Digital Transformation of Transport: A Systematic Review of New Trends, Challenges and Key Strategies for Application

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Abstract

Purpose of the article The purpose of this article is to systematically review the digital transformation of the transport industry. The digital transformation review entails reviewing the new trends used in the digital transformation of transportation, challenges encountered in the digital transformation of transport, and critical strategies applied to ensure that the digital transformation of transport is a success.

Methodology/methods A systematic review method is used in the analysis and review of literature. Data is collected from five databases (Google Scholar, Academia.edu, IEEE, Science Direct and Springer). The PRISMA framework was used to select eligible articles in five stages: defining eligibility criteria; identifying academic journals and databases; creating a query of keywords; collecting, storing, and filtering relevant articles; and performaning data analysis or review

Scientific goal This paper aims to conduct a systematic review of literature and critical analysis regarding the digital transformation of transport, trends, challenges, and essential strategies for application.

Findings The review of articles shows that the transport industry has adopted new trends of digital transformation, forming an efficient transport system. Also, strategies have been discussed to curb the transport industry's challenges amid the digital transformation. The findings contribute to filling research gaps and helping the transport sector.

Conclusions The results revealed that new trends such as Artificial Intelligence, the Internet of things, cognitive computing, robotic process automation, and big data analytics are valuable components of the digital transformation of transport. The challenges are inadequacy of dedicated and skilled IT personnel in the industry, budget constraints, lack of organizational change management, unrealistic business expectations, lack of clear definition of digital transformation & strategy, and ineffective data management. Some strategies for application include adoption of innovative processes and advanced technologies, adaptation of organization-al structures through alignment of strategies with the company's goals and objectives, collaboration among stakeholders, organizational management and running proofs-of-concept.

Keywords: Digital Transformation, Transport sector, New trends, Challenges, Strategies

JEL Classification: M15, M21

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Introduction

Technology has taken over almost every activity of the modern world, from trade, transport, tourism, events, et cetera. Due to the advancement of technology, there has been a significant digital transformation in the sectors mentioned above. The sectors have adopted digital transformation due to the advantages that it comes with. Digital transformation is applying digital technologies to create a new business or modify the existing business processes, culture, and customer experiences to be updated in the market requirements and experiences. In other words, digital transformation is the revolutionary changes that a business undergoes by adopting digital technology. Business sectors mainly undergo digital transformation to redesign customer experiences, incorporate new initiatives, modify existing processes, and adopt a unique culture. The goals mentioned above aim to enable the business to respond to dynamic business scenarios and the existing demands in the market. Digital transformation of the transport industry can help the sector gain a competitive ad-vantage and get hold of the rapidly changing market through the evolution of technology (Heilig, Schwarze, Voß, 2017).

This article presents an elaborative systematic review of the new trends of digital transformation in the transport sector, challenges experienced in digital transformation, and application strategies to ensure a smooth change. In the transport industry, several modern trends are used to speed up the process of digital transformation. Such movements are enabled by technologies such as Artificial Intelligence (AI), Big Data Analytics, Cognitive Computing, Robotic Process Automation, and the Internet of Things (Nekrasov, Sinitsyna, 2019). Other platforms such as the cloud that capture, store, and process information also enable digital transformation (Hartley, Sawaya, 2019). The process of digital transformation in the transport industry faces challenges such as inadequacy of dedicated, skilled Information Technology personnel in the industry, climate change that affect transportation activities, budget constraints, lack of organizational change management, evolving customer needs, lack of defined strategy, inefficient business processes and ineffective data management. To ensure success in digital transformation in the transport industry, the sector should use the available technology to innovate proper strategies for effective transformation (Campos Diez Canseco, 2018). Additionally, the industry should change its operation and adopt new models that ensure digital trans-formation. The industry should also leverage emerging technology to ensure that the shift is swift.

Additionally, the transport industry suffers from severe challenges of asset underutilization, supply chain efficiency, and connectivity and visibility across devices and systems. To help curb digital transformation is vital. Digital transformation mainly involves technology, which positively affects efficiency, market growth, and productivity (Jayakrishnan, Mohamad, Abdullah, 2018). The transportation industry must rely on external resources to ensure efficiency, speed, optimization, and timing due to inadequate digital transformation skills. The transportation industry gains a lot of benefits with the digital transformation. Such benefits include speed, timing, efficiency due to intelligence, and improved machines and equipment due to machine learning algorithms and Artificial intelligence. For the transportation industry to fit in the modern market, digital trans-formation must be initiated effectively. The aforementioned is because other industries that interact with the transport industry have undergone digital transformation. Transportation can affect the whole business model because it plays an essential role in the supply chain (Haq; Genzorova, Corejova & Stalmasekova, 2019).

Since digital transformation has been a new thing in academia and industry, there has yet to be a comprehensive literature review on the topic above. A comprehensive and systematic literature review is significant to ensure continuity of research and development in an aligned and orderly fashion. A substantial contribution of this study is that it surveys and identifies publications from the business industry, such as the transportation industry. Therefore, combining academic and industry publications is critical to digital transformation in the transportation industry.

1 Methodology

A systematic review method is used in this study to present a more comprehensive information on the top-ic. The scope of the review entails any published works relating to the digital transformation of transport. Any publications that are related to the topic would also be included in the systematic review. Generally, this study has utilized the PRISMA framework for systematic literature review. This review involved a five-step approach: defining eligibility criteria; identifying academic journals and databases; creating a query of keywords; collecting, storing, and filtering relevant articles; and performance of data analysis or review.

The first step is defining the eligibility criteria. The eligibility criteria are 1) articles that aims to analyze the digital transformation of transport, trends, challenges and strategies, 2) articles in the form of a journal, 3) original

research articles in English, and 4) articles published from 2013 and beyond. The second step is identifying databases to facilitate the search for articles. The criteria for selection was academic journals and databases that contain information relevant to the digital transformation of transport. The search was tailored to five academic and research databases, which are Google Scholar, Academia.edu, IEEE Xplore, Science Direct and Springer for a broad approach that searches numerous journals concurrently. The third step used for the review was to search and locate any publications relating to the digital transformation of transport. To create the search keywords, we broke down the topic into various subtopics: the importance of digital transformation in transportation, critical trends in digital transformation in the transport industry, challenges in digital trans-formation in the transport industry, and strategies in digital transformation. The search keywords were defined as; Digital Transformation, Transport trends, digital transformation Challenges, digital transformation Strategies. The fourth step is to collect, store and filter relevant articles. Once the search is done based on the keywords, the relevant articles are selected by screening the title, abstract, content and conclusions of the searched articles and also based on the eligibility criteria. The fifth stage is performing data analysis by re-viewing and comparing the selected articles to provide relevant information on the topic. The review process is shown in Figure 1 below.

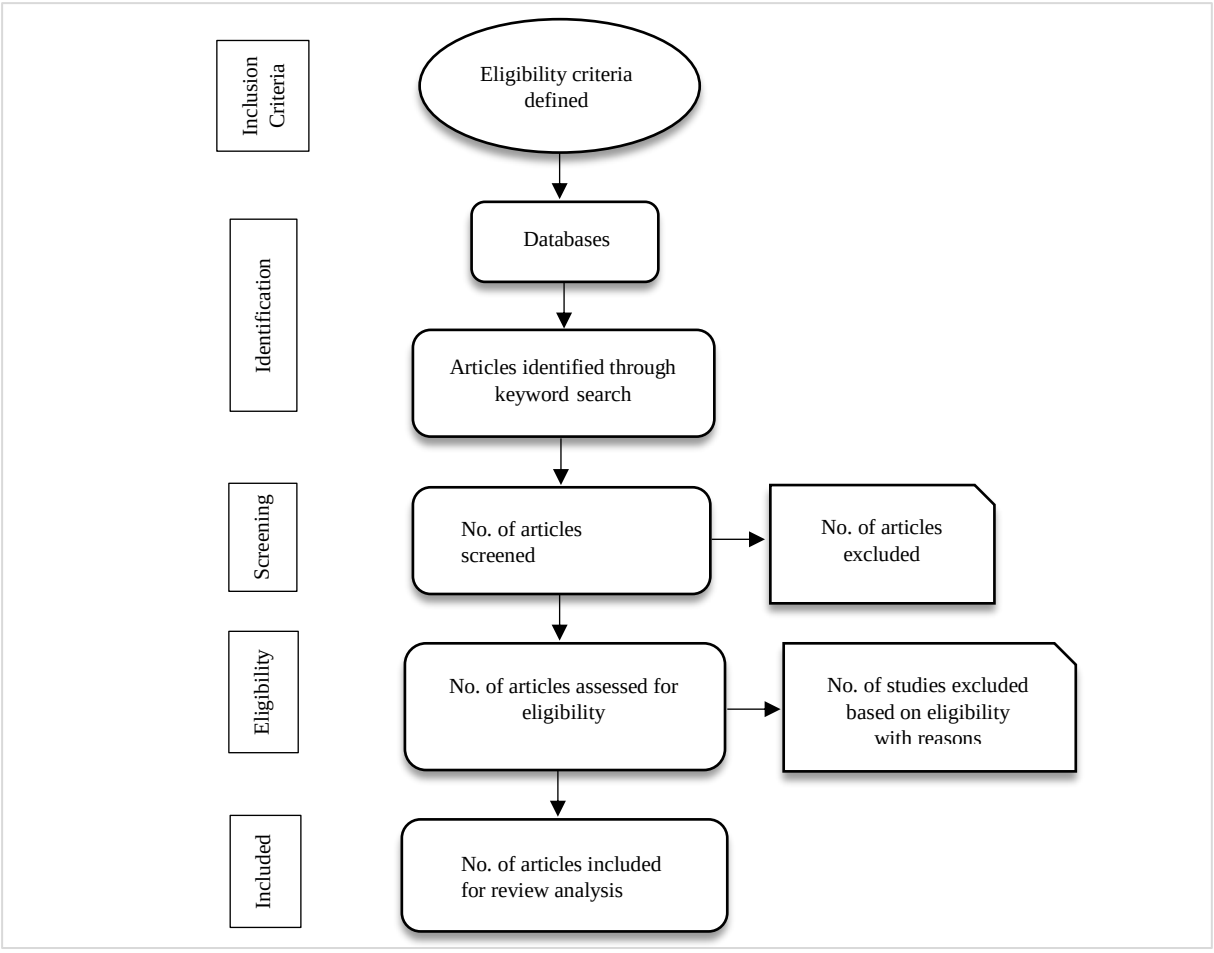

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Figure 1 Structure of methodology for the systematic review

From Figure 1, the eligibility criteria is defined, followed by the selection of databases. The search for articles was tailored to five databases, namely Google Scholar, academia.edu, IEEE, Science Direct and Springer. The keywords which are used to search for articles in the selected databases are Digital Transformation, Transport trends, digital transformation Challenges, digital transformation Strategies.

In the third stage of PRISMA review, as mentioned above, the search span focused on collecting literature of articles with digital Transformation of transport and was set from 2013 to 2021. The recent articles were used for

effective literature review on the latest available data. The language was set to English. The articles which did not meet the criteria were excluded. The screening stage involved 1,500 documents. Only 150 articles/research papers were extracted because they were eligible. The identification process is shown in Figure 2.

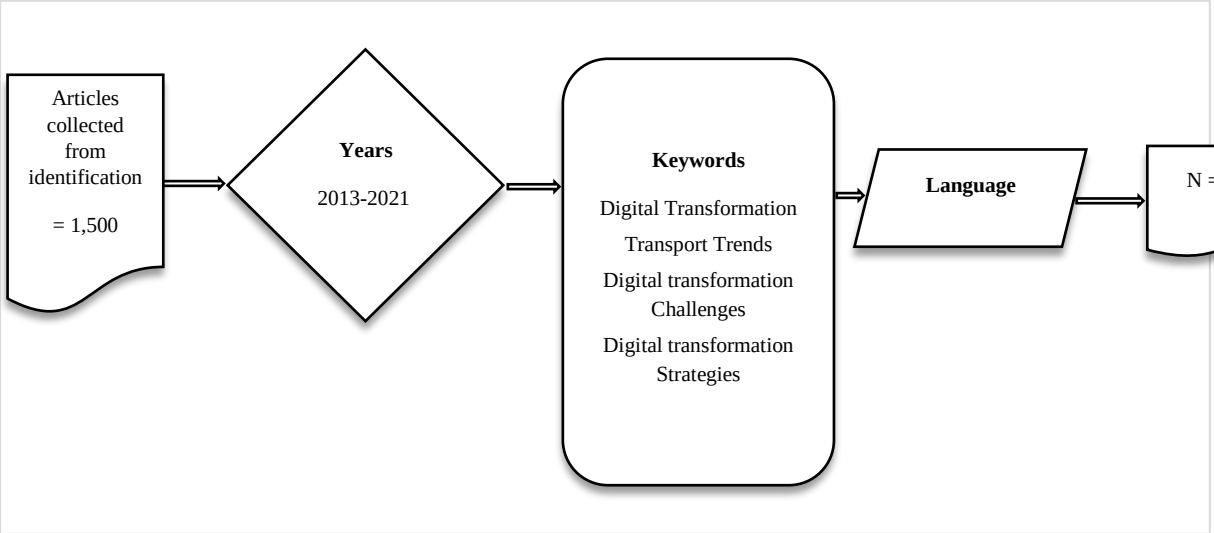

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Figure 2 Identification process

The screening process then takes place based on the eligibility criteria. Abstracts, contents and conclusions for each paper were carefully assessed. The study excluded articles which did not pass the eligibility assessment. Out of the 150 selected articles in the previous stage, 100 were excluded in the fourth stage due to eligibility reasons such as duplication and irrelevance. The screening process is explained in Figure 3.

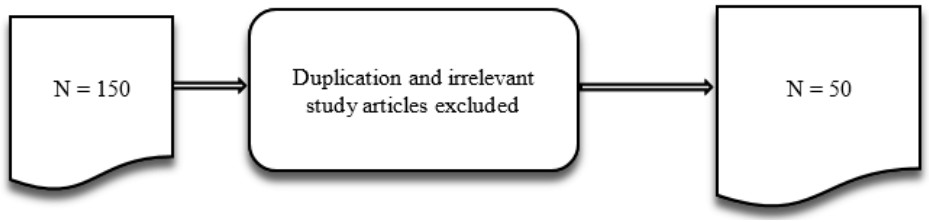

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Figure 3 Screening process

The remaining 50 articles went under thorough eligibility assessment for inclusion and exclusion. The most relevant articles that fulfilled the eligibility criteria were selected and included in the review analysis. A total of 31 articles were selected to perform the literature review. The eligibility and inclusion process is shown in Figure 4.

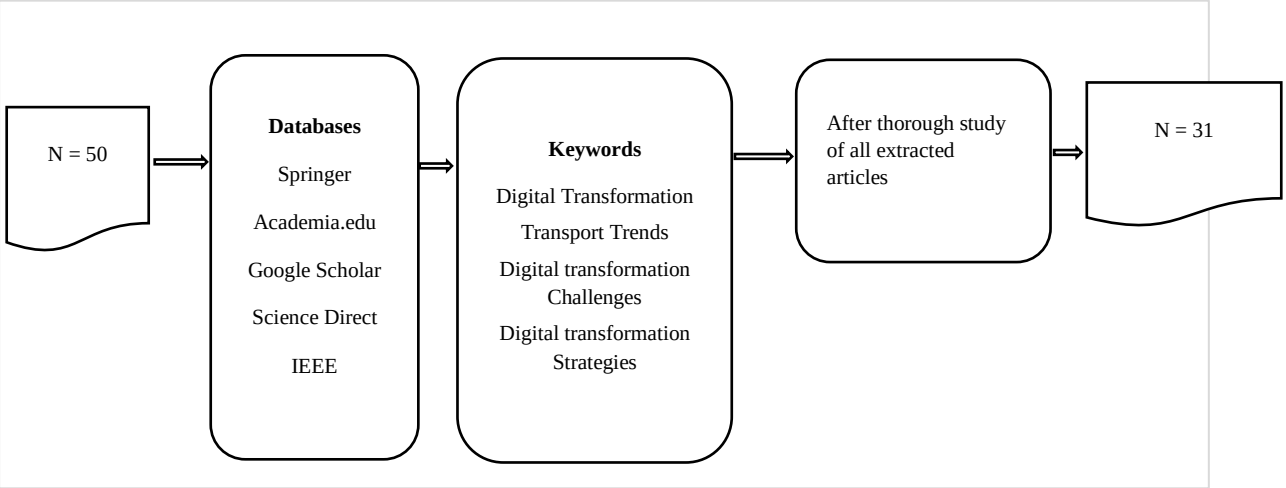

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Figure 4 Eligibility and Inclusion process

2 Data collection and analysis

The study collected data from different databases as shown in Table 1. Following the second inclusion criterion which is in relation to the type of article, the data sources were mainly journals. This is because journals are trusted sources for scientific research and systematic review. After filtering out the most relevant articles, the collected data was analyzed based on the frequency of articles from each journal as shown in Table 1.

Table 1 Sources of data collection and frequency of articles

Source	Number of articles
Google scholar	13
Academia.edu	1
Springer	5
Science Direct	7
IEEE	2
igi-global.com/Google scholar	1
Corporate-leaders.com/Google scholar	1
bluecirclemarketing.com/Google scholar	1

Source: Authors' own work

Table 1 shows the data sources used to search for articles related to the topic under study based on the key-words: Digital Transformation, Transport trends, digital transformation Challenges, digital transformation Strategies.

3 Results

After the exclusion and inclusion process, the results of the selected articles are shown in Table 2 below.. The summary of selected articles are shown in Table 2.

Table 2 Summary of selected articles

No	Source	Authors	Title	Publication year	Type of article
1	Corporate-leaders.com / Google scholar	Hoberg, Krcmar, Welz,	Skills for digital transformation	2017	Journal
2	Academia.edu	Jayakrishnan, Mohamad, Abdullah	Digitalization approach through an enterprise architecture for Malaysia transportation industry	2018	Journal
3	Springer	Matt, Hess, Benlian	Digital transformation strategies.	2015	Journal
4	igi-global.com/Google scholar	Merkaš, Perkov, Bonin.	The significance of blockchain technology in the digital transformation of logistics and transportation.	2020	Journal
5	Springer	Mikalef, Pappas, Krogstie, Giannakos	Big data analytics capabilities: a systematic literature review and research agenda	2018	Journal
6	Springer	Mitchell, Michaski, Cabonell	An artificial intelligence approach	2013	Journal
7	Google Scholar	Nekrasov, Sinitsyna	Digital transformation infrastructure and transportation logistics systems.	2020	Journal
8	Springer	Nekrasov, Sinitsyna	Complex Digital Model of Transport Logistic System Transformation.	2019	Journal
9	Springer/Google Scholar	Salminen, Ruohomaa, Kantola	Digitalization and big data supporting responsible business co-evolution.	2017	Journal
10	bluecirclemarketing.com/Google scholar	Tabrizi, Lam, Girard, Irvin	Digital transformation is not about technology.	2019	Journal
11	Google Scholar	Viale, Zouari	Impact of digitalization on procurement: the case of robotic process automation	2020	Journal
12	Science Direct	Zaharia, Pietreanu	Challenges in airport digital transformation	2018	Journal
13	Springer	Egorov et al.	The Challenges of the Logistics Industry in the Era of Digital Transformation	2020	Journal
14	Science Direct	Tekic, Koroteev	From disruptively digital to proudly analog: A holistic typology of digital transformation strategies	2019	Journal
15	Science Direct	Chinoracký, Čorejová	Impact of digital technologies on labor market and the transport sector	2019	Journal
16	Google Scholar	Heilig, Schwarze, Voß	An analysis of digital transformation in the history and future of modern ports	2017	Journal
17	Google Scholar	Bajgar, Calligaris, Calvino, Criscuolo, Timmis	Bits and bolts: The digital transformation and manufacturing	2019	Journal
18	IEEE	Teresa, Evangelos	Importance of logistics services attributes influencing customer satisfaction	2015	Journal
19	Google Scholar	Suvorova, Naumova, Scherbanyuk, Nos	Digital transformation in the management of container-on-flatcar transportation: evaluation of business effects	2020	Journal
20	Science Direct	Afan, El-shafie, Mohtar, Yaseen	Past, present, and prospect of an Artificial Intelligence (AI) based model for sediment transport prediction	2016	Journal
21	Google Scholar	Abduljabbar, Dia, Liyanage, Bagloee	Applications of artificial intelligence in Transport: An overview	2019	Journal
22	Google Scholar	Zakir, Seymour, Berg	Big Data Analytics	2015	Journal
23	Google Scholar	Papadopoulos, Singh, Spanaki, Gunasekaran, Dubey	Towards the next generation of manufacturing: implications of big data and digitalization in the context of industry 4.0	2021	Journal
24	Google Scholar	Bourke., Kovacova, Kliestikova, Rowland	Smart industrial Internet of things devices, services, and applications: Ubiquitous sensing and sensory data, predictive analytics algorithms, and cognitive computing technologies	2019	Journal

25	Science Direct	Coccoli, Maresca, Stanganell	The role of big data and cognitive computing in the learning process	2017	Journal
26	Google Scholar	Coccoli, Maresca	Adopting cognitive computing solutions in healthcare	2018	Journal
27	Google Scholar	Gružauskas, Ragavan	Robotic process automation for document processing: a case study of a logistics service provider	2020	Journal
28	Science Direct	Alaba, Othman, Hashem, Alotaibi	Internet of Things security: A survey	2017	Journal
29	Science Direct	Atzori, Iera, Morabito	Understanding the Internet of Things: definition, potentials, and societal role of a fast-evolving paradigm	2017	Journal
30	IEEE	Zhao, Ge	A survey on the Internet of things security	2013	Journal
31	Google Scholar	Liu, Zhang, Dutta, Wu, Goh	Digital twinning for productivity improvement opportunities with robotic process automation: Case of greenfield hospital	2020	Journal

Source: Authors' own work

From Table 2, a total of thirty one (31) articles on the trends and challenges of digital transformation of transport as well as the strategies for application were selected for the review analysis. The study took into account the fourth inclusion criterion for the selection of articles, thus, articles published from 2013 and beyond.

3.1 Importance of digital transformation in transport

Advancement in technology brought by digital transformation results in more minor delays during transportation hence quick delivery of goods and services (Heilig et al., 2017). Digital transformation steps that use the Robotics automation process to avoid time-consuming procedures facilitate the transportation efficiency in deliveries, offering a tremendous advantage to the transport sector (Chinoracký, Čorejová, 2019).

Digital transformation guarantees more excellent connectivity between devices by the use of alarms and sensors. Internet of things allows transport companies to connect several devices using sensors and transmit essential decisions over a shared network, which accelerates the process of transportation and improves the safety of passengers (Heilig et al., 2017).

According to Atzori et al. (2017), population worldwide has significantly increased and consequently, there is an increase in demand for a more robust transport system that is very fast and efficient. Digital trans-formation comes with high-speed trains and a rapid transport bus system that carries many passengers, thus reducing traffic congestion of vehicles. Additionally, digital transformations come with the integration of mo-bile technology in the transport system. It allows booking of tickets online, unlike queueing in the bus or train station, and also provides real-time travel information (Nekrasov, Sinitsyna, 2020).

Heilig, Schwarze, and Voß (2017) indicates that digital transformation in transport is expected to increase over the years due to the integration of new technology in transportation.

3.2 Areas in Transportation That Benefit from Digital Transformation

Time and speed are crucial in transportation. A transportation process aims to ensure that items arrive at the right location at the right time and in the best condition; it is also essential to ensure that the machines and equipment used to support the process do not wear out without prior notice (Bajgar et al., 2019). Technology has enabled machine learning algorithms and adapt analytics that can predict such incidences, as mentioned above. With digital transformation, the health of machines and equipment is guaranteed.

In any industry, speed and time are significant factors to consider during the production process (Teresa & Evangelos, 2015). According to Teresa and Evangelos (2015), speed and time are essential elements in transport and logistics. In transportation, high speed and minimal time are substantial for the competitive ad-vantage in the industry. Digital transformation in companies has led to the introduction of Robotic Process Automaton, which acts as the main component to automate and speed up time-consuming processes. With Robotic Process Automation, companies can identify the production process or level that lowers production speed. Most companies can now understand whether the transportation process or the production process in the company is slowing the

production process (Nekrasov, Sinitsyna, 2020). With the information from Robotic Process Automation, the transport industry is highly benefited since other techniques attached to transportation are not delayed.

Big data comes with significant challenges and immense complexities, which require efficient tools and technology to deal with. The transportation industry is one of the essential components of the supply chain. Supply chain, logistics, and transportation need a robust digital transformation strategy for maximum visibility across factors affecting decision-making (Suvorova et al., 2020). Modern technology has led to the invention of applications and tools to unleash the high power or extensive data into simple forms that can be under-stood and analyzed quickly. Today, data visualization and dashboards with self-service capability offer user-level digital transformation (Merkaš, Perkov, Bonin, 2020). The above tool ensures that a large amount of data is represented in a concise, meaningful, and pleasant form. The transport industry also involves the collection, analysis, and presentation of data. After an extended period, the collected data may be massive, and analysis may be complex. Digital transformation, data visualization, and other tools enable one to analyze the transport data in a concise, meaningful, and pleasant form.

3.3 New Trends in Digital Transformation of Transport

Artificial intelligence replicates human intelligence in machines capable of performing tasks that require human thinking and actions (Russell, Norvig, 2002). The machines are built smartly to think and perform tasks like human beings. These machines are considered to be more efficient and reliable than human beings since they do not get exhausted (Mitchell, Michalski, Carbonell, 2013). Artificial intelligence has also enabled the performance of tasks effectively and efficiently since they are performed flawlessly and precisely (Rich & Knight, 1991). Artificial intelligence has immensely contributed to the digital transformation of transport. First, artificial intelligence is used to design automated vehicles including trucks, planes, and ships to improve the safety of goods, passengers and those around them. These AI-integrated devices can perform transportation tasks effectively without supervision (Afan et al., 2016; Abduljabbar et al., 2019). Also, Artificial intelligence (AI) technology is used in the transportation sector to reduce human errors within traffic to ensure that congestion on roads or in any terminuses is avoided. AI is also used to monitor safety regulation compliance as the vehicles are built to sense anybody or any activity against the rules set. Also, Artificial intelligence is currently being used to review vehicle maintenance reports which reduce the risk of wear and tear of the machine unexpectedly (Mitchell et al., 2013).

Another trend identified in the selected articles is the use of big data analytics in transport. Big data analytics is the process used to extract meaningful insights from a vast amount of data or numerous data sets to make conclusions (Zakir, Seymour & Berg, 2015). Some of the insights that can be made through big data analytics include customer preferences, market trends, hidden patterns such as market supply or demand patterns, and unknown correlations (Mikalef et al., 2018; Russom, 2011). Big data analytics has contributed immensely to the process of digital transformation. Big data analytics is significant since industries and businesses use it to better decision-making and prevent fraudulent activities (Salminen, Ruohomaa, Kantola, 2017). Additionally, big data analytics helps the company to create new growth opportunities. Digital transformation of transport has inherited big data analytics because of the following advantages; delivering relevant products, mitigating risk and fraud, improving and optimizing the customer experience, and increasing personalization and proper service delivery (Papadopoulos et al., 2021). Big data analytics is used in the transportation industry to make decisions, ensure safety and proper product delivery, and improve customer experience by analyzing their preferences.

Cognitive computing is also being used in transport. This is when machines are built to mimic human behavior and reasoning to solve complex problems (Modha et al., 2011). Cognitive computing involves modifying algorithms, patterns, and natural computer language modify devices to ensure they are effective. The digital transformation uses cognitive computing to ensure that production processes in the industries that involve machines are effective. The devices can correct the production process if it is tempered (Bourke et al., 2019). The machines are also able to raise the alarm in cases of wear and tear. In transportation, cognitive computing is used to operate the equipment and appliances involved in transport (Coccoli, Maresca, Stanganelli, 2017). These machines can report their status and raise the alarm in case of tear and wear. This has helped to reduce accidents and late deliveries (Coccoli, Maresca, 2018).

Like AI and cognitive computing, robotic process automation is computer software built to simulate human actions (Viale, Zouari, 2020). Robotic process automation is used to reduce or prevent human error. It has formed the main components of digital transformation (Gružauskas, Ragavan, 2020; Liu et al., 2020). In transport, robotic process automation is used to make machines and vehicles to oversee and avoid accidents.

Moreover, Internet of things is one of the major trends recently. It mainly involves the machines or "things" embedded with sensors and technology to ensure the security of the production process (Alaba et al., 2017). Digital transformation of transport has adopted the Internet of things mainly to ensure safety during transportation (Zhao & Ge, 2013). It involves the use of biometric cybersecurity scanners, sensors, alarms, wireless inventory trackers, et cetera (Atzori, Iera, Morabito, 2017; Alaba et al., 2017).

3.4 Challenges in Digital Transformation of Transport

The lack of dedicated IT skills is a major challenge with regards to digital transformation in transport. The digital transformation trends involve the high use of technology. Hence, for digital transformation to be successful, a highly skilled IT team must execute the named processes. There has been a labor deficit of highly qualified IT personnel since more companies are now adopting digital transformation (Hoberg et al., 2017).

Also, the lack of organizational change management poses a great challenge for the digital transformation in the transport sector. Digital transformation needs a shared digital vision from the top management to the lower level of an organization. Additionally, digital transformation requires a form of an organization that is effective and a culture that adopts changes (Zaharia, Pietreanu, 2018). Without effective structure and supportive Culture, digital transformation cannot be effectively executed. Research has shown that 73 % of the organizations believe that their organizational structure rarely supports change due to a lack of KPIs alignment. In comparison, 65% believe there is a lack of vision to compel digital transformation (Zaharia, Pietreanu, 2018).

Another challenge is unrealistic business expectations. The managers of the transport companies seek a faster investment return following digital transformation and forget that it is a dynamic and time consuming process. These managers lack sufficient data and understanding of potential digital transformation outcomes to support their business and demonstrate investment returns (Egorov et al., 2020). According to Zaharia and Pietreanu (2018), 81 percent of companies say the major barrier to digital transformation adoption is the inability to demonstrate short-term ROI. However, 75% of companies have trouble choosing the suitable technology for digital transformation, while 70% believe the decision of adopting digital transformation is not clear.

Tekic and Koroteev (2019) explained that some companies always lack a clear definition of digital trans-formation. They end up making unclear strategies for digital transformation. Lack of system is triggered by a lack of objectives for the digital transformation. Without a good plan, the transformation process fails. There-fore, a company should opt for digital transformation only if they understand it and confirm that it is in tandem with its objective (Jayakrishnan, 2018) .

Transport companies face the challenge of budget concerns or constraints when they fail to set and stick to a budget. Evolving customer needs may lead to an increase in funding and timeline. When the company has not already set a budget, the company may end up making less or no profits. For digital transformation, it is essential that the transport companies set a long-term plan and stick to it to ensure that it yields benefits (Chi-noracký & Čorejová, 2019).

Some studies also identified ineffective data management as challenge to the digital transformation of transport. Most firms are unable to use data insights to improve the efficiency and effectiveness of their operations (Egorov et al., 2020). Also, they are unable to use data insights to enhance their customers' experience and learn from probable mistakes. The majority of the firms have difficulty in collecting the data they need. However, others believe that they lack the ability to standardize the data and capitalize on the resulting information. Additionally, some companies cannot apply the standardized data to improve the efficiency of operation, safety, and customers' experience (Nekrasov, Sinitsyna, 2019). Companies working with inefficient data management systems find it hard to access information or data thereby hindering digital transformation (Tabrizi et al., 2019). For successful digital transformation of transportation, data of all transportation pro-cesses should be well managed. Customer data can be used to gain insights into the customer's preferences and potential future decisions and behaviors. The data can also be used to make internal decisions to help manage the transport system (Nekrasov, Sinitsyna, 2020). Transport companies should use a strategy that ensures it builds a proper management structure for data collections and storage. Also, the companies can use the checklists to guide their data strategy (Tabrizi et al., 2019).

3.5 Strategies for Application

Digital transformation strategies demand communication of the values of changes that digital transformation brings to customers and employees (Tekic, Koroteev, 2019).

Heilig et al. (2017) identified that not only does the adoption of innovative processes and advanced technologies play a role in the success of digital transformation in transport, but also the adaptation of organizational structures. They indicated that the alignment of transformation strategies with the company's goals and objectives guarantees support from top management to lower-level employees in the transport industry. Hence, strategy alignment and collaboration among stakeholders are critical for the transformation of transport operations (Heilig et al., 2017). To ensure that the digital transformation process is successful, there should be an efficient workflow with an excellent and proper leadership style. Outdated organizations' structures with bad leadership styles can impede digital transformation. Matt, Hess, Benlian (2015) also added that organizational management, where the transport industry prepares the employees for what lies ahead of them through training and development of skills are crucial for digital transformation in transport. According to Chinoracký and Čorejová (2019), digital transformation disrupts how different stakeholders of the transport industry operate. It may involve changes in the role of various employees and the way passengers interact with the system. To convince stakeholders, there is a need to run proofs-of-concept and pilot programs before fully implementing digital transformation. Pilot programs involve running the new change in a section of the industry and accessing its results. A successful pilot program will pave the way for the full implementation of digital transformation (Liu et al., 2020).

4 Discussion

Modern technology has made it easy to come up with the digitalization of transportation. As identified from our results, new trends have emerged that support the digital transformation of transport. Such trends are enabled by technologies such as Artificial Intelligence (AI), Big Data Analytics, Cognitive Computing, Robotic process automation, and the Internet of Things (IoT). Other platforms such as the cloud that capture, store, and process information also enable digital transformation in transport.

We found that digital transformation in transport has improved transport efficiency in terms of reduced travel time, fast deliveries, reduced vehicle congestion and passenger safety. Digital transformation has enabled digital transport systems which allows for processes such as online booking and buying of tickets among others. It was identified through literature review that digital transformation allows sectors and businesses to move away from the manual processes and automate their production, such as the payroll process, marketing, etc., to compete effectively in the market. In transport, digital transformation has been fundamental due to the output that has been realized. We also identified that digital transformation in the transport industry faces a number of challenges which can be addressed through the adaptation of organizational structures, alignment of strategies with objectives, as well as cooperation among stakeholders. There is also the need to run pilot tests (proof of concepts) to create the path for the full implementation of digital transformation of transport.

Conclusion

This study provided a systematic review of the literature on digital transformation of transport, the key trends, challenges and strategies for application. From the results and analysis, it can be concluded that digital transformation of transport is underway, and the projections of its importance show a fulgent future for the transportation industry. New trends such as Artificial Intelligence, the Internet of things, cognitive computing, robotic process automation, and big data analytics are valuable components of the digital transformation of transport. Some challenges and strategies to be applied by transport companies to ensure effective digital transformation were identified in this study.

The contribution of this study can theoretically fill the gap in literature linked to a systematic review of the trends, challenges and strategies for digital transformation of transport, and also give practical information to transport managers and stakeholders to gain an overview of digital transformation in transport and how to successfully implement them.

There was a thorough assessment of literature in this study on the subject of Digital transformation of transport. However, there is a potential that some articles were accidentally missed, even though every effort was made to locate any and all relevant papers (as established by the methodology section). Some publications, for instance, may have been published straight to a host website without being registered in any of the databases used. A significant drawback of this study was the inability to include government reports and publications. Hence, future studies should focus on including more databases for literature search, as well as collecting and reviewing government reports and publications for more robust results.

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References

ABDULJABBAR, R., DIA, H., LIYANAGE, S., BAGLOEE, S. A. (2019). Applications of artificial intelligence in Transport: An overview. *Sustainability*, 11(1), 1-24. Doi 10.3390/su11010189.

AFAN, H. A., EL-SHAFIE, A., MOHTAR, W. H. M. W., YASEEN, Z. M. (2016). Past, present, and prospect of an Artificial Intelligence (AI) based model for sediment transport prediction. *Journal of Hydrology*, 541, 902-913. Doi 10.1016/j.jhydrol.2016.07.0480022-1

ALABA, F. A., OTHMAN, M., HASHEM, I. A. T., ALOTAIBI, F. (2017). Internet of Things security: A survey. *Journal of Network and Computer Applications*, 88, 10-28. Doi 10.1016/j.jnca.2017.04.002

ATZORI, L., IERA, A., MORABITO, G. (2017). Understanding the Internet of Things: definition, potentials, and societal role of a fast-evolving paradigm. *Ad Hoc Networks*, 56, 122-140. Doi 10.1016/j.adhoc.2016.12.004

BAJGAR, M., CALLIGARIS, S., CALVINO, F., CRISCUOLO, C., TIMMIS, J. (2019). *Bits and bolts: The digital transformation and manufacturing*.

BOURKE, E., KOVACOVA, M., KLIESTIKOVA, J., ROWLAND, Z. (2019). Smart industrial Internet of things devices, services, and applications: Ubiquitous sensing and sensory data, predictive analytics algorithms, and cognitive computing technologies. *Analysis and Metaphysics*, 18, 50-56. Doi 10.22381/AM1820197

CAMPOS DIEZ CANSECO, H. (2018). *Digital transformation in the transportation industry: LATAM analysis*.

CHINORACKÝ, R., ČOREJOVÁ, T. (2019). Impact of digital technologies on labor market and the transport sector. *Transportation research procedia*, 40, 994-1001. Doi 10.1016/j.trpro.2019.07.139

COCCOLI, M., MARESCA, P., STANGANELLI, L. (2017). The role of big data and cognitive computing in the learning process. *Journal of Visual Languages & Computing*, 38, 97-103. Doi 10.1016/j.jvlc.2016.03.002

COCCOLI, M., MARESCA, P. (2018). Adopting cognitive computing solutions in healthcare. *Journal of e-Learning and Knowledge Society*, 14(1), 57-69. Doi 10.20368/1971-8829/1451

EGOROV, D., LEVINA, A., KALYAZINA, S., SCHUUR, P., GERRITS, B. (2020). The Challenges of the Logistics Industry in the Era of Digital Transformation. In *International Conference on Technological Transformation: A New Role for Human, Machines and Management*, 201-209.

GENZOROVA, T., COREJOVA, T., STALMASEKOVA, N. (2019). How digital transformation can influence business model, Case study for the transport industry. *Transportation Research Proc*edia, 40, 1053-1058. Doi 10.1016/j.trpro.2019.07.147

GRUŽAUSKAS, V., RAGAVAN, D. (2020). Robotic Process Automation for Document Processing: A Case Study of a Logistics Service Provider. *Vadyba*, (2), 119-126.

HARTLEY, J. L., SAWAYA, W. J. (2019). Tortoise, not the hare: Digital transformation of supply chain business processes. *Business Horizons*, 62(6), 707-715. Doi 10.1016/j.bushor.2019.07.006

HAQ, M. S. (2019). *Digital transformation in transportation and logistics*.

HEILIG, L., SCHWARZE, S., VOß, S. (2017). *An analysis of digital transformation in the history and future of modern ports*.

HEILIG, L., LALLA-RUIZ, E., VOß, S. (2017). Digital transformation in maritime ports: analysis and a game theoretic framework. *Netnomics: Economic research and electronic networking*, 18(2), 227-254. Doi 10.1007/s11066-017-9122-x

HOBERG, P., KRCMAR, H., WELZ, B. (2017). *Skills for digital transformation. IDT survey*.

JAYAKRISHNAN, M., MOHAMAD, A. K., ABDULLAH, A. (2018). Digitalization approach through an enterprise architecture for Malaysia transportation industry. *International Journal of Civil Engineering and Technology*, 9(13), 834-839.

LIU, W., ZHANG, W., DUTTA, B., WU, Z., GOH, M. (2020). Digital twinning for productivity improvement opportunities with robotic process automation: Case of greenfield hospital. *International Journal of Mechanical Engineering and Robotics Research*, 9(2), 258-263. Doi 10.18178/ijmerr.9.2.258-263

MATT, C., HESS, T., BENLIAN, A. (2015). Digital transformation strategies. *Business & Information Systems Engineering*, 57(5), 339-343. Doi 10.1007/s12599-015-0401-5

MERKAŠ, Z., PERKOV, D., BONIN, V. (2020). The significance of blockchain technology in the digital transformation of logistics and transportation. *International Journal of E-Services and Mobile Applications*, 12(1), 1-20. Doi 10.4018/IJESMA.2020010101

MIKALEF, P., PAPPAS, I. O., KROGSTIE, J., GIANNAKOS, M. (2018). Big data analytics capabilities: a systematic literature review and research agenda. *Information Systems and e-Business Management*, 16(3), 547-578. Doi 10.1007/s10257-017-0362-y

MITCHELL, R., MICHALSKI, J., CARBONELL, T. (2013). *An artificial intelligence approach*. Berlin: Springer.

MODHA, D. S., ANANTHANARAYANAN, R., ESSER, S. K., NDIRANGO, A., SHERBONDY, A. J., SINGH, R. (2011). Cognitive computing. *Communications of the ACM*, 54(8), 62-71. Doi 10.1145/1978542.1978559

NEKRASOV, A. G., SINITSYNA, A. S. (2020). Digital transformation infrastructure and transportation logistics systems. In *IOP Conference Series: Materials Science and Engineering*, 832(1), 1-6. Doi 10.1088/1757-899X/832/1/012052

NEKRASOV, A. G., SINITSYNA, A. S. (2019). Complex Digital Model of Transport Logistic System Transformation. In *International Conference on Reliability and Statistics in Transportation and Communication*, 244-251.

PAPADOPOULOS, T., SINGH, S. P., SPANAKI, K., GUNASEKARAN, A., DUBEY, R. (2021). *Towards the next generation of manufacturing: Implications of big data and digitalization in the context of industry 4.0*.

RICH, E., KNIGHT, K. (1991). *Artificial intelligence*.

RUSSOM, P. (2011). *Big data analytics: Executive summary*. TDWI best practices report, fourth quarter, 19(4), 1-34.

RUSSELL, S., NORVIG, P. (2002). *Artificial intelligence: A modern approach*.

SALMINEN, V., RUOHOMAA, H., KANTOLA, J. (2017). Digitalization and big data supporting responsible business co-evolution. In *Advances in human factors, business management, training and education*, 1055-1067.

SHYRIAIEVA, L., AFANASIEVA, O., FEDORUK, M. (2019). Development prospects of digital transformation in transportation and logistics. *Economic innovations*, 21(4), 189-198. Doi 10.31520/ei.2019.21.4(73).189-198

SUVOROVA, S., NAUMOVA, E., SCHERBANYUK, I., NOS, V. (2020). Digital transformation in the management of container-on-flatcar transportation: evaluation of business effects. In *IOP Conference Series: Materials Science and Engineering*, 918(1).

TABRIZI, B., LAM, E., GIRARD, K., IRVIN, V. (2019). Digital transformation is not about technology. *Harvard Business Review*, 13, 1-6.

TEKIC, Z., KOROTEEV, D. (2019). From disruptively digital to proudly analog: A holistic typology of digital trans-formation strategies. *Business Horizons*, 62(6), 683-693. Doi 10.1016/j.bushor.2019.07.002

TERESA, G., EVANGELOS, G. (2015). Importance of logistics services attributes influencing customer satisfaction. In *4th International Conference on Advanced Logistics and Transport (ICALT)*, 53-58.

VIALE, L., ZOUARI, D. (2020). Impact of digitalization on procurement: The case of robotic process automation. *Supply Chain Forum: An International Journal*, 21(3), 185-195. Doi 10.1080/16258312.2020.1776089

ZAHARIA, S. E., PIETREANU, C. V. (2018). Challenges in airport digital transformation. *Transportation research procedia*, 35, 90-99. Doi 10.1016/j.trpro.2018.12.016

ZAKIR, J., SEYMOUR, T., BERG, K. (2015). Big Data Analytics. *Issues in Information Systems*, 16(2), 81-90. Doi 10.48009/2_iis_2015_81-90

ZHAO, K., GE, L. (2013). A survey on the Internet of things security. In *Ninth international conference on computational intelligence and security*, 663-667.