppliers without DSCS experience	48	21.82
Preferred customer status (PCS)	Suppliers giving focal firm preferred customer status	175	79.54
	Suppliers who did not give focal firm preferred customer status	45	20.45
Size	1–100	83	37.73
	101–1000	97	44.09
	1001–10000	35	15.91
	10001–100000	5	2.27

Notes: n= 220 (total number of research participants); *Some suppliers supply to multiple divisions
Source: Author's own work

Figure 2 Distribution of participants across countries

Source: Author's own work

chain experience as well as suppliers that do and do not treat the focal firm as a preferred customer as shown in Figure 4. Studies claim that preferred customer status influences collaboration between suppliers and their customers (Bemelmans *et al.*, 2015). The customers who are attractive to the suppliers get awarded the preferred customer status (Hüttinger *et al.*, 2012). Hence it is interesting to investigate the influence of this status in supplier acceptance rankings. The survey consisted of questions that measured suppliers' preferred customer and their digitalisation experience status. The aim of comparing these supplier groups was to understand if the ranking of acceptance factors among the groups were influenced by their experience with digital systems or the preferential status.

Data analysis

After cleaning of the data from any illogical and incomplete responses, the ranking of each acceptance factor was calculated using its mean value in SPSS descriptive analysis. In addition to the mean, standard deviation and variance were also determined. A lower mean represents a higher rank in importance for the acceptance factor. The qualitative analysis report and quantitative acceptance factor rankings can be seen in Tables 3 and 4. In addition to finding the rankings of the acceptance factors based on importance for the total population, a comparison between groups of suppliers was performed. For this a multivariate analysis (MANOVA) was performed among various groups using SPSS. Multivariate analysis of variance is a popular statistical technique used in the social sciences for group comparisons in the context of multiple dependent variables (Finch and French, 2013). The multivariate analysis was performed to find if there was a significant difference in the rankings of acceptance factors among the distinct groups.

Findings: insights from supplier interviews and survey

The surveys and interviews with suppliers provided interesting insights into the suppliers' perspective. While suppliers showed general interest in using digital supply chain systems, results point to potential issues and reservations of suppliers.

Figure 3 Distribution of participants across E-class

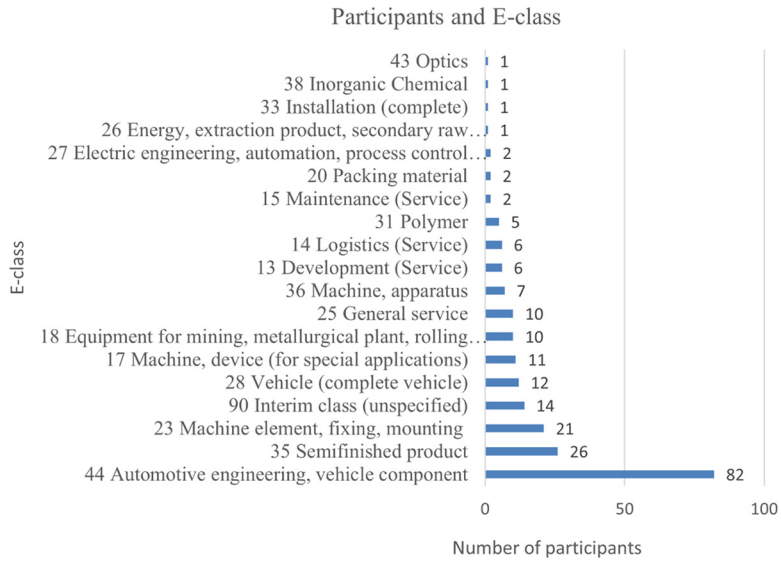


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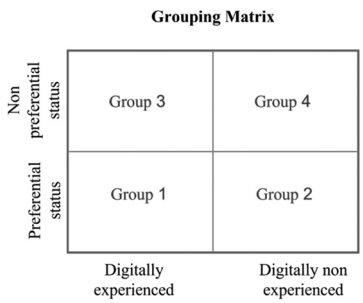
Figure 4 Group matrix based on preferential status and digital experience



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Results of qualitative phase (interviews)

Table 3 outlines the results, different categories, provides quotes representing the factors and counts of times mentioned.

Results of quantitative phase (survey)

The survey focused on the validation of acceptance factors identified during qualtiative interviews – benefits and challenges were not validated as these overlapped with the acceptance factors. For instance, cost was one of the challenges mentioned by most suppliers, and free of charge was one of the acceptance factors that was regarded to help overcome this challenge. In total, 11 factors were identified to drive suppliers' acceptance of customers' digital supply chain system. The overall ranking of acceptance factor is shown in Table 4 where lower scores denote a higher ranking and high scores denote a lower ranking.

The importance ranking results showed that a digital supply chain system that is free of charge for suppliers to use was identified as the most crucial acceptance factor. This factor was not mentioned in any other prior acceptance model. The system saving time for users ranked second among the acceptance factors. The factors "system that should also be beneficial to suppliers" and "system that is user friendly" tied for third place. Both the factors that ranked third place reflect of technology acceptance model influencing factors, perceived ease of use and usefulness (Davis, 1989). Followed by, customers should utilise the same platform for digital systems ranked fifth, which was also not mentioned in any of the adoption theories and models. In addition to the rankings a multivariate analysis was performed among four groups of suppliers shown in earlier Table 4. The Wilk's lambda in multivariate analysis showed insignificance (Sig = 0.175) and accepted the null hypothesis that there is no significant covariance in general ranking of acceptance factors among the four groups. However, the Levene's test of equality of error variance showed significance for four of the acceptance factors ($p < 0.05$). Further, the test between subject effects showed significance for only two out of the four factors, namely "Free of cost" ($p = 0.070$) and "Include suppliers in development phase" ($p = 0.014$) with small effect size (0.048). Figure 5 represents the two acceptance factors that had significant differences among the four group of suppliers.

The blue line in the graph represents acceptance factor "Free of cost". This was considered more important by Group 4 in comparison to Group 1. This implies that suppliers who do not assign preferential treatment to the focal customer firm and do not have experience with digital supply chain systems regard not having to pay for the use of the system more important in comparison to suppliers with digital experience and assigning the customer preferential status. The observed difference in importance could be due to the focal firm being an average customer for this group of suppliers who are thus not interested in investing in the relationship. The other acceptance factor that had a difference in the rankings among the groups was "include suppliers in the development phase". This factor was considered important by Group 2 in comparison to Group 4. A possible explanation for this variance is that a lack of prior

Table 3 Acceptance factors for digital supply chain system integration

Acceptance factors	Definition	Quote	No. of mentions
Free of cost to use	No additional cost on suppliers to use digital system	'If it's free of charge, it's even better'	4
System that saves time	A digital supply chain system that is efficient	'Optimize the processes and reduce the working hours for that process'	7
System with benefits for suppliers	A digital system that has benefits for suppliers not just for customers	'We would be okay with using the customers' system provided some sort of benefit to our company'	2
User-friendly system	A digital system that is easy to use	'The digital supply chain platform should be very user friendly'	5
Time to adopt the system	See point (3)	'Sometimes the customers need something done very quickly and we cannot respond to that'	4
Standard platform digital system	A common digital supply chain platform among customers or at least one among each customer	'Ideally, let's say perfect world, there would be one platform used by everyone'	4
Customer representative for each system	Contact of a representative on the digital system for quick communication during crises.	'It should be definitely having some customer point of contact so that if there are any queries, then we can definitely contact them and ask them to solve it earliest'	4
Financial support from customer for the implementation of the system	See point (3)	See point (3)	1
Systematic rollout of the system	A well planned, smooth integration of new systems with notice in advance	Having a proper enrolment for integration into the system	1
Trainings from customer	See point (3)	'Refreshment training from customer' 'Customer trainings for the suppliers'	9
Include suppliers in the development of the system	Collaborate with suppliers during development of the digital system	'We would like to be in a position to decide with the customer'	3

Source: Authors' own work

Table 4 Acceptance factors, ranking, mean, standard deviation and variance

Rank	Acceptance factors	Mean	SD	Variance
1	Free of cost to use	4.35	3.241	10.503
2	System that saves time	4.55	3.031	9.189
3	System must have benefits for suppliers (e.g.: automated information exchange)	4.85	3.181	10.116
3	System that is user friendly	4.85	2.749	7.559
5	Customer uses just one standard platform for all digital systems	5.51	2.810	7.895
6	Adequate time to adopt the system	5.55	2.545	6.476
7	Customer representative/ contact for the system available	6.19	2.659	7.068
8	Financial support from customer for the implementation of the system	6.98	2.771	7.680
9	Well planned and systematic rollout of the system	7.26	3.157	9.967
10	Training provided by customer	7.75	2.876	8.273
11	Include suppliers in the development of the digital system	8.14	2.760	7.616

Note: The lowest mean refers to highest rank and most important
Source: Authors' own work

experience with digital supply chain systems incites these suppliers to seek out opportunities to collaborate with their preferred customers during the development process.

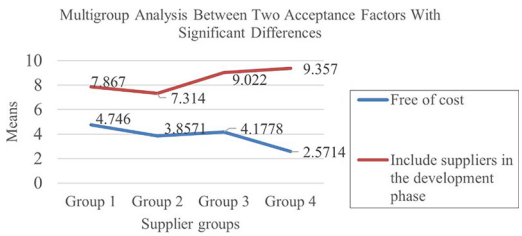
Discussion: research outcomes and implications

Theoretical considerations

In the following, the acceptance factors found in the study are categorized into the three dimensions of the TOE framework as shown in Figure 6.

The first set of factors pertains to characteristics of the technology itself. According to previous studies applying the TOE framework, one of the primary barriers to the adoption of novel innovation is the cost associated with its implementation (Marzi *et al.*, 2023; Scur *et al.*, 2023). Our finding that suppliers expect access to digital systems should be provided to them at free of charge confirms this. Similarly, the second acceptance factor "system that saves time" serves as an extension of the findings from a user experience study conducted by Li *et al.* (2021). Suppliers are inclined to employ systems that display

Figure 5 Multigroup analysis between two acceptance factors with significant differences



Note: Lower average refers to better ranking
Source: Author's own work

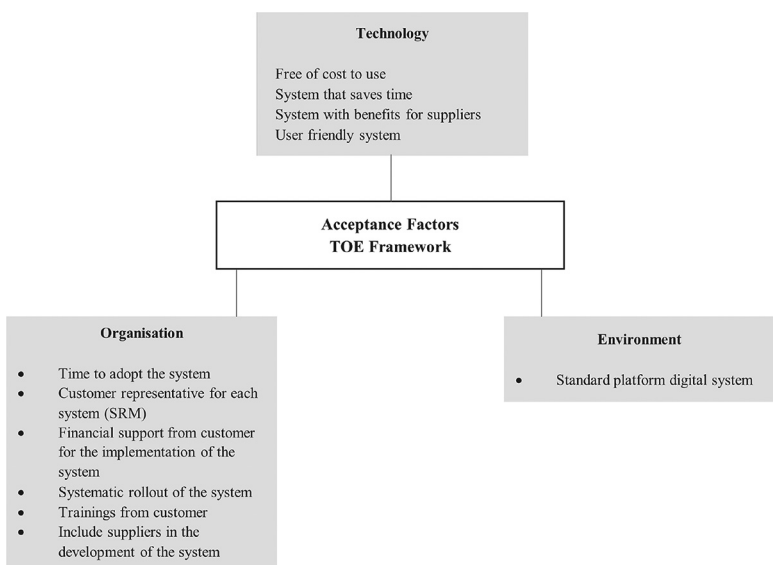
high levels of efficiency enabling them to reduce expenses and save time. Specifically, the first two ranked acceptance factors "a free-of-cost system" and "a time-saving system" were identified as key drivers for supplier acceptance. The third factor that confirms previous research is the presence of benefits for suppliers in a system. Previous research emphasises the importance of establishing a relative advantage for users, which refers to the degree to which the adoption of new technology can improve organisational performance in an intra-organisational context (Obiad *et al.*, 2022; Khan and Ali, 2018; Nath *et al.*, 2022; Alshamaila *et al.*, 2013; Qi and Che Azmi, 2021; Bhardwaj *et al.*, 2021). This study thus confirms that also for suppliers the provision of benefits is an important factor in facilitating technological adoption in an inter-organisational context. The fourth acceptance factor of user-friendliness that we identified has been confirmed by previous user experience studies (Li *et al.*, 2021; Chan and Chong, 2013; Bhardwaj *et al.*, 2021). The previously mentioned factors of "system benefitting the suppliers" and "being user-friendly" are not limited to the technology dimension of the TOE framework. They also align with the primary influencing factors of the Technology Acceptance Model (Charness and Boot, 2016) and the Diffusion of Innovation (DOI) which have both suggested that relative benefits for users are important (Rogers, 1962).

The second set of identified factors relates to the organisational context in which the technology is used and that possibly influences its adoption. Especially when the system is to be introduced to suppliers, the manner by which adoption is carried out has a decisive influence on chances for success. For instance, studies using the TOE framework for exploring intra-organisational digitalisation have identified vendor support as vital for successful adoption for customers (Bhardwaj *et al.*, 2021; Ghobakhloo *et al.*, 2011). This is also confirmed an inter-organisational context as exemplified by the two factors we found relating to whether suppliers receive support in terms or "financial support from customers for the implementation of the system" and "training from customer". In addition to supporting previous findings, we identify several novel acceptance factors, thereby extending the TOE framework in an inter-organisational context. These include that customers grant "time to adopt the system" and apply supplier relationship management principles by allocating "a customer representative for each system", administering "a systematic rollout of the system" as well as "involving suppliers in the development of the system".

Last but not least, in relation to the environmental context dimension of the TOE, the complexity of the digital system landscape matters to suppliers. Specifically, our findings indicate suppliers typically must fulfil the requirements relating to systems integration of many different customers across many different digital platforms such that they prefer customers to possibly use a "standard platform for digital systems". This would avoid that suppliers have to adopt a multitude of platforms, thus also further diminishing chances of successful adoption.

Our study challenges existing notions established by prior acceptance studies about the factors that drive adoption of

Figure 6 Supplier acceptance factors under TOE framework



Source: Author's own work

digital systems. Specifically, our findings indicate that training, which is considered a key factor in the adoption of technology in the TAM (Sharma and Yetton, 2007; Luse *et al.*, 2013), may not be the most important factor when it comes to acceptance of digital supply chain systems by suppliers. Interestingly, in our study, training from customers was ranked as the least important acceptance factor. We found that other factors, such as offering the system free of charge and ensuring time savings for its users, were more important than training for the successful implementation of digital supply chain systems in supply chain. By challenging existing notions about the role of training in technology adoption, our study contributes to the literature on acceptance theories. Our findings offer new insights into the factors that drive supplier acceptance of digital supply chain systems and can help companies build better collaboration with their suppliers and improve their digital supply chain systems.

In comparison to the existing literature on digital supply chain system adoption conducted within an inter-organisational context, this study identified additional factors driving the adoption and implementation of digital systems beyond the single organisational perspective. The results give a clear indication what customer firms can do to improve supplier integration during implementation of digital supply chain systems: ensuring an easy-to-use system for the supplier and offering mutual benefits. Focusing on these aspects time otherwise spend on supplier involvement and intensive trainings can be saved and invested much better, for instance, during the development phase to create a highly user-friendly system not requiring too much training of suppliers. In conclusion, the findings show the factors that will drive suppliers' acceptance to adopt digital supply chain system without any pressure from the customer. By considering the expectations from supplier the implementation of digital supply chain system can be achieved in a collaborative fashion that is in line with supplier concerns.

Managerial implications

This research provides a comprehensive overview for managers and practitioners how to approach their integration efforts by offering a ranking of factors that drive supplier acceptance. Firstly, companies could start offering their digital system as a free of cost system for suppliers to use. This could tremendously increase the chances of a supplier accepting the new digital system as initial resistance towards adoption is decreased. Secondly, the customer companies could invest in developing a time-saving system for suppliers. Such an investment can effectively minimize the time and effort required in the setup as well as day-to-day use of the digital system for both the customer and supplier, thus benefitting all users involved. An efficient system is important for users to allocate available resources efficiently (Li *et al.*, 2021). Thirdly, firms may benefit from systematically identifying the benefits for supplier and integrating them into the digital systems (Wagner, 2003). This can be done by involving those suppliers in the development phase with which the customer has a preferential status. With this approach companies can strengthen their business relationship and collaboration with suppliers who sees them as an attractive customer at the same time also help in digital system development that is useful for the end users (Taha *et al.*, 2011).

The aforementioned factors represent the top three ranked acceptance factors based on their importance. In addition to that, companies should focus on developing an intuitive digital system to improve the user experience. This will eliminate additional resource requirements in the later phases for training purposes, thus making training the least important if the execution of user-friendly system is prioritised. Furthermore, in general suppliers also expect a customer uses a common digital system for their process rather than having to use multiple systems. Other acceptance factors such as adequate time to adopt the system, having customer representative for the system, financial support from customer for the implementation, a well-planned and systematic rollout of the system, training provided by customer and including suppliers in the development of the digital system must be something companies should consider. Interestingly most of the acceptance factors found in this study underly a common theme – the pivotal topic of supplier relationship management. Many of the factors such as customer representative for each system, including suppliers in development phase, financial support from customer and time to adopt the system can be achieved easily by strengthening the supplier relationship management and collaboration (Cao and Zhang, 2011). To summarise, incorporation of supplier acceptance factors could increase the rate of digital supply chain system adoption and the findings of this research contributes towards it. The companies should always strive for identifying the main benefits their respective supplier base is expecting. Companies could also use the findings for policy development, build better collaboration with suppliers for accelerating their supply chain digitalisation and integrating with their supply chain partners.

Limitations and future research direction

As the implementation of digital supply chain systems occurs in various types of industries, the acceptance factors found in this research possibly are applicable in other contexts and between other vertical supply chain partners further down or up the chain. However, the challenges, benefits and support required could vary depending on the industry and the digital supply chain system itself. The authors call for further research exploring suppliers' perspective in other fields of business to expand research on the supplier perspective. Future research must be undertaken to investigate the effectiveness of considering these acceptance factors in a digital supply chain system implementation.

References

Ageron, B., Bentahar, O. and Gunasekaran, A. (2020), "Digital supply chain: challenges and future directions", *Supply Chain Forum: An International Journal*, Vol. 21 No. 3, pp. 133-138.

Alicke, K., Jürgen, R. and Andreas, S. (2016), "Supply chain 4.0 – the next-generation digital supply chain", available at: www.mckinsey.com/capabilities/operations/our-insights/supply-chain-40–the-next-generation-digital-supply-chain

Alshamaila, Y., Papagiannidis, S. and Li, F. (2013), "Cloud computing adoption by SMEs in the North East of

England", *Journal of Enterprise Information Management*, Vol. 26 No. 3, pp. 250-275.
Banerjee, A., Lücker, F. and Ries, J.M. (2021), "An empirical analysis of suppliers' trade-off behaviour in adopting digital supply chain financing solutions", *International Journal of Operations & Production Management*, Vol. 41 No. 4, pp. 313-335.
Bemelmans, J., Voordijk, H., Vos, B. and Dewulf, G. (2015), "Antecedents and benefits of obtaining preferred customer status: experiences from the Dutch construction industry", *International Journal of Operations & Production Management*, Vol. 35 No. 2, pp. 178-200.
Benbasat, I. and Barki, H. (2007), "Quo vadis TAM?", *Journal of the Association for Information Systems*, Vol. 8 No. 4, pp. 211-218.
Bhardwaj, A., Garg, A. and Gajpal, Y. (2021), "Determinants of blockchain technology adoption in supply chains by small and medium enterprises (SMEs) in India", *Mathematical Problems in Engineering*, Vol. 2021, pp. 1-14.
Bhargava, B., Ranchal, R. and Ben Othmane, L. (2013), "Secure information sharing in digital supply chains", 2013 3rd IEEE International Advance Computing Conference (IACC), 2013-02-01, *IEEE*.
Bienhaus, F. and Haddud, A. (2018), "Procurement 4.0: factors influencing the digitisation of procurement and supply chains", *Business Process Management Journal*, Vol. 24, doi: 10.1108/BP MJ-06-2017-0139.
Büyüközkan, G. and Göçer, F. (2018), "Digital supply chain: literature review and a proposed framework for future research", *Computers in Industry*, Vol. 97, pp. 157-177.
Cao, M. and Zhang, Q. (2011), "Supply chain collaboration: impact on collaborative advantage and firm performance", *Journal of Operations Management*, Vol. 29 No. 3, pp. 163-180.
Chan, F. and Chong, A. (2013), "Determinants of mobile supply chain management system diffusion: a structural equation analysis of manufacturing firms", *International Journal of Production Research*, Vol. 51 No. 4, pp. 1196-1213.
Charness, N. and Boot, W.R. (2016), "'Chapter 20 – technology, gaming, and social networking'", in Schaie, K.W. and Willis, S.L. (Eds), *Handbook of the Psychology of Aging*, 8th ed., Academic Press, San Diego, pp. 389-407.
Choi, T.-M., Wallace, S.W. and Wang, Y. (2018), "Big data analytics in operations management", *Production and Operations Management*, Vol. 27 No. 10, pp. 1868-1883.
Corsten, D. and Felde, J. (2005), "Exploring the performance effects of key-supplier collaboration", *International Journal of Physical Distribution & Logistics Management*, Vol. 35 No. 6.
Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, Vol. 13 No. 3, pp. 319-340.
Delligatti, J. (2019), "The benefits and challenges of digital supply chain integration", The Digital Supply Chain Company, available at: www.sdi.com/resources/blog/benefits-and-challenges-digital-supply-chain-integration/
Denzin, N.K. (2017), "The Research Act".
Duvall, M. (2007), "cover story: wal-mart's faltering RFID initiative", available at: www.baselinemag.com/enterprise-apps/Cover-Story-WalMarts-Faltering-RFID-Initiative/
Enrique, D.V., Lerman, L.V., Sousa, P.R.D., Benitez, G.B., Bigares Charrua Santos, F.M. and Frank, A.G. (2022), "Being digital and flexible to navigate the storm: how digital transformation enhances supply chain flexibility in turbulent environments", *International Journal of Production Economics*, Vol. 250, p. 108668.
Finch, H. and French, B. (2013), "A monte Carlo comparison of robust MANOVA test statistics", *Journal of Modern Applied Statistical Methods*, Vol. 12 No. 2, pp. 35-81.
Flynn, B.B., Huo, B. and Zhao, X. (2010), "The impact of supply chain integration on performance: a contingency and configuration approach", *Journal of Operations Management*, Vol. 28 No. 1, pp. 58-71.
Gangwar, H., Date, H. and Ramaswamy, R. (2015), "Developing a cloud-computing adoption framework", *Global Business Review*, Vol. 16 No. 4.
Ghadimi, P., Donnelly, O., Sar, K., Wang, C. and Azadnia, A.H. (2022), "The successful implementation of industry 4.0 in manufacturing: an analysis and prioritization of risks in Irish industry", *Technological Forecasting and Social Change*, Vol. 175, p. 121394.
Ghobakhloo, M., Arias-Aranda, D. and Benitez-Amado, J. (2011), "Adoption of e-commerce applications in SMEs", *Industrial Management & Data Systems*, Vol. 111 No. 8, pp. 1238-1269.
Guest, G., Bunce, A. and Johnson, L. (2006), "How many interviews are enough?", *Field Methods*, Vol. 18 No. 1, pp. 59-82.
Gupta, H., Kumar, S., Kusi-Sarpong, S., Jabbour, C.J.C. and Agyemang, M. (2021), "Enablers to supply chain performance on the basis of digitization technologies", *Industrial Management & Data Systems*, Vol. 121 No. 9, pp. 1915-1938.
Hadaya, P. and Pellerin, R. (2010), "Determinants of construction companies' use of web-based interorganizational information systems", *Supply Chain Management: An International Journal*, Vol. 15 No. 5, pp. 371-384.
Huo, B. (2012), "The impact of supply chain integration on company performance: an organizational capability perspective", *Supply Chain Management: An International Journal*, Vol. 17 No. 6, pp. 596-610.
Hüttinger, L., Schiele, H. and Veldman, J. (2012), "The drivers of customer attractiveness, supplier satisfaction and preferred customer status: a literature review", *Industrial Marketing Management*, Vol. 41 No. 8, pp. 1194-1205.
Ivanov, D., Blackhurst, J. and Das, A. (2021), "Supply chain resilience and its interplay with digital technologies: making innovations work in emergency situations", *International Journal of Physical Distribution & Logistics Management*, Vol. 51 No. 2, pp. 97-103.
Jenkins, A. (2022), "Digital supply chain explained".
Johnson, R.B., Onwuegbuzie, A.J. and Turner, L.A. (2007), "Toward a definition of mixed methods research", *Journal of Mixed Methods Research*, Vol. 1 No. 2, pp. 112-133.
Kamaruddin, N.K. and Zulkifli Mohamed, U. (2009), "Supply chain technology adoption in Malaysian automotive suppliers: IMS", *Journal of Manufacturing Technology Management*, Vol. 20 No. 3, pp. 385-403.
Kayikci, Y., Gozacan-Chase, N., Rejeb, A. and Mathiyazhagan, K. (2022), "Critical success factors for implementing

blockchain-based circular supply chain", *Business Strategy and the Environment*, Vol. 31 No. 7, pp. 3595-3615.

Kelle, U. (2006), "Combining qualitative and quantitative methods in research practice: purposes and advantages", *Qualitative Research in Psychology*, Vol. 3 No. 4, pp. 293-311.

Kessler, M., Arlinghaus, J.C., Rosca, E. and Zimmermann, M. (2022), "Curse or blessing? Exploring risk factors of digital technologies in industrial operations", *International Journal of Production Economics*, Vol. 243, p. 108323.

Khan, A.N. and Ali, A. (2018), "Factors affecting retailer's adoption of mobile payment systems: a SEM-neural network modeling approach", *Wireless Personal Communications*, Vol. 103 No. 3, pp. 2529-2551.

Korpela, K., Hallikas, J. and Dahlberg, T. (2017), "Digital supply chain transformation toward blockchain integration".

Kuckartz, U. (2019), "Qualitative text analysis: a systematic approach", ICME-13 Monographs, Springer International Publishing, pp. 181-197.

Kurnia, S. and Johnston, R.B. (2000), "The need for a processual view of inter-organizational systems adoption", *The Journal of Strategic Information Systems*, Vol. 9 No. 4, pp. 295-319.

LaBerge, L. and O'Toole, C.S. (2020), "How COVID-19 has pushed companies over the technology tipping point—and transformed business forever kernel description", available at: www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever

Lee, S.-Y. (2021), "Sustainable supply chain management, Digital-based supply chain integration, and firm performance: a cross-country empirical comparison between South Korea and Vietnam", *Sustainability*, Vol. 13 No. 13, p. 7315.

Lei, T. (2022), "Research on the influencing factors of user acceptance of blockchain application in government services under TOE framework", *Highlights in Science Engineering and Technology*.

Li, X., Zhao, L. and Lee, S.H. (2021), "Measuring user experiences with e-sourcing platforms: the development of the e-sourcing experience index", *Journal of Fashion Marketing and Management: An International Journal*, Vol. 25 No. 3, pp. 430-447.

Liu, D.Y., Chen, S.W. and Chou, T.C. (2011), "Resource fit in digital transformation", *Management Decision*, Vol. 49 No. 10, pp. 1728-1742.

Lund, T. (2012), "Combining qualitative and quantitative approaches: some arguments for mixed methods research", *Scandinavian Journal of Educational Research*, Vol. 56 No. 2, pp. 155-165.

Luse, A., Mennecke, B.E. and Townsend, A. (2013), "Experience richness: effects of training method on individual technology acceptance", 2013 46th HI International Conference on System Sciences, pp. 853-862.

Luthra, S. and Mangla, S.K. (2018), "Evaluating challenges to Industry 4.0 initiatives for supply chain sustainability in emerging economies", *Process Safety and Environmental Protection*, Vol. 117, pp. 168-179, doi: 10.1016/j.psep.2018.04.018.

Macvaugh, J. and Schiavone, F. (2010), "Limits to the diffusion of innovation", *European Journal of Innovation Management*, Vol. 13 No. 2, pp. 197-221.

Marie-Christin, S., Johannes, W.V., Julian, M.M. and Kai-Ingo, V. (2019), "Kick-start for connectivity: how to implement digital platforms successfully in industry 4.0", *Technology Innovation Management Review*, Vol. 9 No. 10.

Marzi, G., Marrucci, A., Vianelli, D. and Ciappei, C. (2023), "B2B digital platform adoption by SMEs and large firms: pathways and pitfalls", *Industrial Marketing Management*, Vol. 114, pp. 80-93.

Mathivathanan, D., Mathiyazhagan, K., Rana, N.P., Khorana, S. and Dwivedi, Y.K. (2021), "Barriers to the adoption of blockchain technology in business supply chains: a total interpretive structural modelling (TISM) approach", *International Journal of Production Research*, Vol. 59 No. 11, pp. 3338-3359.

Mitra, T., Kapoor, R. and Gupta, N. (2022), "Studying key antecedents of disruptive technology adoption in the digital supply chain: an Indian perspective", *International Journal of Emerging Markets*, Vol ahead-of-print No ahead-of-print, doi: 10.1108/IJOEM-07-2021-1052.

Mthimkhulu, A. and Jokonya, O. (2022), "Exploring the factors affecting the adoption of blockchain technology in the supply chain and logistic industry", *Journal of Transport and Supply Chain Management*, Vol. 16, doi: 10.4102/jtscm.v16i0.750.

Nath, S., Khayer, A., Majumder, J. and Barua, S. (2022), "Factors affecting blockchain adoption in apparel supply chains: does sustainability-oriented supplier development play a moderating role?", *Industrial Management & Data Systems*, Vol. 122 No. 5.

Nguyen, T.H., Le, X.C. and Vu, T.H.L. (2022), "An extended Technology-organization-environment (TOE) framework for online retailing utilization in digital transformation: empirical evidence from Vietnam", *Journal of Open Innovation: Technology, Market, and Complexity*, Vol. 8 No. 4, p. 200.

Nielsen, J. and Landauer, T.K. (1993), "'A mathematical model of the finding of usability problems", Proceedings of the SIGCHI conference on Human factors in computing systems – CHI, *93*, 1993-01-01, ACM Press.

Obiad, M., Lutfi, A., Almaiah, D., Alshira'h, A., Alshirah, M., Alqudah, H., Alkhassawneh, A., Alsyouf, A., Alrawad, M. and Abdelmaksoud, O. (2022), "Assessing the intention to adopt cloud accounting during COVID-19", *Electronics*, Vol. 11 No. 24, p. 4092.

Parker, D. (2020), "Supply-Chain digitization is no longer optional", www.supplychainbrain.com/blogs/1-think-tank/post/31062-in-2020-supply-chain-digitization-is-no-longer-optional

Patsavellas, J., Kaur, R. and Salonitis, K. (2021), "Supply chain control towers: technology push or market pull – an assessment tool", *IET Collaborative Intelligent Manufacturing*, Vol. 3 No. 3, pp. 290-302.

Pulles, N.J., Schiele, H., Veldman, J. and Hüttinger, L. (2016), "The impact of customer attractiveness and supplier satisfaction on becoming a preferred customer", *Industrial Marketing Management*, Vol. 54, pp. 129-140.

Qi, Y. and Che Azmi, A. (2021), "Factors affecting electronic invoice adoption and tax compliance process efficiency",

Transforming Government: People, Process and Policy, Vol. 15 No. 1, pp. 150-168.

Rogers, E.M. (1962), *Diffusion of Innovations*, Free Press of Glencoe.

Saldana, J.M. (2012), *The Coding Manual for Qualitative Researchers*, 2 ed., SAGE Publications, London.

Samaranayake, P., Laosirihongthong, T., Adebanjo, D. and Boon-Itt, S. (2022), "Prioritising enabling factors of Internet of things (IoT) adoption in digital supply chain", *International Journal of Productivity and Performance Management*, doi: 10.1108/ijppm-12-2021-0698.

Schiele, H. (2012), "Accessing supplier innovation by being their preferred customer", *Research-Technology Management*, Vol. 55 No. 1, pp. 44-50.

Schniederjans, D.G., Curado, C. and Khalajhedayati, M. (2020), "Supply chain digitisation trends: an integration of knowledge management", *International Journal of Production Economics*, Vol. 220, p. 107439.

Schumacher, S.C., Schiele, H., Contzen, M. and Zachau, T. (2008), *Die 3 Faktoren Des Einkaufs: Einkauf Und Lieferanten Strategisch Positionieren*, Wiley-VCH Verlag, Weinheim, Germany.

Scur, G., da Silva, A.V.D., Mattos, C.A. and Gonçalves, R.F. (2023), "Analysis of IoT adoption for vegetable crop cultivation: multiple case studies", *Technological Forecasting and Social Change*, Vol. 191, p. 122452.

Sharma, R. and Yetton, P. (2007), "The contingent effects of training, technical complexity, and task interdependence on successful information systems implementation", *MIS Quarterly*, Vol. 31 No. 2, pp. 219-238.

Soiferman, L.K. (2010), "Compare and contrast inductive and deductive research approaches".

Stank, T.P., Keller, S.B. and Daugherty, P.J. (2001), "supply chain collaboration and logistical service performance", *Journal of Business Logistics*, Vol. 22 No. 1, pp. 29-48.

Taha, Z., Alli, H. and Abdul-Rashid, S.H. (2011), "Users involvement in new product development process: a designers' perspectives", *Industrial Engineering & Management Systems*.

Tasnim, Z., Shareef, M.A., Baabdullah, A.M., Hamid, A.B. A. and Dwivedi, Y.K. (2023), "An empirical study on factors impacting the adoption of digital technologies in supply chain management and what blockchain technology could do for the manufacturing sector of Bangladesh", *Information Systems Management*, Vol. 40 No. 4, pp. 1-23.

Tham, J. (2021), "The impact of digital transformation on supply chain capabilities and supply chain competitive performance", available at: https://packagingrevolution.net/why-external-supply-chains-need-digitalization/

Tornatzky, L.G., Fleischer, M. and Chakrabarti, A.K. (1990), *The Processes of Technological Innovation*, Lexington Books, London.

Wagner, S.M. (2003), "Intensity and managerial scope of supplier integration", *Journal of Supply Chain Management*, Vol. 39 No. 3.

Wang, Y.M., Wang, Y.-S. and Yang, Y. (2010), "Understanding the determinants of RFID adoption in the manufacturing industry", *Technological Forecasting and Social Change*, Vol. 77 No. 5.

Weerabahu, W.M.S.K., Samaranayake, P., Nakandala, D. and Hurriyet, H. (2022), "Digital supply chain research trends: a systematic review and a maturity model for adoption", *Benchmarking: An International Journal*, Vol. 30 No. 9.

Wong, L.-W., Leong, L.-Y., Hew, J.-J., Tan, G.W.-H. and Ooi, K.-B. (2020), "Time to seize the digital evolution: adoption of blockchain in operations and supply chain management among Malaysian SMEs", *International Journal of Information Management*, Vol. 52, p. 101997, doi: 10.1016/j.ijinfomgt.2019.08.005.

Xue, L., Zhang, C., Ling, H. and Zhao, X. (2013), "Risk mitigation in supply chain digitization: system modularity and information technology governance", *Journal of Management Information Systems*, Vol. 30 No. 1, pp. 325-352.

Yang, M., Fu, M. and Zhang, Z. (2021), "The adoption of digital technologies in supply chains: drivers, process and impact", *Technological Forecasting and Social Change*, Vol. 169, p. 120795, doi: 10.1016/j.techfore.2021.120795.

Zeng, F., Chan, H.K. and Pawar, K. (2021), "The effects of inter- and intraorganizational factors on the adoption of electronic booking systems in the Maritime supply chain", *International Journal of Production Economics*, Vol. 236, p. 108119.

Zhou, W., Chong, A.Y.L., Zhen, C. and Bao, H. (2016), "E-Supply chain integration adoption: examination of buyer–supplier relationships", *Journal of Computer Information Systems*, Vol. 58 No. 1.

Zhu, K. (2004), "The complementarity of information technology infrastructure and E-Commerce capability: a Resource-Based assessment of their business value", *Journal of Management Information Systems*, Vol. 21 No. 1.

Further reading

So, S. and Sun, H. (2010), "Supplier integration strategy for lean manufacturing adoption in electronic-enabled supply chains", *Supply Chain Management: An International Journal*, Vol. 15 No. 6, pp. 474-487.

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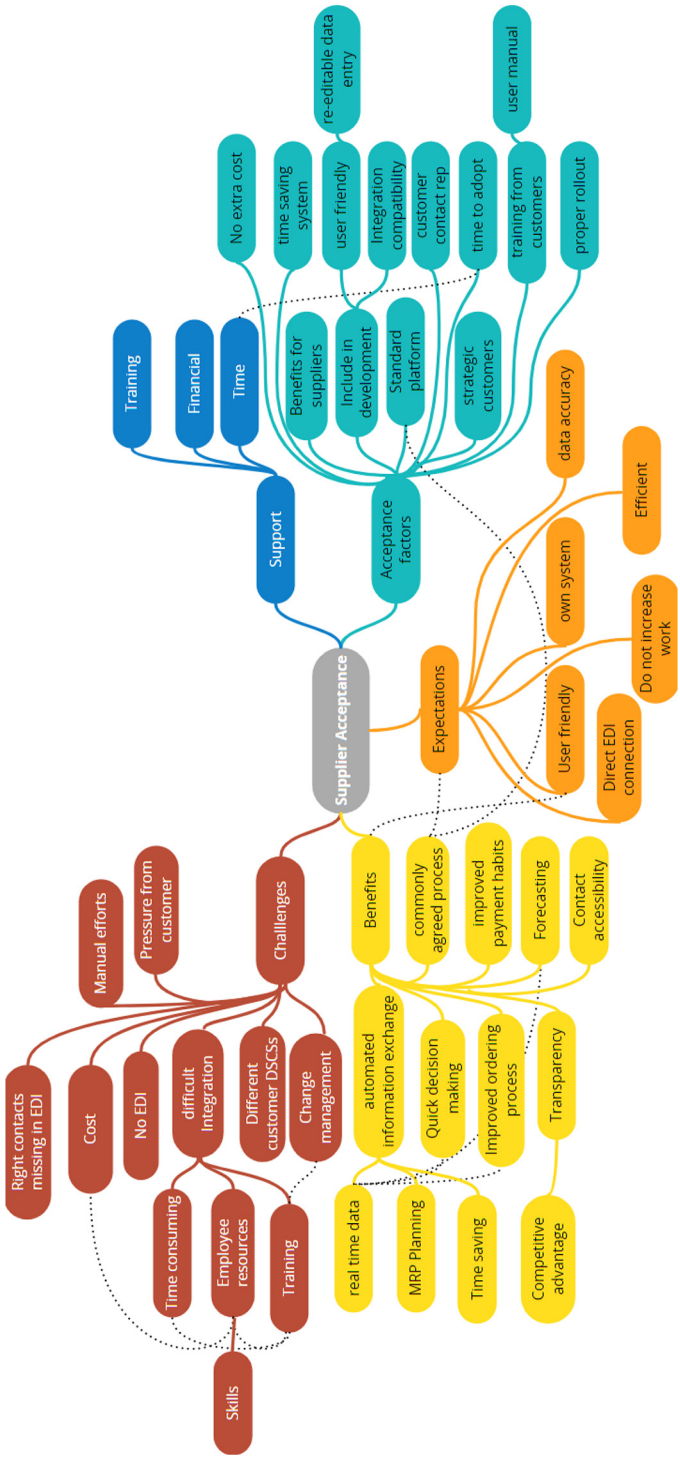
Appendix

Figure A1 Qualitative findings from the supplier interviews – benefits, challenges, support and acceptance factors



Source: Author's own work