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Digital Innovation and Supply Chain Information Management: Implications of Diffusion of Innovation Theory

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ABSTRACT:

With the advancement of digital technology, innovation has taken the place of automated processes and practices, which leads enterprises to achieve competitive advantage over each other. This dissertation aims to investigate the impact of digital innovation in supply chain information management in companies operating in European countries. This study used 31 European countries as sample for one point in time, 2023. Eurostat database was used to collect the data of digital innovation and supply chain management information. Then the hypothesis was tested by performing OLS regression and further heteroskedasticity test was conducted to validate the result. The findings suggest that the more the enterprises use any type of business software, the more frequently they use electronic form to share their supply chain information with the customers and suppliers. This research provides insights about how digital innovation can be useful to enterprises in achieving its goals. Especially, the enterprises can bring new digital tools or innovations in their business processes, face future challenges, and create capabilities to the enterprises to achieve best supply chain performance. Enterprises need to change their approaches and adopt new ways to get the utmost benefits of their resources. This is the first research contributing towards digital innovation and supply chain information management by examining how adoption of digital technologies can lead to digital information sharing by the enterprises. The study and model increase the insight on digital innovation as a strategic resource for enterprises to improve the performance and productivity of the enterprises.

KEYWORDS: Digital innovation, information sharing, Diffusion of Innovation, European Countries, Digital Technology.

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Abbreviation

DOI= Diffusion of Innovation
DI= Digital Innovation
GDI= Global Digitization Index

1 Introduction

This section gives a brief background information of this study including the importance, purpose, research problems and objectives, and the scope covered in this study. This will help to understand the context based on which the whole research was conducted and the clear outline of the structure of the study.

1.1 Background of the Study

The concept of digital innovation has attracted the attention of both researchers and practitioners across various disciplines such as economic, strategy, supply chain management and marketing (Beltagui et al., 2020; Nowicka, 2019). Digital innovation is a way of interaction of IoT, tools and people which allows the information diffusion and knowledge exchange considering that knowledge is the centre of profit, particularly in the age of digital advancement (Pauleen & Wang, 2017). Digital innovation is mainly stimulated by the enterprise's motivation towards investment in new technologies and adequate training to the employees, ensuring that workforce skills improves and enterprise becomes competitive and sustainable over time (Singh & El-Kassar, 2019).

In the age of digital technology, innovation-driven innovation becomes a strategic engine of development and competitiveness (Huang et al., 2023). Acemoglu & Restrepo (2019) discovered that the frequent use of digital technology can replace human labor by producing, boosting the allocation of production factors and transforming the actual value creation model. Moreover, with the adoption of digital technology, digital innovation leads to improved firm performance and introduction of new products, services and business models (Bharadwaj et al., 2013). Huang et al. (2023) found that digital innovation effectively enhances companies' economic effectiveness, plays a key role in increasing the industrial and value chain and develops the products and services.

Previous literature documented that company's digital innovation can empower reshaping and upgradation which ultimately leads to new logic of enterprise value

creation (Meng et al., 2023). Additionally, with the increased use of digital technology, enterprises can improve their operational processes which consequently enhance the responsiveness of decision-making, precision, improve efficiency, decrease operating expenses and ultimately achieve improved performance (Z. Li et al., 2024). In the field of supply chain, when companies adopting digital transformation, it changes the way of operations and creates spillover effects on upstream and downstream supply chain stakeholders (Z. Wang et al., 2022). Moreover, Li et al. (2024) found that company's digital innovation significantly increases the supply chain management level. In supply chain, information sharing is one of the key factors to ensure the performance and reduce the value chain costs.

Previous literature documented that information sharing can help to improve the order quantity choice of suppliers in a two-level supply chain by knowing the autoregressive demand process (H. L. Lee et al., 2000). Additionally, Raghunathan (2001) discovered that the manufacturers can also use their information to reduce the chance of forecast variations so that they do not need to make additional investment for information sharing. Therefore, it can be said that the relevance of information sharing depends to different supply chain configurations and flexibility is needed about how to share information and which information is shared (Chan & Chan, 2009). Since the companies supply chain performance is mostly dependent on information (Hult et al., 2004), it is essential to ensure the proper dissemination of information. Therefore, the use of digital innovation in the context of sharing supply chain information seems to be helpful. With the line of previous studies, the research aims to identify how digital innovation impacts the supply chain information management in European countries.

1.2 Context of the Study

The study uses the European countries as sample to conduct the research and conclude the results. The rationale behind choosing European countries lies in the increased use of digital technologies in these countries. The European Union set targets for transforming the businesses digitally by 2030 where they aim to achieve 90% or more of

small enterprises to reach at least a basic digital intensity and 75% of EU companies to use digital services such as cloud computing, big data analysis or use of AI (Eurostat, 2025). Based on current information, in 2024, more than 74% EU companies achieved the basic digital intensity level (Eurostat, 2025). Moreover, the European Union adopted New European Innovation Agenda in 2022 which sets targets for Europe to have innovation wave and start-ups (European Union, 2023).

Previously, Europe was deeply reliant on US technology which made enterprises, government and households vulnerable to sanctions, surveillance and political pressure (The Guardian, 2026). This dependency includes defence systems, communications, cloud services, payments which creates the concerns of security and sovereignty (The Guardian, 2026). Therefore, now some countries and EU bodies are working on making stronger EU level decision-making, more enforcement of laws related to data and considering one single European market. In response of this complications, European countries are working on their infrastructural development and cyber security initiatives. Therefore, new funding programme was introduced named Digital Europe Programme (DIGITAL) which focuses on exposing more digital technologies to households, firms and governments activities (European Commission, 2026b). This programme was mainly introduced to protect the Europe's evolving digital needs. After Covid-19 and Russia-Ukraine war, European countries are trying not only to strengthen the digital infrastructure but also create efficient cyber security networks and protections (European Commission, 2026b). In this regard, this programme 2025-2027 was also amended with time to keep the pace with digital priorities (Digibyte, 2026).

Moreover, the European Commission has provided funding calls under the Digital Europe Programme where they planned to allocate over 204 million euro to increase the development and application of innovative technologies all over the EU (European Commission, 2026a). The key target area are artificial intelligence and big data, digital access to government sector, to provide digital skills, to complete the Network of European Digital Innovation Hubs, to ensure the access of mobile diving licenses, to

invest in biomedical research and personalised healthcare, to share data all over the enterprises and to combat disinformation (European Commission, 2026a).

Based on the context, the research aims to build relationship between digital innovation and supply chain information management in European countries to understand if the increased digital technology application can increase the information sharing to the customers or suppliers or not.

1.3 Research Objectives and Questions

The key objective of the study is to examine how digital innovation affect the supply chain information management in European countries in 2023. As digital innovation is transforming the business landscape, enterprises adjust their operations accordingly to achieve the competitive advantage and improve performance (Akter et al., 2016). Moreover, in the digitalized age, rapid advancement of technology urges business managers to accept the change of innovative technology in their daily operations to get the most benefits of being competitive and fulfil customer needs (Aydiner et al., 2019). Previous studies also suggested that digital technologies and vast data can play an essential role in improved decision making and overall business activities (Raguseo, 2018). Moreover, Narasimhan & Nair (2005) found that if the information in supply chain is well-shared, it is possible to coordinate and manage supply chain effectively which consequently helps to achieve competitive advantage.

Although there is research on how digital innovation impact on business activities and performance, little is known about digital innovation impact on information sharing by enterprises. Based on this previous literature of digital innovation impact on business performance, this study aims to come with the following key research question.

- To what extent does the digital innovation in enterprises impact the supply chain information management (information sharing) in European countries?

To answer the research question, the following objectives are formulated.

- To identify the adoption rates of using business software in enterprises of European countries.
- To find out how digitalization impacts the supply chain information management of the enterprises operating in European countries.

1.4 Scope of the Study

This study focuses on the impact of digital innovation on supply chain information management across European countries for the year 2023. Digital transformation is one of the top strategic priorities in Europe as the Digital Decade initiative by EU defines the clear targets to steer and shape digital transformation until 2030 (Eurostat, 2025). This quantitative study addressed the research questions by using the Eurostat statistics to understand to what extent the 31 European countries enterprises use digital technologies to communicate their supply chain information to customers and suppliers. A publication by Eurostat stated that nearly 13% of EU businesses used artificial intelligence technologies in the year of 2024 which was 8% in 2023 and set new targets to achieve more digital intensity by 2030 (Eurostat, 2025) which makes the European countries the appropriate as sample.

The study purposefully considered the calendar year 2023 due to the unavailability of data, which limits the generalizability of the conclusions beyond the selected timeframe. However, the cross-sectional data analysed the country wise changes on the relationship between digital innovation and supply chain information management in the one point of time which allows to understand the comparability among countries. The study also applied Diffusion of Innovation theory as base to formulate the hypothesis. Using diffusion of innovation theory as the theoretical framework, the study investigates how any business software within enterprises can be adopted, diffused and integrated in supply chain information sharing. The theory helps to explain how perceived usefulness, compatibility and enterprise readiness can spread the digital innovations and

consequently shape flow of information to different stakeholders within the supply chains.

1.5 Structure of the Study

The remaining part of the study is structured as mentioned below. Chapter 2 of this dissertation illustrates brief yet thorough literature review of the planned study to understand the existing relationship between digital innovation and supply chain management information and find the research gap based on which the study can be conducted. The theoretical framework including the hypothesis development is described in chapter 3, mentioning the definitions of the theories used and discussing the logic behind having the theory. Chapter 4 depicts the planned research methodology covering the research design, sample and data, variables definitions, model used and data analysis techniques. The next chapter, chapter 5, then presents the research findings and analysis using the planned methodology described, provides the answers to the research questions and conclude the findings. Lastly, chapter 6 describes the conclusions of the study, including contributions, implications, limitations and avenues for future research.

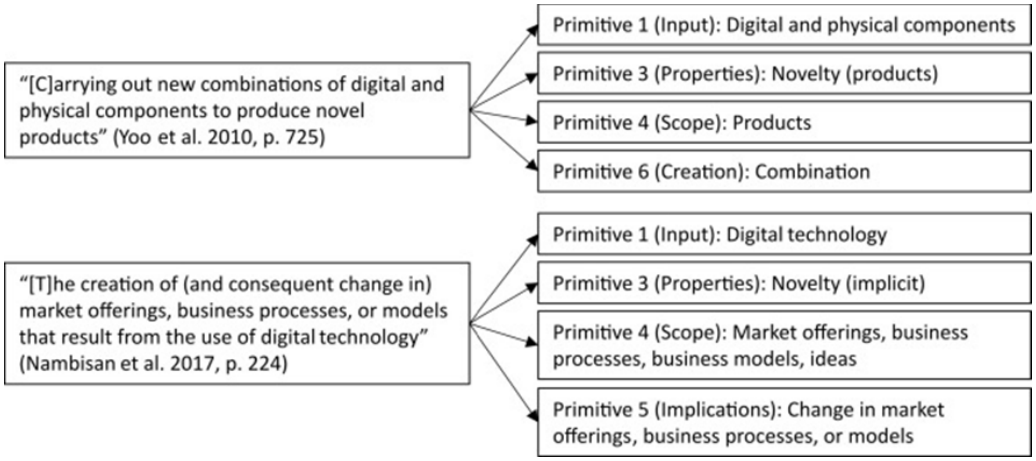
2 Literature review

This section presents an overview of the existing research on the study of digital innovation and sharing of supply chain information electronically by summarizing concepts, findings and gaps in previous literature. It starts with the key definitions of the concept of digital innovation and information sharing and later illustrates the conceptual background of this topic. Finally, this section outlines the previous findings on the relationship and links the findings to the rationale, direction, or conceptual framework.

2.1 Digital Innovation

In simple terms, digital innovation is the application of digital technology in a variety of innovations (Nambisan et al., 2017). The term digital refers to the transformation of analog information to binary form so that the computers can understand. The key characteristics of digital technology are malleability which means the systems can be changed or re-programmed; homogeneity which refers to the common languages or formats and transferability which includes sharing, coping or moving the files instantly unlike physical objects (Yoo et al., 2010). Consequently, it helps to enable new actions, limit people's activities and connect deeply to human activities. Therefore, it can be said digital innovation is about the planned and coordinated effort of generating new goods, processes, services, platforms and models in each setting which altered the structure and creation of goods and services creating new avenues for value creation and appropriation (Nambisan et al., 2017). Figure 1 depicts the two most popular definitions of digital innovation. Based on this Hund et al. (2021) identified six primitives of digital innovation: (i) input (ii) involvement (iii) properties (iv) scope (v) implications (vi) creation. Following these six primitives, Hund et al. (2021) defined digital innovation as a new creation or adoption of product, service, process, or business model that uses digital technology, inherently unbounded and create value.

Figure 1. Two popular definitions of digital innovation (Source: Hund et al. 2021).



Digital innovation is also termed as the combination of both physical and digital products to develop new objects (J. Lee & Berente, 2012), including the adoption of IT in enterprises to change the business processes, services and structures (Kohli & Melville, 2019). The key activities of digital innovation involve initiation, which consists of businesses recognizing and employing knowledge to identify opportunities; development, which includes the creation and execution of information systems solutions; implementation, focusing on the technical and operational configuration of systems and exploitation, comprising the utilization of current data and systems for maximum value (Cooper & Zmud, 1990). Therefore, the digital innovation transformation now is not just about supporting business activities but also aligning with enterprises to support its strategic goals (Henderson & Venkatraman, 1999).

With time, the term digital innovation evolves due to the frequent conceptual breakthroughs by researchers. The change started with the articulation of digital objects' properties. For example, Faulkner & Runde (2013) argued that digital things are non-material, different from physical objects, have a stable structure, depend on material supports such as hard drives and CD-ROMs and require physical devices to be stored, shared or used. On the other hand, Kallinikos et al. (2013) described digital objects having four key characteristics such as editable, interactive, open, and distributed. They

also argued that digital objects are different from other symbolic objects like texts, images and sounds due to active agents of processing information, transforming data and generating new output automatically through different computational techniques. Moreover, when digital technology is built into any physical objects, the nature of product changes, creates more product value and the whole business structure needs to be adapted with the new digital features (Yoo et al., 2010). Therefore, smartphones are not only smarter devices, the calling function is just one of many applications of smartphones. Smartwatches and smart rings are not just accessories, it helps to monitor the patterns of sleep, steps, heartbeats, breathing and oxygen levels in blood. Verganti (2009) digital parts become more generative, reprogrammable and recombinable which allows firms to look for ways to identify the hidden customer needs and create new types of value.

Initially, the term digital is used in contradiction to physical which means most value came from physical things such as machines, buildings or factories but now digital assets such as software, algorithms, data, data platforms have become more important than physical assets (Giustiziero et al., 2023). With the evolution of the term digital, the researchers now agree on digital tools now becoming unique sources of value creation through new product innovation (Yoo et al., 2024). They suggested that the term digital does not certainly signify different material capabilities, but it means the ways digital resources are used, owned and turned into value has changed. Therefore, digital innovation cannot be studied only by focusing on one factor instead of looking into how many factors interact together. This shift has led to understanding digital systems (infrastructures, platforms, and ecosystems) which are also essential for conceptualizing digital innovation.

The digital infrastructure includes all the information technologies and business structures which are essential for a company to function properly (Tilson et al., 2010). Moreover, it essentially acts as public good which reduces business costs and allows companies to innovate more efficiently (Kulkov et al., 2023). Therefore, the necessity of

infrastructure for digital innovation has been frequently recognized (de Reuver et al., 2018). A country or industry having strong digital infrastructure creates tightly knit industrial ecosystems which help to connect, share or communicate with each other easily, experiment more often without spending more money and have new and disruptive innovations faster (Hu et al., 2025). This study used business software as a measure of digital infrastructure and eventually innovation as core software applications is essential for the functioning of enterprises.

2.2 Information Sharing

Information sharing is considered as the key components of “total quality management” and the “new organization” (Constant et al., 1994). When different parties held control for resources, information sharing becomes the prerequisite for resource combination (Haeussler, 2011). Moreover, information sharing reduces information asymmetry by improving information awareness, transparency, access to resources, participation in governance, and decision-making among entities who else hold inadequate or fragmented information (Clarkson et al., 2007).

Previous literature found that information sharing is essential for improved organizational effectiveness, innovation, learning, trust, flexibility and business goal achievement. For instance, Pagano & Jappelli (1993) identified that information sharing helps lenders to distinguish between safe and risky borrowers which consequently reduce default selection and allows more precise loan pricing. If the lender exchange borrower’s information risky borrowers can be separated from safe borrowers and can charge higher interest rates. Therefore, information sharing improves credit market efficiency and decreases information asymmetry. Zhou & Benton (2007a) also found that effective information sharing improves the supply chain practices significantly. In supply chains, shared information is mostly dependent on trust, and the trust is continuously renewed with experience (Ebrahim ‐ Khanjari et al., 2012). As the trust grows when the shared information becomes accurate and with negative experiences often cause trust to diminish faster than positive experiences build.

Mesmer-Magnus & DeChurch (2009) found information sharing as key factor of team performance as it allows members of the team to combinedly use available resources which ultimately results in positive performance across various organizational contexts. Haeussler (2011) also stated that information sharing is a fundamental aspect of scientific progress which leads to societal benefits in both academia and industry perspectives. Due to the exchange and combine of resources, researchers can extend each other's work and conclude results more quickly than they can manage to do it alone. G. Li et al. (2021) found the importance of information sharing in an online marketplace between sellers.

Information sharing significantly improves the supply chain performance by ensuring coordinated partnerships and lowering uncertainties (Yu et al., 2001). Previous literature suggested that the supply chain performance of the companies is mostly dependent on available accurate and up-to-date marketing data at all the levels of the supply chain (Towill, 1997). With the available data and sharing the data with other supply chain nodes help an organization to increase the speed of information flow within the supply chain, foster the efficiency of the supply chain and address the customer needs faster. Hence, information sharing can gain competitive advantage in the long run (S. Li & Lin, 2006). With increased information sharing, it is also possible to ensure high level of supply chain integration which enables enterprises to introduce newer products to the market early and make dependable delivery. If the information is high quality, the information sharing can positively contribute to satisfaction of customers (Spekman et al., 1998). Additionally, the increased level of information sharing leads to lower operating costs, quicker order cycle time and higher order fulfillment rate (Fu-ren Lin et al., 2002).

2.3 Digital innovation and Information Sharing

Rapid transformation in technology has motivated enterprises to change their traditional methods, processes and products and compete in the global market. With the increased significance of digital innovation in business operations, firms are trying to improve their

expertise and efficiency by adopting new methods in production process (Al-Sa'di et al., 2017). As digital transformation is evolving and enterprises are motivated to adopt the changes, companies need not only to discover the innovations and innovative mechanisms to transform their businesses but also to train themselves to get the utmost benefits from the transformation in changing environments (Nasiri et al., 2023). Therefore, it is argued that enterprises need to understand how they can get value from digital technologies and develop capabilities to derive the expected benefits.

In this regard, Saleem et al., (2021) identified that strengthening the enterprise ability of using digital tools into innovative solutions is highly dependent on clear communication among partners. For sustainable performance, it is essential to align digital capabilities with active information sharing methods which leads to obtain competitive advantage (Saleem et al., 2021). Moreover, Le et al. (2025) found that by leveraging digital technologies and digital processes, enterprises can create connected networks which accelerate real time information and faster information sharing. With more advanced technologies, the information exchange becomes more transparent, accurate and secure. Moreover, the digital ecosystem is the key enabler of seamless communication as it allows higher processing capacity and allows fast response to market demands with higher flexibility (Le et al., 2025). Zissis (2023) also found that sharing information is essential for information sharing and reduces misinformation.

2.4 Research Gap

Previous literature already demonstrates that the advancement of digital technology is positively associated with higher levels of firm performance and particularly supply chain performance. Most research concentrated their studies on the benefits of digitalization from big data to natural processing languages, showing that various types of digital tools contribute towards information accuracy, communication and coordination within supply chain networks. However, despite all the cited relationships, there is no such research showing the direct relationship between digital innovation and motivation of electronic use to share information with the customers and suppliers. There is a lack of

empirical evidence showing the relationship in European context as there is highly increasing trend of digital technology adoption in most European countries. According to Global Digitalization Index (GDI) 2024, out of 10 countries in the list, 5 countries are from Europe which grab the attention to conduct the research in the context of European countries.

To address these gaps, the present study focuses on how the use of business software influences the percentage of electronic supply chain information sharing with customers and suppliers, which offers a generalized understanding of digital integration in supply chain information communication.

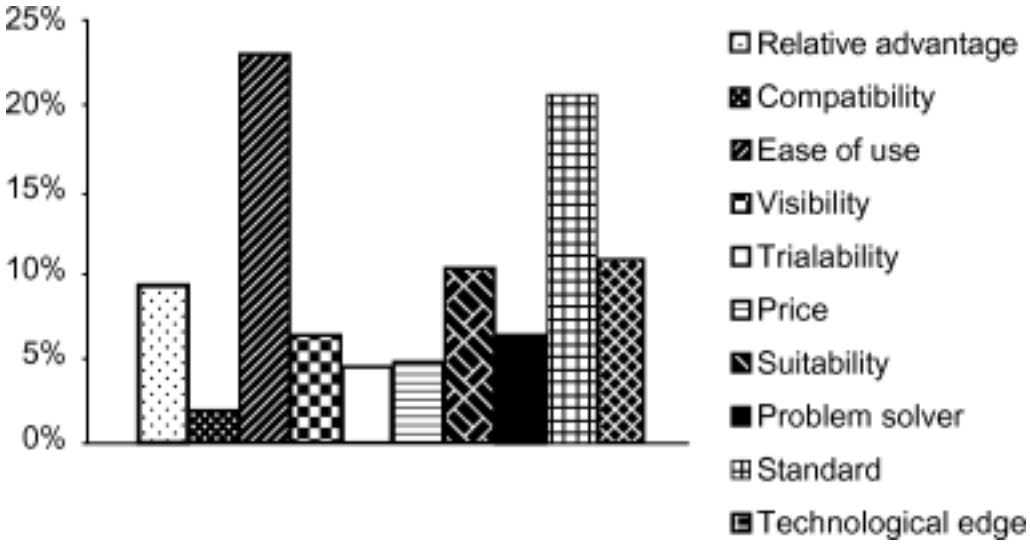
3 Theoretical Framework and Hypothesis Development

This section outlines the main theoretical foundation of the research, describes how the theory selected is connected with the study context, explains the core variables, builds logical arguments of how proposed relationships can be formulated and presents the conceptual model to construct the hypothesis that can be empirically tested.

3.1 Theoretical Framework

The traditional diffusion of innovation (DOI) theory is an approach of determining how organizations use an innovation in their settings. The initial theoretical base of DOI theory was described by Rogers et al., (1995) where he suggested five key characteristics which also called as factors affecting innovation are (i) 1) innovation factors (ii) individual factors (iii) task factors (iv) environmental factors and (v) organizational factors.

Figure 2. Innovation factors items (Mustonen-Ollila & Lyytinen, 2003).



Each factors have multiple traits that can influence the innovation of enterprises. In DOI research, these traits act as independent variables which lead to the impact on

dependent variable, the possibility or propensity of adopting an innovation (Mustonen-Ollila & Lyytinen, 2003; Wejnert, 2002).

Innovation can be defined as “an idea, practice, or object perceived as new by an individual" or more precisely, as "new production inputs, machines, processes, and techniques adopted by firms or entrepreneurs for their own use (Frambach, 1993). In this research, enterprises using any business software can be considered as innovation. Business software can be considered as a technological innovation that an enterprise can utilize as strategic asset to obtain competitive advantage. When an enterprise starts using software, the decision of using the software depends on the software´s relative advantage such as increased profitability or cost savings and also its compatibility with the enterprise present needs and values. Moreover, the complexity of the software such as the difficulties understanding and use of the software can negatively impact the innovation process. This can be a barrier in a country with limited resources. In addition, the trialability of the innovation process can encourage innovation as the more easily an enterprise can experiment with the software, the more eager the enterprise will be to adopt the technology. Observability is also essential for the rate of adoption as when the benefits of the software are visible by potential adopters, the motivation to adopt the software will spread more frequently through the market. The attributes of the business software can influence the decisions of adopting new processes; however, broad research finds that relative advantages, complexity and compatibility notably affect the adoption behavior of enterprises (Lu & Hsiao, 2022).

Diffusion is the process of communicating through certain channels over time among the members of the society (Rogers et al., 1995). Whereas innovation concentrates on the formation and advancement of a new idea or process, diffusion theory is applied to figure out the factors affecting speed and rate of adoption (Frambach, 1993).

Information sharing within and outside enterprise is crucial and technological innovations can provide more access to the level of sharing (F. Wang & Zou, 2025). There

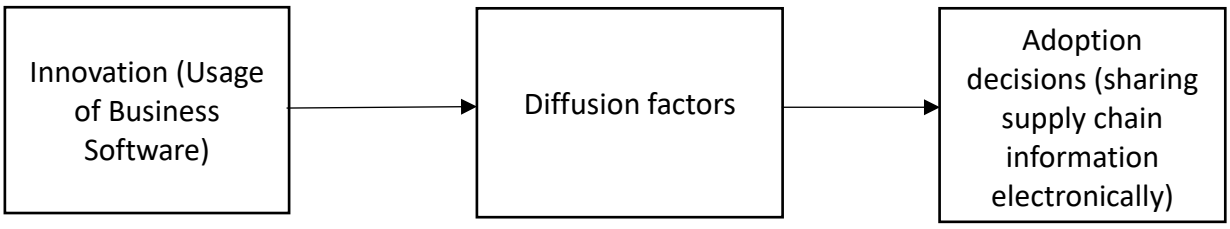
are different types of innovation in enterprises such as product, process, marketing and organizational innovation. The information sharing can be explained as organizational innovation which refers to the implementation of new methods and practices in enterprises (Hassan et al., 2024). The methods and practices involve internal and external networking, information management methods and strategic communication (Hassan et al., 2024). Therefore, the adoption of business software, considered as digital tool, enhances the organization of relations with other organizations, suppliers or customers. Moreover, it can always change the traditional approach of managing information both inside and outside.

3.2 Hypothesis and research model

Based on the DOI theory, this study identifies how innovation can diffuse adoption across enterprises. Therefore, the hypothesis considers the usage of any business software as an organizational innovation and therefore facilitates the adoption decisions of sharing supply chain information electronically. The following hypothesis is formulated based on the argument

H1: The more the enterprises use any type of business software, the more frequently they use electronic form to share their supply chain information with the customers and suppliers.

Figure 3. Hypothesis Development (Source: Author's work).



4 Research Methodology

This section describes how the research was planned, conducted and statistically analyzed to maintain the reliability of the findings. This section is divided into four parts: (i) sample and data, where the sampling strategy and data used were described; (ii) variable definitions, where it detailed the measures used and the reasoning of choosing the measures; (iii) estimation model, where it outlined the baseline model to test the hypotheses and explained it and (iv) data analysis techniques, where it described the analysis methods and validation processes.

4.1 Sample and data

The research is based on digital innovation impact on degree of supply chain information sharing within European countries. Eurostat database is used to form the sample for this research which is an official website of European Union. Eurostat collects data directly from domestic official statistical departments, however some of the information is not always available for all the countries for same year (Álvarez-Martínez & López-Cobo, 2018). Previous research also used the same database as one of their data collection sources for European and euro area countries and found it reliable (Csegődi, 2026; Girardi et al., 2016; Srakar et al., 2018). Since there are data limitations for other years in the database, the research used only one point in time and included calendar year 2023. The research is a country-level and cross-sectional study using 31 European countries as observational units. Countries were selected based on data availability of selected variables in the database. The data for countries' enterprises were collected by considering the firms having 10 persons employed or more to maintain consistency for all measures. Moreover, the industry selection is based on all activities in the business economy except agriculture, forestry and fishing, and mining, quarrying, and financial sector due to data availability in the database. All the data collected for variables are in the form of percentages of enterprises except GDP (as it is a country level variable).

The total number of countries used in this research is 31 which is listed in Table 1.

Table 1. List of European countries.

Belgium	Bulgaria	Czechia	Denmark	Germany	Estonia
Ireland	Greece	Spain	France	Croatia	Italy
Cyprus	Latvia	Lithuania	Luxembourg	Hungary	Malta
Netherlands	Austria	Poland	Portugal	Romania	Slovenia
Slovakia	Finland	Sweden	Norway	Bosnia and Herzegovina	Montenegro
Serbia					

4.2 Variable definitions

4.2.1 Measures of Supply Chain Information Management

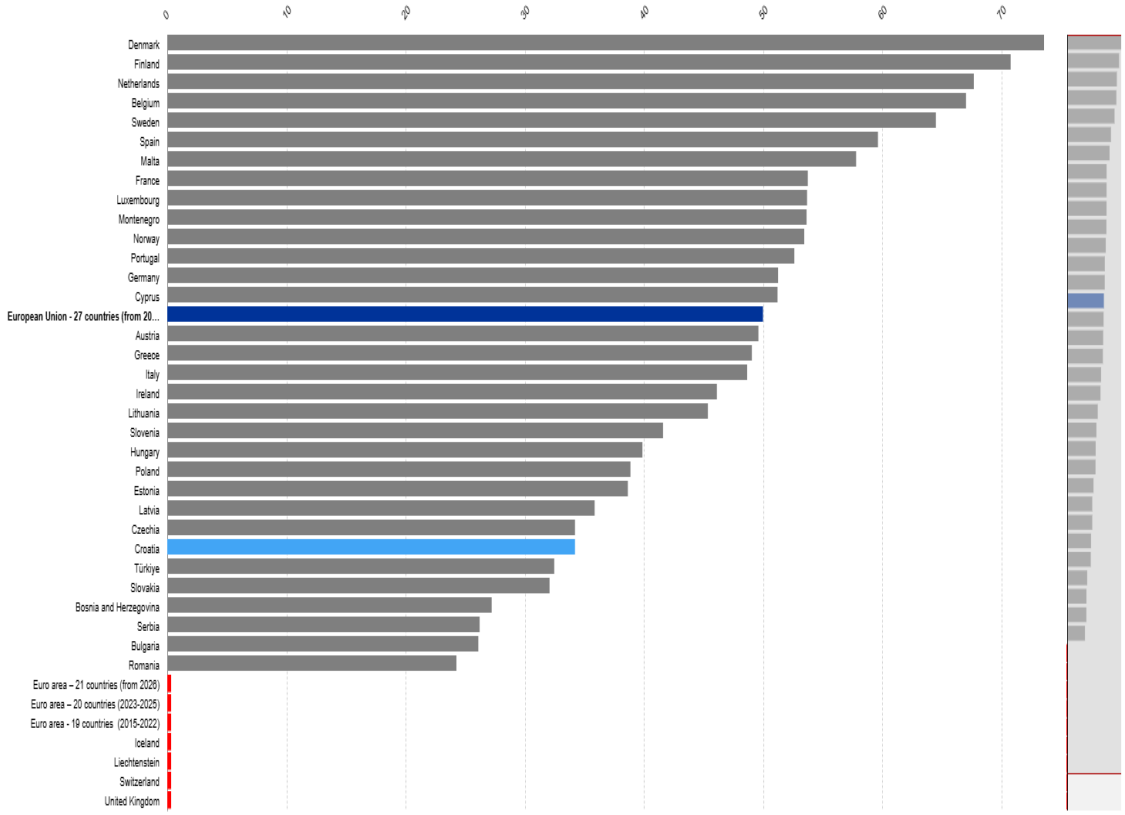
For effective supply chain and information management, it is essential to timely disseminate the information to the related parties. Zhou & Benton (2007) found that supply chain practice becomes more valuable when information sharing is high across firms. Hence, this research tries to identify the intensity of supply chain information sharing to the customers or suppliers. The study used the percentage of enterprises sharing information across countries from Eurostat to compare how the innovation of digital technologies enables information sharing. This measure is helpful to understand the real innovation behavior as it captures the actual enterprise level practices, not perceptions through survey. Moreover, the measure was collected from Eurostat which is standardized and allows cross-country comparability.

4.2.2. Measures of Digital Innovation

The study uses the Eurostat database to collect the innovation of digital technologies in European countries. The percentage of enterprises using any business software such as

ERP, CRM or BI in the year 2023 was used as digital technology adoption which captures key digital infrastructure. The data is from enterprises with at least 10 employees in all business activities except certain areas. Figure 4 shows the country based digital innovation rates in 2023 which illustrates Denmark enterprises has the highest innovation rates of any business software and Romania has the least innovation rates.

Figure 4. Share of enterprises using any business software (ERP, CRM or BI) (Source: Eurostat).



4.2.3. Control variables

The study used GDP, ICT specialists and internet access by enterprises as control variables. Table 2 explains the control variables used in the model. GDP is measured by GDP per capita in PPS which helps to control the country-level effect in the model. ICT specialists is measured by percentage of ICT specialists employed by the enterprises from total employment. Internet access by enterprises is measured by percentage of internet access by enterprises across countries.

Table 2. Variable Definitions (Source: Author's work).

Variable (Measures)	Definitions	Data Source
Dependent Variable:		
Supply chain information management (SCM)	Percentage of enterprises which share supply chain management information electronically with suppliers or customers	Eurostat
Independent Variable:		
Digital Innovation (BS)	Percentage of enterprises using any business software (ERP, CRM or BI)	Eurostat
Control Variables:		
GDP	GDP per capita in PPS	Eurostat
Internet access by enterprises (INT)	Percentage of internet access by enterprises	Eurostat
ICT Specialists (ICT)	Percentage of ICT specialists employed by the enterprises	Eurostat

4.3 Empirical Model

The research adopted the following OLS regression model to investigate the hypothesis.

$$SCM_i = \beta_0 + \beta_1 BS_i + \sum Controls_i + \varepsilon_i \qquad (1)$$

The left-hand side of the equation (1) SCM_i is the percentage of enterprises sharing supply chain information electronically in country i. BS_i is the percentage of enterprises using any business software (Enterprise Resource Planning, Customer Relationship Management, or Business Intelligence) in the year 2023 in country i. The variable to control country level effect is GDP of the country i which is measured by GDP per capita

in Purchasing Power Standards average set to equal 100. GDP is generally considered to do the comparison of economic well-being of people. INT_i is the percentage of enterprises where persons employed have access to the internet. ICT_i is the percentage of total employment employed as ICT specialists.

4.4 Data analysis techniques

The research used Stata 16 to test the hypothesis and conclude the results. The study analyzed data by conducting descriptive statistics, Pearson correlation, multicollinearity test, OLS regression and heteroskedasticity tests. The descriptive statistics summarize the mean, standard deviation, minimum and maximum of the data. It helps to understand the data before running the regression and identify the variations exists across data. The Pearson correlation helps to examine relationships between variables through coefficient. The multicollinearity test is conducted to ensure that the independent variable in the model is not highly correlated with each other. OLS regression is used to examine the relationship between the dependent and the independent variable. Lastly, heteroskedasticity tests are essential to improve the reliability of the results.

5 Findings and Analysis

This section reports the data collected and outputs of the statistical results. The section has five parts: descriptive statistics, pairwise correlation, multicollinearity test, OLS regression and heteroskedasticity test.

5.1 Descriptive Statistics

Table 3 shows the descriptive statistics for the sample. Here, on average 22% of enterprises share their supply chain information electronically to the customers and suppliers. The standard deviation is 8.485 which indicates moderate variations across countries. Moreover, the minimum is 9.41% and maximum is 37.92% which suggests that there is wide range of sharing in countries. The business software usage by enterprises is nearly 50%, which indicates that half of the enterprises are connected with any of the software in their daily operations. The ICT specialists employed of the total employment is around 5% which defines the less ICT specialists working in the enterprises. The average GDP per capita in PPS is around 100 which illustrates high quality of life in countries having significant deviation of 44.051. The minimum GDP is 35 whereas the maximum is 248, which depicts the wide differences in GDP. Mostly all the enterprises have internet access as the average is approximately 99% which makes it nearly saturated.

Table 3. Descriptive Statistics (Source: Authors work).

Variable	Obs	Mean	Std. Dev.	Min	Max
SCM	31	22.335	8.485	9.41	37.92
BS	32	47.467	13.458	24.27	73.59
ICT	31	4.961	1.5	2	8.7
GDP	32	100.062	44.051	35	248
INT	32	98.624	1.594	93.2	100

5.2 Pairwise correlation

Table 4 shows the Pearson´s correlation coefficients for the variables. The results illustrate that SCM, percentage of enterprises sharing supply chain information electronically to customers and suppliers is positively correlated with using business software by enterprises, BS which explains that enterprises using any business software tend to share more supply chain information electronically. Moreover, SCM is slightly correlated with GDP at 10% significant level. However, SCM is not statistically correlated with having ICT specialists in enterprises and internet access across enterprises.

For independent variable, BS is positively correlated with ICT specialists, GDP and internet access. Among control variables, the variables are positively correlated except ICT and INT and INT and GDP.

Table 4. Pairwise Correlation (Source: Author's work).

Variables	(1)	(2)	(3)	(4)	(5)
(1) SCM	1.000				
(2) BS	0.412**	1.000			
	(0.021)				
(3) ICT	0.196	0.624***	1.000		
	(0.298)	(0.000)			
(4) GDP	0.296*	0.452***	0.626***	1.000	
	(0.105)	(0.009)	(0.000)		
(5) INT	0.080	0.396**	0.222	0.155	1.000
	(0.668)	(0.025)	(0.231)	(0.397)	

**** p<0.01, ** p<0.05, * p<0.1*

5.3 Multicollinearity tests

Table 5 shows the multicollinearity test among the variables. All VIF values are within recommended threshold by Gujarati & Porter (2009). The mean VIF is 1.7 (very low), which also does not exceed the threshold value, which suggests that there is no multicollinearity problem in the model. Although some of the independent and control variables are moderately correlated, all the variables can be included in the model due to not having any serious correlations.

Table 5. Variance inflation factor (Source: Author's work).

	VIF	1/VIF
ICT	2.104	.475
BS	1.858	.538
GDP	1.666	.6
INT	1.17	.855
Mean VIF	1.7	

5.4 Baseline regression

Table 6 presents the OLS regression analysis used to test the hypothesis regarding the relationship between enterprises using any business software and the extent of enterprises sharing the supply chain information electronically. It reports that there is positive and statistically significant effect on degree of sharing of supply chain information as the p value is less than 0.10. On the other hand, the coefficients of ICT, GDP and INT are not statistically significant to sharing supply chain information electronically. The regression result suggests that innovation of digital technologies can effectively manage the supply chain information which can help to manage relationships within the value chains and to attain competitive advantage. The result is also broadly consistent with prior literature (Capestro et al., 2024) emphasizing the importance of knowledge sharing.

Table 6. OLS Regression (Source: Author's work).

Degreeofsharing	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
Shareusinganybusinesssoftware	.289963	.1477858	1.96	0.061	-.0144076	.5943336
ICTSpecialists	-1.417142	1.428369	-0.99	0.331	-4.358923	1.524638
GDP	.0560409	.0435047	1.29	0.209	-.0335586	.1456405
Internetaccessbyenterprises	-.6481052	1.053095	-0.62	0.544	-2.816996	1.520785
_cons	73.60782	102.0642	0.72	0.477	-136.5973	283.8129

The result indicates a significant and positive relationship between the usage of any business software and information sharing electronically in supply chains. However, there is no significant relationship with other control variables (ICT, GDP and INT).

5.5 Heteroskedasticity tests

Here the Breusch–Pagan/Cook–Weisberg test for heteroskedasticity was conducted to test the reliability of the OLS regression model. The null hypothesis is constant variance (homoskedasticity) and p value is 0.7937. Since the p value is greater than 0.10, the null hypothesis is rejected. Therefore, there is no evidence of Heteroskedasticity which ensures the reliability of the OLS regression model. This result of Heteroskedasticity test means that the hypothesis is correctly tested and the assumption of the model appears reasonable. Therefore, it can be suggested that digital innovation impacts enterprises motivation to share the supply chain information electronically to the customers and suppliers.

Assumption: Normal error terms
Variable: Fitted values of Degree of sharing
H0: Constant variance
chi2(1) = 0.07
Prob > chi2 = 0.7937

The finding of the research indicated that the application of data management tools and digital technologies improves the ways in which enterprises interact with the related stakeholders and support the idea of increased use of business software facilitates effective and frequent information sharing. Additionally, various digital tools pairing with high levels of information sharing leads to improved supply chain performance. Furthermore, the result also indicates that the increased use of data-driven technology motivates effective communication and exchange business knowledge which ultimately increases the competitiveness and meet customer demands.

6 Conclusions

This section briefly describes all the key insights of the study. Starting with identifying the main findings of how digital innovation influences supply chain information management in European countries, the study then highlights the implications of the research for academics, enterprises and policymakers and acknowledge key limitations of the study. Finally, it suggests some future research directions which will help future researchers to get some ideas to contribute to the literature of digital innovation and information sharing.

6.1 Conclusion

Digital innovation is a multidimensional concept which includes all the aspects of a company aimed at performance improvement and business objectives achievement. Openness to digital innovation is now the perquisites to sustain in this rapidly changing business environments. Particularly, modern supply chain is operating in a complex, global and uncertain environments where traditional systems are no longer manage information efficiently. This study contributes to the study by explaining how using business software motivates the enterprises to share supply chain information electronically.

The findings indicate a significant and positive relationship between the usage of any business software and information sharing electronically in supply chains. This study found that the higher extent of digital innovation in enterprises the supply chain information electronically in European countries. With increased adoption of digital business solutions, the enterprises encourage to share supply chain information more frequently to the customers and suppliers using electronic means. This study suggests that digital innovation plays a key role in increasing connectivity and communication across supply chain stakeholders. Based on the Diffusion of Innovation theory, the findings suggest that higher rate of adoption and effective use of digital technologies enhance more systematic, timely, and structured information communication. Finally,

the study states that digital innovation is not only the process of competing with other enterprises achieving competitive advantage but also a key enabler of improved supply chain information management in European countries.

6.2 Implications of the study

This research is the first study that both theoretically and empirically investigates the relationship between digital innovation and information sharing in digital form using diffusion of innovation theory. The study facilitates the idea how digital innovation motivates the use of digital form which ultimately assists enterprises to understand how digital tools can be used as strategic asset and helped in achieving desired firms' objectives. This finding suggests managers of the enterprises that digital tools can assist them make effective decisions in business practices and bring innovative solutions in the current age of digitalization.

The study contributes to the diffusion of theory usage in the context of digital innovation and supply chain information management. Theoretically, this study describes how DOI influences integration of business software in enhancing organizations relations with other organizations, suppliers or customers. As an innovation, digital tools push the enterprises towards adoption of new practices and processes.

The present study agrees that the innovation can be diffused to adoption of new processes which helps top management and policy makers to adopt data-driven technologies in all types of enterprises to introduce new or sustainable business models in the market. Effective use of various digital technologies can assist managers to understand how the available resources can be used properly and get the utmost benefits. More electronic information sharing makes the information timely which reduces the firm's internal risk, operating costs and achieve competitiveness.

In practical terms, in a rapidly evolving business environment, the enterprises should focus on stakeholders' needs and engagement. Rapid communication enables the

enterprises to understand the needs of the stakeholders (suppliers and customers) and act on it so that they could compete with the competitors and meet the needs of customers.

6.3 Limitations of the study

The dissertation has several limitations which limit the generalizability of the study. Firstly, this study only used the year 2023 due to time and data limitations which makes the data cross-section in nature. The cross-section data can arise the biasness in the study as purposefully selected the year. With other years included will make the result more reliable and validated.

The research work focused on the industry selection based on all activities in the business economy except agriculture, forestry and fishing, and mining, quarrying, and financial sector due to data availability in the database which also limit the results to other sectors. Moreover, the research is only for companies having 10 or more people which did not differentiate the companies into small, medium and large enterprises.

The research work included only one independent variable due to data and time limitations. Additionally, the study considered digital innovation (enterprises using any software), not including the various technologies such as big data, artificial intelligence and natural language processing which did not provide enough evidence of the existing result. In digital innovation, previous literature focused on process, product, organizational and service innovation in their model which are missing in this study.

Moreover, the study only considered whether the enterprise use electronic form to share the supply chain information to the customers or suppliers which exclude the quality of information and how the information sharing is managed within the supply chains (e.g. manufacturers to distributers and distributers to customers). For measuring supply chain performance of enterprises, it is essential to identify the quality of information that is sharing within the supply chains.

6.4 Future Research

Overcoming the present study limitations, future research can be extended by including more years of research and make a panel data so that data can be compared among countries. The longitudinal data over time is essential to check the credibility of the results.

Future studies should add on the current study model by adding more independent variables such as various types of digital technologies and their impact on information sharing in supply chains. On the other hand, future researchers could also check various digital innovation concepts to ensure the reliability of the study. Various robustness tests can be conducted by dividing the enterprises into small, medium and large segments. Moreover, new moderating variables can be included such firm absorptive capacity or competitive strategy to advance the existing model and more new results.

The quality of the information that is sharing can be considered in future studies. As this research is only captured whether the information is shared or not, future research can consider how well digital innovation improves the quality of information that is shared. Therefore, information quality acts as a key outcome variable which links digital innovation to tangible advances in supply chain collaboration and performance.

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