Digital Transformation Framework: A Bibliometric Approach

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Abstract

In the age of the digital economy, the organizations will not succeed just by relying on traditional management practices. To flourish in the digital age, businesses need to use digital innovations in their processes, structures, values and products. In these years, digital transformation (DT) is a very important topic and it is studied in many researches. Therefore, in this article we tried to examine the literature to find out what topics has been studied so far in digital transformation. We want to know what are the main dimensions in adopting and implementing digital transformation in organizations. By applying bibliometric analysis, we found that most publications in this field are in business/management/economic research area and since 2015, the number of articles published in this field has increased significantly. Many results concerning the country, citation and co-citation analysis are presented in this paper. Also, and as a result of cluster analysis of literature, we found five DT key features. According to our findings, when implementing and adopting DT, companies tend to focus in subjects like organization, technology, individuals/roles, external pressures, perceived benefits and challenges for deploying solutions. At last, we derived a conceptual framework based on these main elements in order to accelerate digital transformation roadmap in organizations.

Keywords

Digital Transformation, Conceptual Framework, Bibliometric Analysis, Citation Analysis, Co-citation Analysis, Cluster Analysis

1. Introduction

In the last few years, every discussion with c-suite leaders about business growth and expansion ends in DT (Buss, 2018). According to the managers and consultants, DT is an important topic, and it is a path to growth, and it brings more market opportunity for organizations (Schroeck et al., 2019). DT changes the face of firms into digital workplaces. Before the Covid-19 pandemic situation, European companies had understood the importance of implementing DT (Probst et al., 2018). Many of them had started their journey to produce highly customized products and services to increase their competitiveness. The Covid-19 crisis shows that it is even more critical. It appears to play an essential role as a catalyst for digital acceptance in organizations (Blackburn et al., 2020; Fitzpatrick et al., 2020) and it may become an enabler of DT. In a pandemic situation, physical distancing is crucial and it brings

reducing the number of employees. Also, it supports paper-less strategies which result in reducing the human interaction, cost, inaccuracy, and errors of the processes. So, the connected workers' strategies and technologies are inevitable. Also, they need connected data, horizontal networking of customers and suppliers, real-time metrics, and big data analytics. By deploying technologies like the Internet of things, artificial intelligence augmented reality and virtual reality, and 3D printing, implementing DT is achievable (ULAS, 2019). On the other hand, companies which transformed their business digitally will meet their sustainability missions to reduce the carbon footprint and to improve energy efficiency (ElMassah & Mohieldin, 2020). As Google Trends shows, in recent years, DT has received significate attention. The search rate of 'digital transformation' is much higher than the search rate of 'business process management', 'business process reengineering', 'digitalization' and 'digitization'.

DT is not only about technology (Tabrizi et al., 2019), therefore it is pertinent to unveil the main related topics studied within DT, such as (Vial, 2019), to understand the main dimensions that comprise DT. So, in this paper we want to answer this question: "What are the main dimensions studied in digital transformation and how they are related?".

The main objective of our research is to identify the major research subjects and components in the digital transformation studies, and to understand how they are related? Our Specific objectives are:

- RQ1: What are the main dimensions in digital transformation that explored by researchers.
- RQ2: Who are the major researchers involved in digital transformation.
- RQ3: From here we expect to derivate the main components of digital transformation.

In order to gain those objectives, we performed a bibliographic analysis which is applied to identify the cooperation patterns of countries, authors and publications (Capobianco-Uriarte et al., 2019; Guo et al., 2019) and generate a map of most occurrence words in the literature (van Nunen et al., 2018).

Our study embodies three contributions. First, it improves the perception of theoretical corpus of the digital transformation research, and shows the research trends in the literature of digital transformation. It helps researchers to understand what topics have been worked on the most and what issues need to be addressed. Second, it motivated the researchers to work on digital transformation with business and management point of view, and it leads to business growth in industry and society. Third, by representing the conceptual framework, we intended to give organizational leaders an overview of the key ingredients for implementing and adopting digital transformation in their companies.

This paper is structured as follows. In section 2, we presented a brief theoretical background of digital transformation. Then in section 3, we introduced the methodology, and in section 4, we present the results. In the discussion section, we summarized the highlighted results and comparison with others' findings. At last, this study ends with a conclusion section which consists of remarks and contributions and future work.

2. Current State of Digital Transformation

Before 2000 the digitization made human life much easier by developing digital computing, Internet, personal computers, video games, database, automation, digital broadcast, 2G network (Heslop, 2019; Kotarba, 2018; Press, 2015). For example, in the logistic industry between the 1960s and 1990s multi-purpose transportation significantly changed existing transportation frameworks to coordinated transportation frameworks and from 1990 to 2000, digitization empowered a high level of automation

in terminal tasks (Heilig et al., 2017).From 2000 to 2015, social media and intelligent gadgets changed the way customers interact with companies and, furthermore, the clients desire to have better accessibility, user experience and response time (Schallmo et al., 2017).After 2014 digital transformation projects begin to appear (Press, 2015; Reis et al., 2018a). We can look at the graph of this phrase in the Google Trends and see growth from 2014. In 2015 some disruption happened in media, telecom and financial services (Press, 2015). Today, businesses want to develop their mobile devices to make value for their customers (Schallmo et al., 2017). Also, technologies like artificial intelligence, IoT, big data, and cloud computing have been used by companies (Press, 2015).

According to Resego et al. (Resego et al., 2017), there is a lack of a unified and overarching definition of digital transformation as well as inconsistencies in the existing literature. So, by systematic literature review, they describe the digital transformation phenomenon and its drivers and impacts, and they investigate how digital capabilities impact on organizations. Vial (Vial, 2019) describes the digital transformation phenomena and looking into a complete collection of Information System literature on digital transformation. Then he presents 8 building blocks of DT process which are use of digital technologies, disruptions, strategic response, changes in value creation paths, structural changes, organizational barriers, negative impacts and positive impacts.

Some researchers found the challenges of digital transformation in manufacturing such as traditional processes, resistance to change, legacy business model, limited automation, budget restrictions, absence of relevant knowledge and skills, inflexible company structure, security (Albukhitan, 2020; Vogelsang et al., 2019). For leveraging these barriers, there should be several drivers in organizational, external and individual adoption levels like process and workplace improvements, vertical and horizontal integration, management support, cost reduction, customer and market demand, supply chain innovation push, government and employee support (Liere-Netheler et al., 2018; Papagiannidis et al., 2020).

Some papers concentrate on organizational readiness for digital innovation in firms. Lokuge et al. (Lokuge et al., 2019), developed a model for evaluating organizational readiness for digital innovations. This model includes seven dimensions which are resource readiness, IT readiness, cognitive readiness, partnership readiness, innovation valance, cultural readiness, and strategic readiness. On the other study, Sanchez and Zuntini (2018), formulated a framework to assess how companies respond to the digital transformation process. This framework concludes external forces, strategies for value chains, and resources and capabilities.

There are several papers which study the information system's theory in digital transformation. For instance, Steiber et al., (2020) applied innovation diffusion theory for two large industrial firms and used the framework which was developed based on this theory. They identified drivers of digital transformation in General Electric and Siemens HER/Health Services. Also, they found out that this theory works well on the process of identifying those factors which are economic incentives, pilots, storytelling and top management, mobility of external peoples, standardization of innovation, and corporate venturing and acquisition. Sanchez proposes a framework based on the five competitive force model, value chain model, and resource-based view. It evaluates organizational readiness based on resources, capabilities, and management choices in a new era (M. Sánchez, 2017).

Although many studies have been conducted on DT, digital transformation has not been studied as an independent subject (Reis et al., 2018) and has always been studied in the context of other concepts like information systems, business model and industry.

3. Methodology

This paper follows a bibliometric analysis to pursue our study's objectives, which has become a popular methodology in business and management studies (Teixeira et al., 2013; Zupic & Čater, 2015). For answering the research question, we wanted to apply a bibliometric analysis of digital transformation. We applied co-countries analysis, citation analysis, co-citation analysis and factor analysis, co-occurrence analysis and cluster analysis. The research approach of this paper consists of three steps: data search in scientific digital libraries, data extraction, data preparation and data analysis.

3.1. Data Search & Extraction

At first, we needed to extract the data, and those were retrieved from the Web of Science on July 7, 2020. Web of Science was picked as a search tool since it is the most broadly acknowledged utilized database for the study of scientific papers (Yang et al., 2013).

The expression "digital transformation" was taken as a search subject in all metadata of research. We used quotation mark around digital transformation, and this means it must appear as an exact phrase. Because we were looking for researches that have studied exactly the term digital transformation. For example, we are not looking for digitalization or digitization, as they have different meanings. So, we found 2361 publications in concern to digital transformation from 1968 to 2020. We exported the data several times because the web of science just extracts 500 records per time.

3.2. Data Preparation & Analysis

We found out that some words in these extracted files are the same, and the differences are just in plural or singular manner. So, we decided to merge those words in the extracted files such as Algorithm/Algorithms, Model/Models, or System/Systems.

We used the analysis of the results of the Web of Science to investigate what are the document types and research areas of publications. We wanted to understand the trends of the research areas in those publications, so we used the analysis of the results for each year and made a pivot table to generate

the bar chart in order to show what percentage of publications have been in specific areas each year.

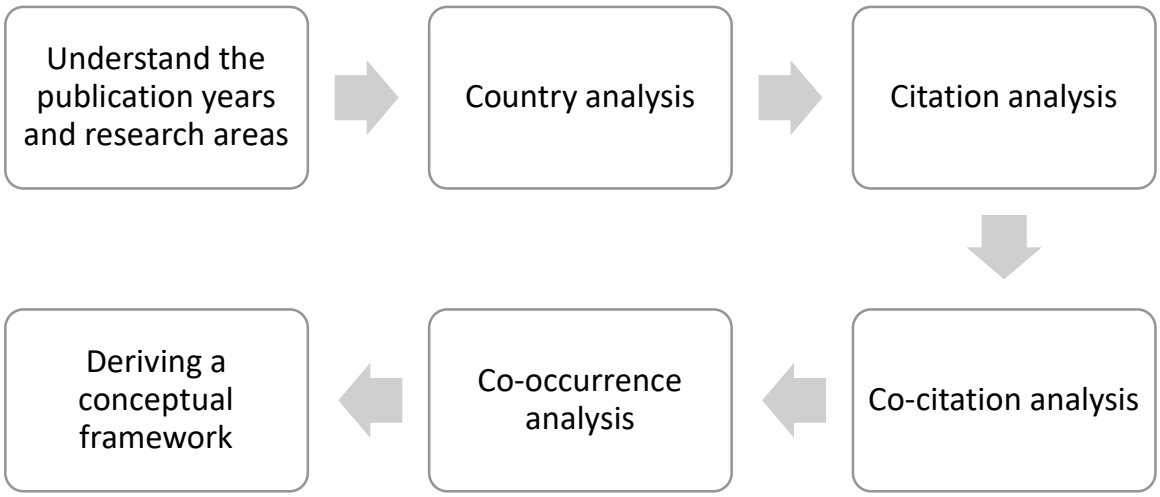

Figure 1. The flow of the research process

We used VOSviewer to conduct the analysis, which is a software program developed by van Eck and Waltman (2010) and used for constructing and viewing bibliometric networks. The next approach is country analysis to recognize which countries have more researchers on this topic. We used VOSviewer as a tool to identify in which countries the publications were distributed. We also used citation analysis to identify the most cited articles. Finding the most cited publication will help us to understand what works have had the greatest impact on the subject (Ferreira, 2011)We applied co-citation analysis for those top-cited papers to understand the semantic relationship between them. This method develops the knowledge structure and dynamic evolution of the concepts. We used VOSviewer to generate the co-citation network for those top-cited publications. Then we analyzed the clusters of the co-citation map by interpreting the content of each work in the same cluster. We tried to find similar themes in those publications and generated a generic title for each cluster. You can see the research flow in figure 1.

For the last part, we did a cluster analysis to figure out which words are most used in digital transformation research? We ran co-occurrence analysis in VOSviewer and created a map based on titles and abstract fields with the minimum number of 15 occurrences. Then we used cluster analysis techniques to understand what are the more repeated words in the title and abstract of these 2361 publications. We tried to show the relatedness of these terms in the same cluster and generated a label for each cluster that cover all the words in that cluster.

After the cluster analysis, we used the key concept of each cluster as a variable to derive a conceptual framework for the adoption of digital transformation. We tried to explain the logic behind each cluster and clarify the propose relationships among those concepts.

4. Results

4.1. Publication Years and Research Areas

For understanding the annual trends of digital transformation publications, we use the Web of Science result analysis part and extracted the number of publications for each year. Figure 2. plots the number of works in digital transformation per year. The first paper was published in 1968, but before 2010, only 49 articles were published in this field. The works related to "digital transformation" increased very slowly until 2010. Especially after 2016 the number of publications has dramatically excessed. As mentioned earlier, the data for this study was extracted on July 7, so we will see a decrease in 2020. However, 277 works have been published to that date. Therefore, according to this trend, by the end 2020, this amount is seemed to increase more than the number of studies in 2019.

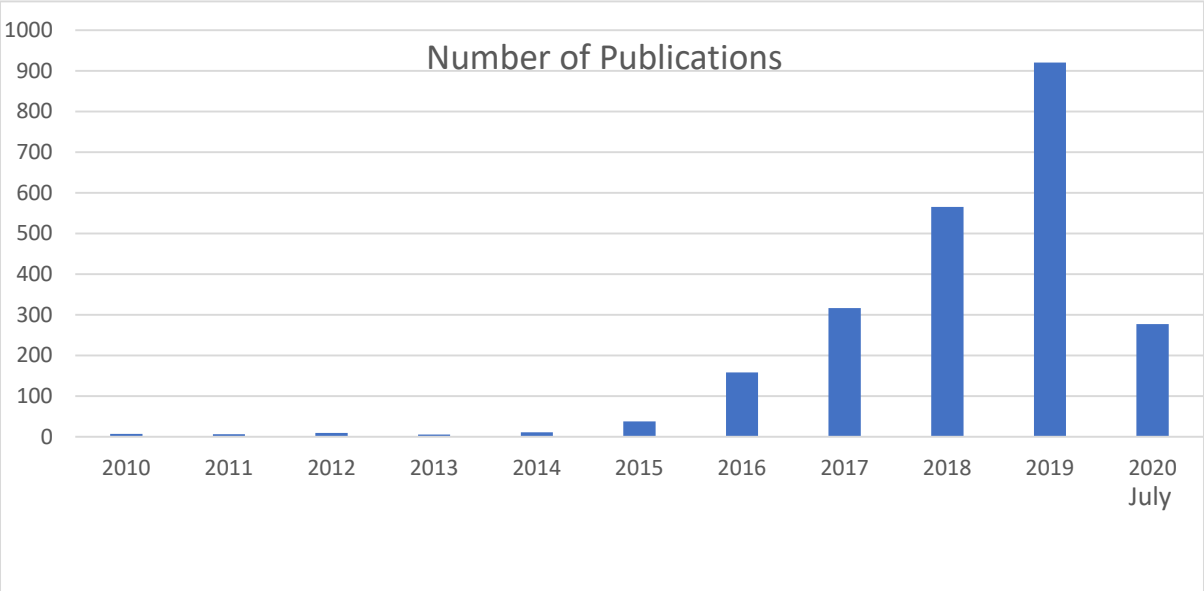

Figure 2. Annual trends of publications in digital transformation extracted from the Web of Science from 2010 –July 2020

In the next analysis, to identify what are the research categories of these 2361 publications, we also used Web of Science result analysis and gather data about the research area and number of publications in each of that. It is important to note that an article may come in more than one area of research. Because, for example, it is possible that an article is both in the field of management and communication.

Most publications are in business/management/economy and computer science which is about %48 of all works. Also, %24 of publication is in the engineering research area. This makes sense because digital transformation means using technology and digital innovations in processes, structures and every aspect of the organization to improve efficiency and create more value for customers (Hinings et al., 2018). In figure 3 you can see the proportion of articles published in a particular research field.

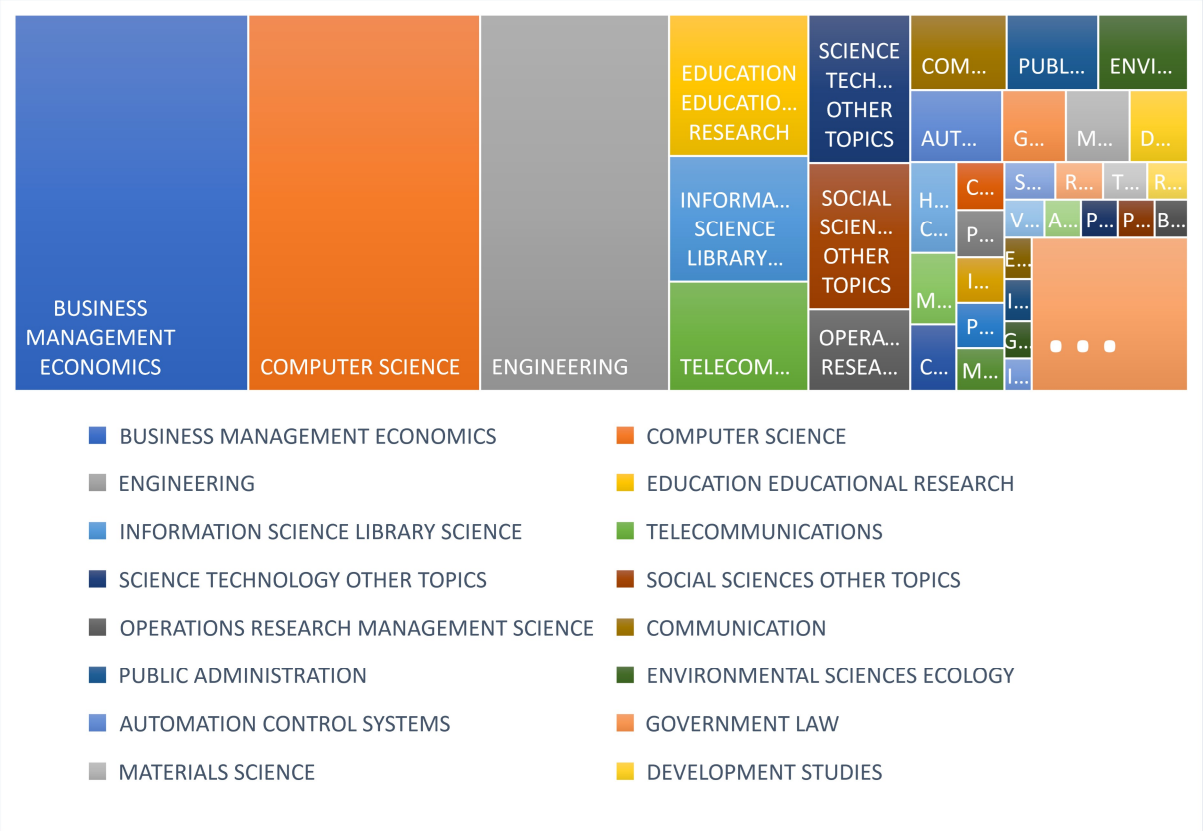

Figure 3. Research category of publications

4.2. Country Analysis

To identify which countries these publications are distributed, we did citation analysis in VOSviewer. The results showed that in the 61 countries, Germany has the highest total link strength with 379 documents and 1092 citations. That is because Germany adopted digital strategies to become a leader in innovative technologies like AI and block chain (*National Strategies*, 2019). According to Bloomberg in 2020 German took the first place in Innovation index which is based on patent activity, personal research concentration, tertiary education, technology company density, productivity, manufacturing value-added, research and development expenditures (Jamrisko, 2020). Although Russia and Romania published more articles in this field, the USA has higher total link strength which means the cooperation with other countries are higher than those countries. But it seems the digital transformation strategies could be the next economic growth in those countries especially in Romania (Spiridon et al., 2018; Thorniley, 2019). In general, based on these references, the key areas in digital transformation are business processes, management, innovation in product and services, digital technologies, and this aligns with research fields in figure 3.

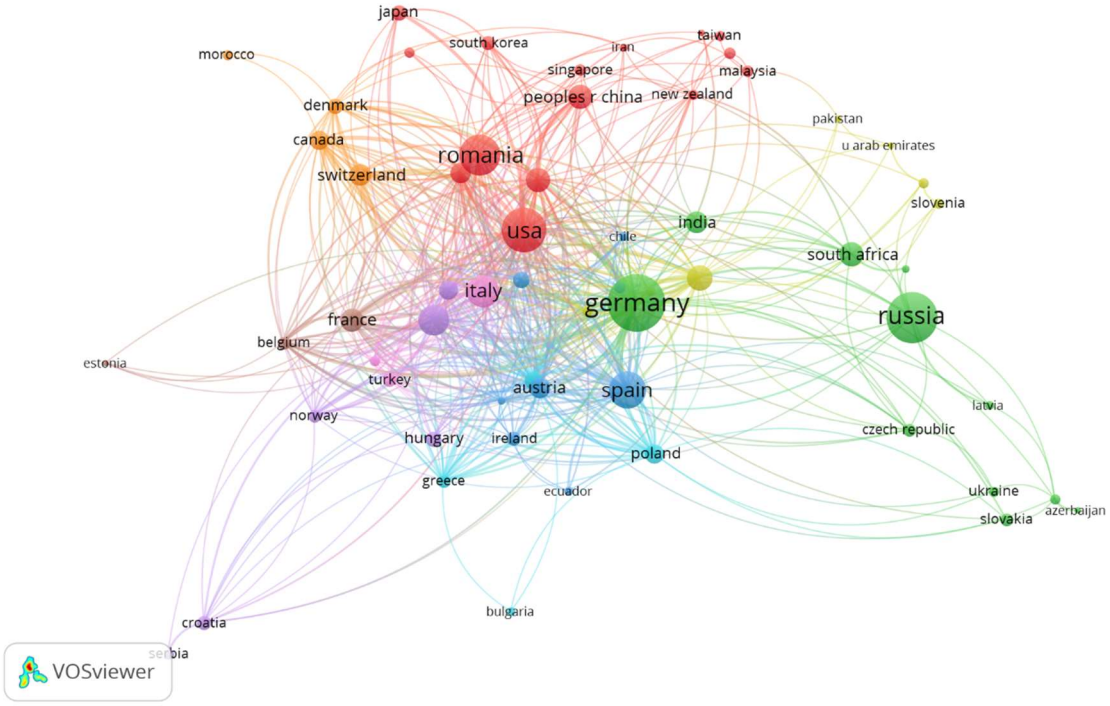

Figure 4. Research countries of publications and their relations

You can see the network of cooperation and distribution of countries in figure 4. The different colour shows the number of clusters, and each item has a specific colour that represents to which cluster it belongs. The countries with the same colours are closely related to each other in terms of cooperation. For example, this map shows that the publications of Germany, Russia, South Africa and India mostly cite each other. Table 1 shows the cluster colour and number of countries in each cluster separately. In each cluster, the names of the countries that are mostly related to each other are also mentioned.

Table 1. Cluster analysis of research countries of publications

Cluster Color	Number of Countries	Name of Countries
1. Red	15	USA, Romania, China, Australia, Iran, …
2. Green	11	Germany, Russia, South Africa, India, …
3. Dark Blue	8	Spain, Austria, Brazil, Colombia, Argentina, …
4. Yellow	7	Portugal, Slovenia, Scotland, Lithuania, Egypt, UAE, …
5. Purple	6	England, Finland, Hungary, Croatia, Norway, Serbia
6. Blue	4	Poland, Netherland, Greece, Bulgaria
7. Orange	4	Switzerland, Canada, Denmark, Morocco
8. Brown	3	France, Belgium, Estonia
9. Lilac	3	Italy, Turley, Mexico

4.3. Citation Analysis

In the previous section we understand which countries are cooperating together so we need to analyze which authors work together and what are the best and essential publications in digital transformation. For this purpose, we ran a citation analysis to count the number of times others have cited the paper, and we used VOSviewer tools to analyze it. Table 2 shows the 22 most cited studies between the 2361 publications.

The paper, **The digital transformation of healthcare: current status and the road ahead**, written by Agarwal et al., (2010), is cited by 226 articles. On the other hand, the paper, **Understanding digital transformation: A review and a research agenda**, by Vial (2019), has the strongest links of all papers. It means that This means that these 2361 publications referenced this article the most.

Table 2. The 22 most cited publications on digital transformation

Rank	Reference	Citations frequency	Links	Main Findings
1	The digital transformation of healthcare: current status and the road ahead. (Agarwal et al., 2010)	226	2	This paper provided an overview of the current status of Health IT (HIT) research. Then identified three major areas for further research which are (1) HIT design, implementation, and meaningful use; (2) measurement and quantification of HIT payoff and impact; and (3) extending the traditional realm of HIT. In each domain, the specific question discussed and appropriate method suggested.
2	Innovation diffusion in global contexts: determinants of post-adoption digital transformation of European companies. (Kevin et al., 2006)	209	2	Developing an integrative model to study the determinants of post-adoption stages of innovation diffusion, using enterprise digital transformation. Specifying four innovation characteristics (relative advantage, compatibility, costs and security concern) and four contextual factors (technology competence, organization size, competitive pressure and partner readiness) Testing the model and the results showed that innovation diffusion can be better understood by including both innovation characteristics and contextual factors.
3	Digital Transformation Strategies. (Matt et al., 2015)	118	3	In this paper, a digital transformation strategy formulated that serves as a central concept to integrate the entire coordination, prioritization, and implementation of digital transformations within a firm.
4	Options for formulating a digital transformation strategy. (Hess et al., 2016)	68	5	Generate guidelines for senior executives to handle the challenges of formulating digital transformation.
5	Industry 4.0 technologies: Implementation patterns in manufacturing companies. (Frank, Dalenogare, et al., 2019)	59	1	This paper studied Industry 4.0 technology patterns in 92 manufacturing companies. Then proposed a framework with front-end and base technologies of Industry 4.0.
6	Open Innovation: Research, Practices, and Policies. (Bogers et al., 2018)	59	0	This article described the state of open innovation at the intersection of research, practice, and policy. It discusses some key trends (e.g., digital transformation), challenges (e.g., uncertainty), and potential

				solutions (e.g., EU funding programs) in the context of open innovation and innovation policy.
7	External Knowledge and Information Technology: Implications for Process Innovation Performance. (Trantopoulos et al., 2017)	53	1	In this paper, they draw on the knowledge-based view of the firm to investigate how search in external knowledge sources and information technology for knowledge absorption jointly influence process innovation performance. Their model was tested on a nine-year panel (2003–2011) of Swiss firms from a wide range of manufacturing industries. They found that data access systems and network connectivity hold very different potential for the effective absorption of external knowledge, and the subsequent realized economic gains from process innovation. Their findings demonstrated how firms should coordinate strategies for sourcing external knowledge with specific IT investments in order to improve their innovation performance.
8	The Role of Dynamic Capabilities in Responding to Digital Disruption: A Factor-Based Study of the Newspaper Industry. (Karimi & Walter, 2015)	52	2	This study built on disruptive innovation theory by ascertaining the role of dynamic capabilities in the performance of response to digital disruption. Empirical results suggested that first-order dynamic capabilities that are created by changing, extending or adapting a ' 'firm's existing resources, processes, and values are positively associated with building digital platform capabilities and that these capabilities impact the performance of response to digital disruption.
9	How Chief Digital Officers Promote the Digital Transformation of their Companies. (Singh & Hess, 2017)	48	2	Chief Digital Officers (CDOs) are establishing themselves as new executives at the top management level of companies that go through a digital transformation. This study presented six case studies of CDOs and described how they fulfil their positions. From these cases, they identified the main factors that drive the employment of CDOs, the three role types that CDOs primarily play and the skills and competencies they should have for each role type.
10	Hummel's Digital Transformation Toward Omnichannel Retailing: Key Lessons Learned. (Hansen & Kien, 2015)	42	2	With the phenomenal growth of mobile and social media, many organizations realize they need an online presence to reach out to digitally savvy customers. But delivering seamless customer experience across various online and offline channels is increasingly challenging. This article described how Hummel, a European sports fashion company, overcame the challenges and successfully transitioned toward omnichannel retailing. Based on this case, they

				provided insights to guide organizations with similar ambitions and the implications for their CIOs.
11	The Digital Transformation of Traditional Business. (Andal-ancion et al., 2003)	42	1	The authors conducted case research of 20 large companies in North America and Europe across different industries to discover the effects of new information technologies (NIT) in transforming industries and value chains. They commenced their study by collecting information through literature and Web research and supplemented that with interviews of company executives and consultants at a global management-consulting firm.
12	Digital transformation by SME entrepreneurs: A capability perspective. (Li et al., 2017)	39	1	They were investigating how entrepreneurs of SMEs with inadequate capabilities and limited resources drove digital transformation in their companies. They are deriving a process model that aims to describe and explain how SME entrepreneurs, drive digital transformation through managerial cognition renewal, managerial social capital development, business team building, and organizational capability building.
13	Digital innovation and transformation: An institutional perspective. (Hinings et al., 2018)	36	0	In this, they identified three types of institutional arrangements critical for digital transformation: digital organizational forms, digital institutional infrastructures, and digital institutional building blocks. Then the implications of an institutional perspective on digital transformation is discussed.
14	Tackling the digitalization challenge: how to benefit from digitalization in practice. (Parviainen et al., 2017)	32	1	This paper describes the digital transformation model, which help firms considering the changes. This model has four steps: 1. positioning the company in digitalization, 2. defining goals, 3. analyzing the current state of digitalization goals, 4. Defining and implementing a roadmap for reaching the goals.
15	How Big Old Companies Navigate Digital Transformation. (Sebastian et al., 2017)	32	1	This research described findings of 25 companies in their digital transformation journeys. In this regard, they defined two digital strategies - customer engagement and digitized solutions and two technology-enabled assets - an operational backbone and a digital services platform.

16	Information technology and good life. (StorIterman & Fors, 2004)	28	0	This paper is a conceptual article that discussed the ways IS research can contribute to understanding the technology and transformation of today's life.
17	Understanding digital transformation: A review and a research agenda. (Vial, 2019)	24	11	Reviewing a comprehensive body of IS literature on digital transformation. They built a conceptual definition of digital transformation. Offering a research agenda for future research on digital transformation.
18	Clusters and Industry 4.0 – do they fit together? (Gotz & Jankowska, 2017)	23	0	Reviewing Industry 4.0 Discussing the ways to facilitate the business transformation toward Industry 4.0.
19	DIGITAL TRANSFORMATION OF BUSINESS MODELS — BEST PRACTICE, ENABLERS, AND ROADMAP. (Schallmo et al., 2017)	22	0	Clarifying the definition of digital transformation. Introducing a structured approach with phases, activities and results based on literature review. Offering the definition of digital transformation of business models and its enablers.
20	Data-driven operations management: organisational implications of the digital transformation in industrial practice. (Golzer & Fritzsche, 2017)	21	0	Investigating the importance of big data in digital transformation Identifying the fields of action for operations management related to data processing
21	Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective. (Frank, Mendes, et al., 2019)	20	1	Exploring the integration of servitization types and digitization levels. Servitization types can be offered in three levels: manual, digital and industry 4.0. Industry 4.0-related services add value for customers and for internal processes.
22	How AUDI AG Established Big Data Analytics in Its Digital Transformation. (Dremel et al., 2017)	20	2	Providing recommendations for how traditional manufacturing organizations can successfully introduce big data analytics and master the related organizational transformations.

4.4. Co-citation Analysis

We use co-citation analysis to identify the ties between publications related to digital transformation (Pinto et al., 2014). We applied the 22 top-cited works to create a semantic map among them. We use VOSviewer as a tool for generating this network. Based on the results, four clusters were created. Articles that were conceptually more similar were grouped together. This co-citation network among the 22 most cited papers is shown in Figure 5.

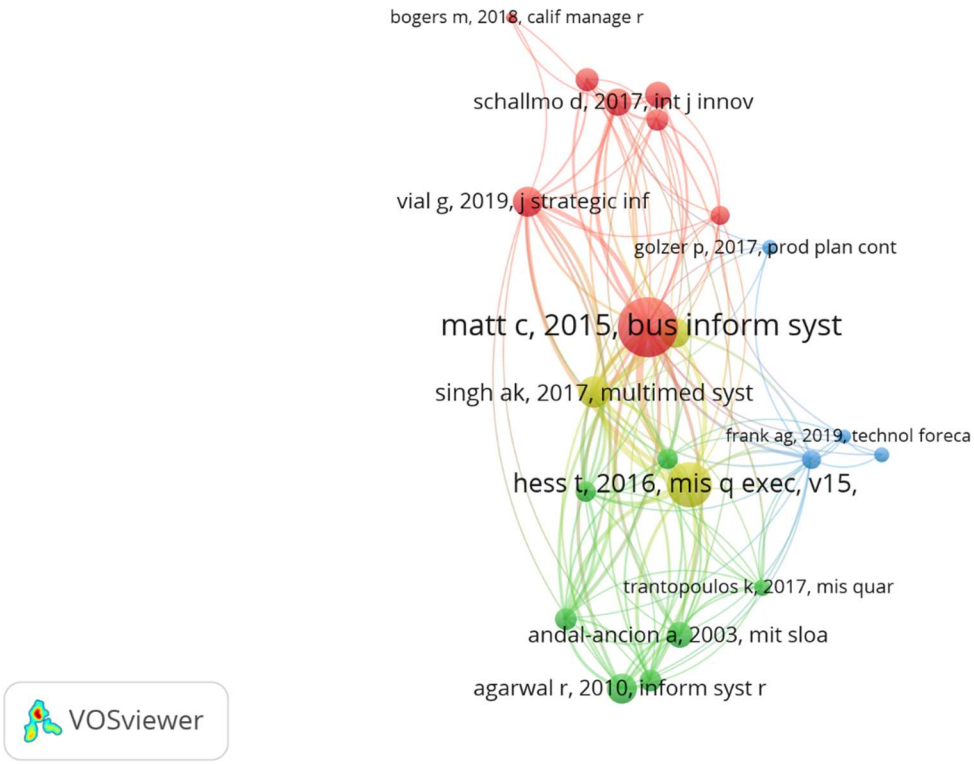

Figure 5. Co-citation network among the top 22 most cited publications

By using cluster analysis, we can easily find connections between the articles in the same clusters. For example, in cluster 1, there are relations between the work of Bogers, M. et. Al., (2018), Frank, A. et.al., (2019), Hinings, B. et. Al., (2018), Matt, C. et.al., (2015), Parviainen, P. et.al., (2017), Schallmo, D. et. al., (2017), Storlterman, e. Fors, ac. (2004) and Vial, G. (2019). They are all focus on "Digital Transformation, Innovation and Business Model". The main focus of the publication on cluster 2 is "digital transformation and information systems". You can easily find the semantic relation among those publications in cluster 2 that are shown in table 2. The articles on cluster 3 are mainly about "digital transformation and industry 4.0" and the last cluster is about "digital transformation and people".

Table 2. Cluster analysis of co-citation network

Digital Transformation, Innovation and Business Model	Digital Transformation and Information System Theories	Digital Transformation and Industry 4.0	Digital Transformation and People
Bogers, M. et. Al., (2018).	Agarwal, R et al., (2010).	Dremel, C, et al. (2017).	Hess, T, et al. (2016).
Frank, A. et.al., (2019).	Andal-ancion, A. et. Al., (2003).	Frank, A. et.al., (2019).	Sebastian, I. t.al., (2017).
Hinings, B. et. Al., (2018).	Hansen, R. Kien Sia, S. (2015).	Golzer, Ph. Fritzsche, A. (2017).	Singh, A. Hess, T. (2017).
Matt, C. et.al., (2015)	Karimi, J. Walter, Zh. (2015).	Gotz, M. Jankowska, B. (2017).	
Parviainen, P. et.al., (2017).	Li, L. et.al., (2018).		
Schallmo, D. et. al., (2017).	Trantopoulos, K. et. Al., (2017).		
Storlterman, e. Fors, ac. (2004).	Zhu, K et.al., (2006).		
Vial, G. (2019).			

The impact of digital transformation on the business model of organizations has been studied in many articles. Because the business model is the basic and hidden logic of the organization that shows what values and benefits will reach customers and business partners. It is through the business model that companies can differentiate themselves from their competitors. They can also communicate with their customers and design competitive advantages. So, in the age of the digital economy, transforming the business model is a necessity by leveraging technology. The companies must have abilities to test innovation quickly. It means that they should run real-time experiments with their products and services and get the results from the market.

Becoming a digital readiness requires a massive change in how an organization thinks. It is about changing the culture, governance and adopting the way of working. The organizations with a culture of agility, adaptability and the readiness to adjust are success in the digital transformation process. The firms should have a growth mindset and not afraid of failure but learn from them. The employees should not be concerned about evaluation and they just have the willing to learning and development. If they a sense of ownership, they can produce tremendous results. The success in the digital transformation process will not happen unless the people have the willingness to take risks. Furthermore, in the organization with transparency culture, the tensions of easily available data which is the results of digital transformation will reduce. If the organization has the DevOps culture, which is an emphasis on agility, teamwork, growth, eliminate silos, team accountability, clarity to measure risks and ease of sharing, the digital transformation process occurs successfully.

One of the trends in digital transformation studies is Industry 4.0, and it is also referred to as the fourth industrial revolution. Industry 4.0 will boost success, take advantage of opportunities, and decrease the risks. As mentioned before, studies have been conducted to examine the challenges of digital transformation in factories, and the number of drivers and incentives have been found to improve its implementation.

There are a number of studies that have examined the application of information system theories in the field of digital transformation. Because information systems provide digitization and digitalization, and on the other hand, can facilitate the transformation process. As a result, it is important to know whether these theories are also relevant to digital transformation or not.

4.5. Co-occurrence Analysis based on Title and Abstract Fields

The co-occurrence analysis has been applied to figure out what are the critical points of the articles. We Performed a co-occurrence analysis based on title and abstract in the VOSviewer with the minimum number of 15 occurrences. The VOSviewer produces a visual map to simplify the analysis of co-occurrence in order to distinguish the most significant words in the publications. In figure 6, we can see this map which contains 403 words in 5 clusters. In this network, the size of circles shows the occurrences of keywords, so it represents the importance of the word in the documents. The clusters are the group of more occurrence terms in the title and abstract of publications which related together. In other words, they are group data sets that are categorized in the same meaningful classes. The words with high correlation with each other having tendency to put into the same cluster. These clusters are shown with different colours.

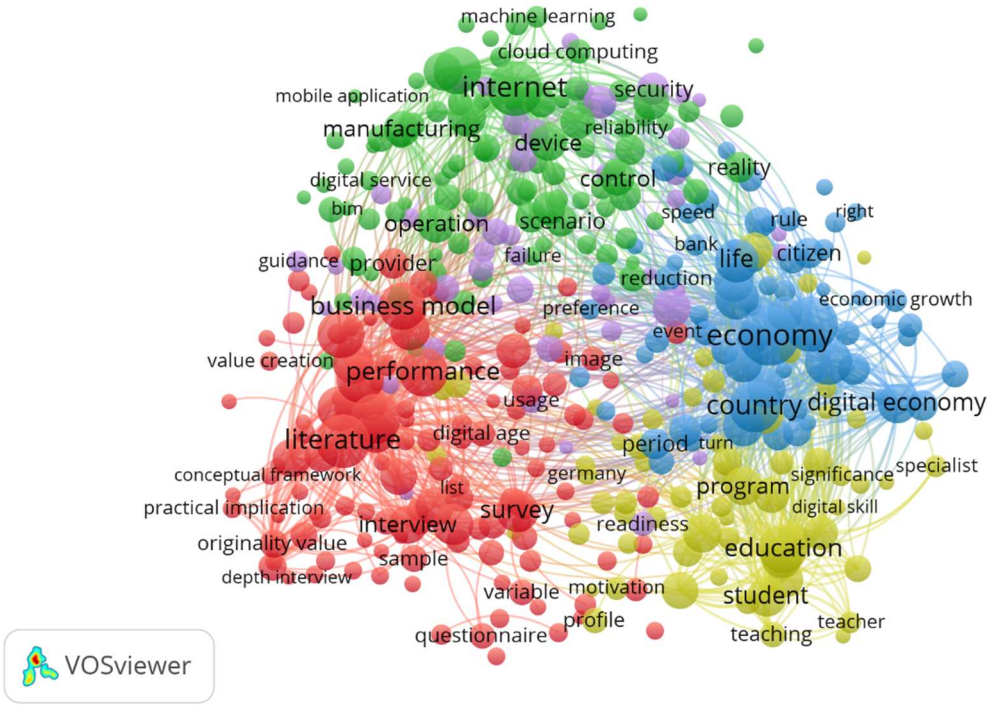

Figure 6. Co-occurrence network among the title and abstract fields of 2361 publication

We listed the 20 most occurrence terms of each cluster in Figure 7. Then we tried to label each cluster by a specific word which has the most interpretation of it. The first cluster is displayed in red and the main keywords refer to various components of an organization such as business model, business process, organizational structure, size, different stakeholders, strategy, culture, value, capabilities and competitive advantages. In general, this cluster is related to the internal factors of the organization. In order to cover all these words, we decided to label this cluster as the word **organization**.

The second cluster contains all kinds of disruptive technologies like AI, IoT, blockchain and cloud computing. It also refers to technological devices and industry 4.0. We decided to consider **technology** as a label for this cluster because, in our opinion, it can best describe the words contained in it.

The third cluster, displayed in blue, contains all the words that describe the organization's **external pressures,** so we labeled this cluster with this word. These forces can be economical, social, governmental, technological, political, environmental or based on regulations, rules, rights and policies.

In the fourth cluster, we can see many words related to **people** and their characteristics, skills and motivations. This shows the importance of the role of people in digital transformation. The individual characteristics and their attitude toward change are the significant criteria for adopting digital transformation in the organization.

Finally, the last cluster refers to the results and outcomes of implementing digital transformation in the organization. It contains several words related to the benefits and challenges of deploying digital transformation like security, awareness, safety, trust, transparency, privacy, agility and cybersecurity besides several challenges and weaknesses. Also, this cluster includes readiness index and maturity model of digital transformation and some guidelines and governance principles for implementing digital transformation. Therefore, we decided to call this cluster by **Perceived Benefits & Challenges**.

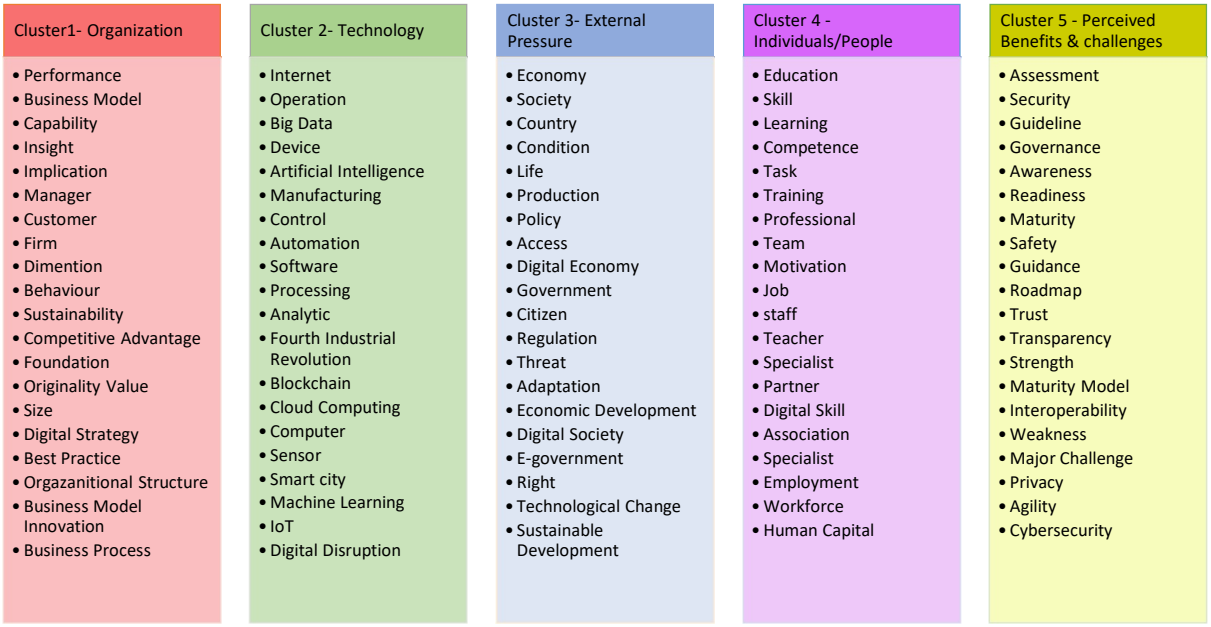

Figure 7. Cluster analysis of co-occurrence network among the title and abstract fields of 2361 publication

4.6. Deriving conceptual framework

After understanding the main subjects and components of digital transformation, we tried to use them as a variable to propose a conceptual framework for the adoption of digital transformation in

organizations. Based on co-citation analysis and co-occurrence analysis of literature, we figured out that the main concepts that have been explored in digital transformation are organization, people, technology, external pressure, perceived benefits and challenges, and information system theories.

Organization and its descriptive measures like size, structure, business model, strategical and managerial issues, customer perspective, is an important context for the adoption of the digital transformation process in the organization. The other important theme that should consider in this concern is everything about the individuals like motivation, attitude toward change, skill and expertise.

One of the major components in the adoption of digital transformation in companies is the technology point of view. Organizations should apply some disruptive technologies in their internal processes, products and services, business model and finally redefine its value proposition.

On the other hand, environmental context and external pressure are always an important issue for directing the firms. It is about economic, social, governmental and competitive threats, policies, regulations, rights and conditions. The companies should respond to these issues for running their businesses.

By implementing digital transformation in organizations, there are several benefits and challenges that companies will confront like security, safety, trust, transparency, privacy, agility and cybersecurity. Proper management of weaknesses and strengths will increase the maturity of the organization, and it shows the organizational readiness for adoption of digital transformation.

Figure 8 shows the conceptual framework we proposed based on bibliometric analysis. In this model, we do not use the information system theories as dimensions of this framework. But we believe that the study of information system and technology adoption theories play an important role in digital transformation research. It is necessary to examine the implications of these theories like TOE, DOI, Institutional theory, Resource-based view and 'Porter's five forces to validate this model.

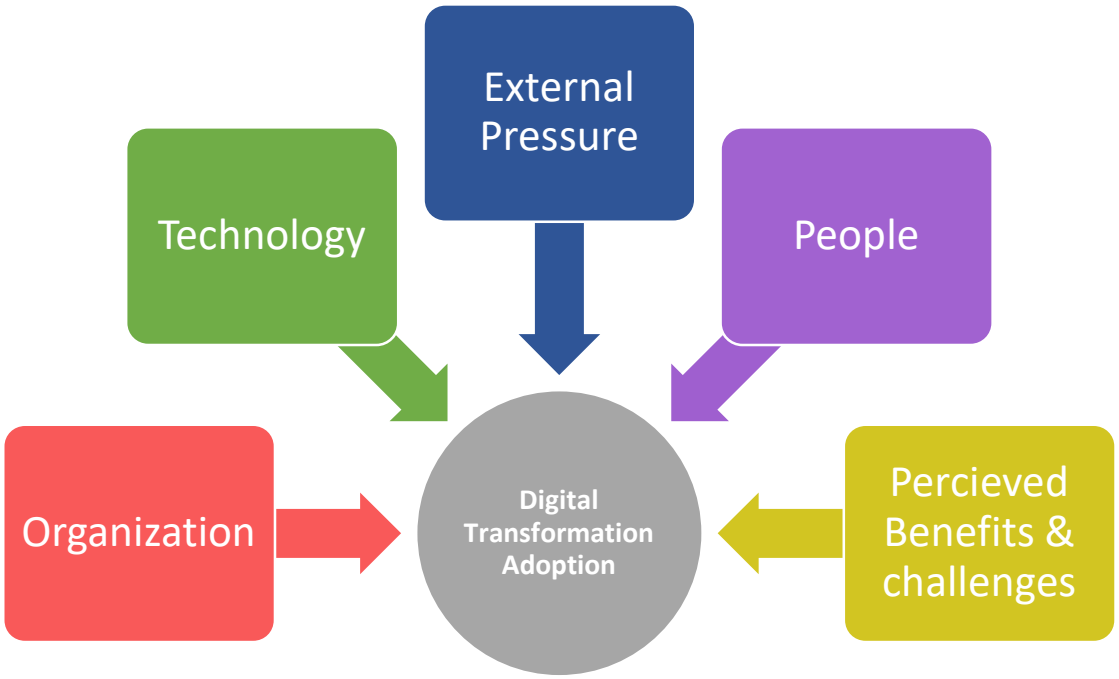

Figure 8. Conceptual framework for adoption of digital transformation

As mentioned earlier, the dimensions shown in figure 8 are important for consideration in digital transformation research. For this reason, we decided to analyzed the 22 most cited papers in terms of those dimension. This means that we examine whether these publications have considered the mentioned dimensions in their research or not. In the matrix below, if the study covers the corresponding dimension, then we put a sign on that cell. We can see that the most studied dimension is technology and it is considered in almost all of the 22 publications and the perceived benefits and challenges dimension is the less studied one. So, there are some gaps in these studies that need additional research.

Table 3. Analyzing the 22 most cited publications in terms of the research framework dimensions

Publication	Organization	Technology	External Pressure	People	Perceived Befits & Challenges
The digital transformation of healthcare: current status and the road ahead. (Agarwal et al., 2010)		*	*		*
Innovation diffusion in global contexts: determinants of post-adoption digital transformation of European companies. (Kevin et al., 2006)	*	*	*		*
Digital Transformation Strategies. (Matt et al., 2015)	*	*		*	
Options for formulating a digital transformation strategy. (Hess et al., 2016)	*	*			*
Industry 4.0 technologies: Implementation patterns in manufacturing companies. (Frank, Dalenogare, et al., 2019)		*			
Open Innovation: Research, Practices, and Policies. (Bogers et al., 2018)		*	*		
External Knowledge and Information Technology: Implications for Process Innovation Performance. (Trantopoulos et al., 2017)	*	*	*	*	
The Role of Dynamic Capabilities in Responding to Digital Disruption: A Factor-Based Study of the Newspaper Industry. (Karimi & Walter, 2015)	*	*		*	*
How Chief Digital Officers Promote the Digital Transformation of their Companies. (Singh & Hess, 2017)				*	
Hummel's Digital Transformation Toward Omnichannel Retailing: Key Lessons Learned. (Hansen & Kien, 2015)	*	*	*		

The Digital Transformation of Traditional Business. (Andal-ancion et al., 2003)	*	*	*		
Digital transformation by SME entrepreneurs: A capability perspective. (Li et al., 2017)	*	*		*	
Digital innovation and transformation: An institutional perspective. (Hinings et al., 2018)	*	*		*	*
Tackling the digitalization challenge: how to benefit from digitalization in practice. (Parviainen et al., 2017)	*	*	*		
How Big Old Companies Navigate Digital Transformation. (Sebastian et al., 2017)	*	*			
Information technology and good life. (Storlterman & Fors, 2004)		*			*
Understanding digital transformation: A review and a research agenda. (Vial, 2019)	*	*	*	*	*
Clusters and Industry 4.0 – do they fit together? (Gotz & Jankowska, 2017)	*	*	*		
DIGITAL TRANSFORMATION OF BUSINESS MODELS — BEST PRACTICE, ENABLERS, AND ROADMAP. (Schallmo et al., 2017)	*	*			
Data-driven operations management: organisational implications of the digital transformation in industrial practice. (Golzer & Fritzsche, 2017)		*			*
Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective. (Frank, Mendes, et al., 2019)		*	*		
How AUDI AG Established Big Data Analytics in Its Digital Transformation. (Dremel et al., 2017)	*	*			

5. Discussion

In this research, we analyzed 2361 publications from 1968 to July 7, 2020. We performed research area, country, citation, co-citation and co-occurrence analysis to take a look at the state of the art on the topic to find the main areas, gaps and key features in implementing and adopting of digital transformation. We found these key features relevant to main academic digital transformation sources.

As Rogers stated in his book (Rogers, 2016), in the digital age, companies should consider changes related to customers, competition, data, innovation and value and these are five domain of digital transformation. The author explains some solutions related to customer networks (reinventing marketing funnel, path to purchase and core behaviors of customer netwoeks), platforms, big data, agility and rapid development, disruption of business model to bring a company from analogue to digital. These strategies fit into the framework we have extracted from the literature review. Customers, innovations and value related to organization dimension. Data fits the technology part and competition relates to external pressure.

According to Ross (Ross et al., 2019), there are five essential building blocks for digital transformation which are operational backbone, digital platform, external developer platform, shared customer insights and accountability framework. Operational backbone relates to core 'company's operations and it fits with organization dimension of our conceptual framework. The digital platform is about components for digital offerings, and it is relevant to the technology part of our framework. Accountability framework related to people dimension because it describes the distribution of responsibilities between individuals. The external developer platform fits to more than one part of our proposed framework which is technology and external pressures. Shared customer insights are part of the perceived benefits and challenges dimension of implementing digital transformation in an organization.

In general, every company is different in implementing and adopting of digital transformation, and it depends on its legacy, challenges, and opportunities. That is why we want to extract the knowledge of digital transformation in scientific studies. The framework we have outline does not have a step-by-step process for implementing and adopting the digital transformation process in the organization, but it is intended to give you an overview of the key ingredients to succeed in the digital economy.

6. Conclusion and Future Work

In this research, we wanted to know what are the research areas are involved in digital transformation, and what are the primary countries and most cited papers in this field? We found that most publications are in business/management/economic, computer science and engineering. In terms of countries, Germany, Russia and Romania are top countries based on the number of publications but the USA has more cooperation with other countries than Russia and Romania. The most important papers in digital transformation are related to innovation and business model, information system theories, industry 4.0 and people. Also, in this study, we help researchers to analyze the scientific performance of publications in digital transformation easily and know other researchers in this field to follow them and to work with

them if necessary. Our work motivates researchers to identify the gaps and key opportunities for further research.

On the other hand, we wanted to review the knowledge in literature and understand what are the main themes in digital transformation. According to cluster analysis, the key areas in digital transformation are the organization, technology, external pressure, people and perceived benefits and challenges.

Also, we aimed to make a framework for identify the main dimension of digital transformation in companies. So, by using the main components found in the literature, we derived a conceptual framework. This framework will help the organization to consider important issues in implementing and adopting digital transformation.

As we told before, these days the COVID-19 pandemic situation has accelerated the digital transformation journey of the companies. Many organizations need to digitalize their business process and interactions with their customers and suppliers. They need to change their business model and try to get more margin from those new solutions. So, for further research, we want to analyze the drivers of digital transformation in the organization and analyze the importance of it on sustainable business models. Based on the bibliometric analysis, we find the information system and technology adoption theories are important in digital transformation so we will study theories such as like TOE, DOI, Institutional theory and try to propose a model.

References

Agarwal, R., Gao, G., DesRoches, C., & Jha, A. K. (2010). The digital transformation of healthcare: Current status and the road ahead. *Information System Research*, *21*(4), 796–809. https://doi.org/10.1287/isre.1100.0327

Albukhitan, S. (2020). *Developing Digital Transformation Strategy for Manufacturing*. *170*, 664–671. https://doi.org/10.1016/j.procs.2020.03.173

Andal-ancion, A., Cartwright, P., & Yip, G. (2003). The Digital Transformation of Traditional Business. *MIT Sloan Management Review*, *44*(4), 34–41.

Blackburn, S., LaBerge, L., O'Toole, C., & Schneider, J. (2020). Digital strategy in a time of crisis. *Mckinsey Digital*. https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-strategy-in-a-time-of-crisis

Bogers, M., Chesbrough, H., & Moedas, C. (2018). Open Innovation: Research, Practices, and Policies. *California Management Review*, *60*(2), 5–16. https://doi.org/10.1177/0008125617745086

Buss, D. (2018). CEO Voices: Digital Transformation Is Everything. *Chiefexecutive.Net*. https://chiefexecutive.net/ceo-voices-digital-transformation/

Capobianco-Uriarte, M. de las M., Casado-Belmonte, M. del P., Marín-Carrillo, G. M., & Terán-Yépez, E. (2019). A Bibliometric Analysis of International Competitiveness (1983–2017). *Sustainability*, *11*. https://doi.org/doi:10.3390/su11071877

Dremel, C., Herterich, M., Wulf, J., Waizmann, J., & Brenner, W. (2017). How AUDI AG Established Big Data Analytics in Its Digital Transformation. *MIS Quarterly Executive*, *16*(2), 81–100.

ElMassah, S., & Mohieldin, M. (2020). Digital transformation and localizing the Sustainable Development Goals (SDGs). *Ecological Economics*, *169*. https://doi.org/10.1016/j.ecolecon.2019.106490

Ferreira, M. P. (2011). A bibliometric study on Ghoshal's managing across borders. *Multinational Business Review.*, *19*(4), 357–375. https://doi.org/10.1108/15253831111190180

Fitzpatrick, M., Gill, I., Libarikian, A., Smaje, K., & Zemmel, R. (2020). The digital-led recovery from COVID-19: Five questions for CEOs. *Mckinsey Digital*. https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-digital-led-recovery-from-covid-19-five-questions-for-ceos

Frank, A. G., Dalenogare, L. S., & Ayala, N. F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics*, *210*, 15–26.

Frank, A. G., Mendes, G. H. S., Ayala, N. F., & Ghezzi, A. (2019). Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective. *Technological Forecasting and Social Change*, *141*, 341–351. https://doi.org/10.1016/j.techfore.2019.01.014

Golzer, Ph., & Fritzsche, A. (2017). Data-driven operations management: Organisational implications of the digital transformation in industrial practice. *Production Planning & Control*, *28*(16), 1332–1343. https://doi.org/10.1080/09537287.2017.1375148

Gotz, M., & Jankowska, B. (2017). Clusters and Industry 4.0 – do they fit together? *European Planning Studies*, *25*(9), 1633–1653. https://doi.org/10.1080/09654313.2017.1327037

Guo, Y.-M., Huang, Z.-L., Guo, J., Li, H., Guo, X.-R., & Nkeli, M. J. (2019). Bibliometric Analysis on Smart Cities Research. *Sustainability*, *11*. https://doi.org/doi:10.3390/su11133606

Hansen, R., & Kien, S. (2015). Hummel's Digital Transformation Toward Omnichannel Retailing: Key Lessons Learned. *MIS Quarterly Executive*, *14*(2), 51–66.

Heilig, L., Schwarze, S., & Voß, S. (2017). *An Analysis of Digital Transformation in the History and Future of Modern Ports*. the 50th Hawaii International Conference on System Sciences. http://hdl.handle.net/10125/41313

Heslop, B. (2019). *A Brief History of Digital Transformation TRANSFORMATION*. https://www.contentstack.com/blog/all-about-headless/digital-transformation-history-infographic

Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016). Options for Formulating a Digital Transformation Strategy. *MIS Quarterly Executive*, *15*(2), 123–139. https://doi.org/DOI:10.7892/BORIS.105447

Hinings, B., Gegenhuber, T., & Greenwood, R. (2018). Digital innovation and transformation: An institutional perspective. *Information and Organization*, *28*, 52–61.

Jamrisko, M. (2020). *Bloomberg Innovation Index—Germany Breaks Korea's Six-Year Streak as Most Innovative Nation*. Bloomberg. https://www.bloomberg.com/news/articles/2020-01-18/germany-breaks-korea-s-six-year-streak-as-most-innovative-nation

Karimi, J., & Walter, Zh. (2015). The Role of Dynamic Capabilities in Responding to Digital Disruption: A Factor-Based Study of the Newspaper Industry. *Journal of Management Information Systems*, *32*(1), 39–81. https://doi.org/10.1080/07421222.2015.1029380

Kevin, Z., Dong, S., Xu, S., & Kraemer, K. L. (2006). Innovation diffusion in global contexts: Determinants of post-adoption digital transformation of European companies. *European Journal of Information Systems*, *15*(6), 601–616. https://doi.org/doi:10.1057/palgrave.ejis.3000650

Kotarba, M. (2018). DIGITAL TRANSFORMATION OF BUSINESS MODELS. *Foundations of Management*, *10*, 2080–7279. https://doi.org/10.2478/fman-2018-0011

Li, L., Su, F., Zhang, W., & Mao, J. (2017). Digital transformation by SME entrepreneurs: A capability perspective. *Information System Journal*, *28*(6), 1129–1157.

Liere-Netheler, K., Packmohr, S., & Vogelsang, K. (2018). *Drivers of Digital Transformation in Manufacturing*. the 51st Hawaii International Conference on System Sciences. https://doi.org/DOI: 10.24251/HICSS.2018.493

Lokuge, S., Sedera, D., Grover, V., & Xu, D. (2019). Organizational readiness for digital innovation: Development and empirical calibration of a construct. *Information & Management*, *56*, 445–461. https://doi.org/10.1016/j.im.2018.09.001

Matt, C., Hess, T., & Benlian, A. (2015). Digital Transformation Strategies. *Business & Information Systems Engineering*, *57*(5), 339–343.

National Strategies. (2019). German Digital Technologies. https://www.ki-strategie-deutschland.de/home.html

Papagiannidis, S., Harris, J., & Morton, D. (2020). WHO led the digital transformation of your company? A reflection of IT related challenges during the pandemic. *International Journal of Information Management*. https://doi.org/10.1016/j.ijinfomgt.2020.102166

Parviainen, P., Tihinen, M., Kääriäinen, J., & Teppola, S. (2017). Tackling the digitalization challenge: How to benefit from digitalization in practice. *International Journal of Information Systems and Project Management.*, *5*(1), 63–77. https://doi.org/DOI: 10.12821/ijispm050104.

Pinto, C. F., Serra, F. R., & Ferreira, M. P. (2014). A Bibliometric Study on Culture Research in International Business. *Brazilian Administration Review*, *11*(3), 340–363. https://doi.org/DOI: 10.1590/1807-7692bar2014309

Press, G. (2015). *A Very Short History of Digitization*. Forbes. https://www.forbes.com/sites/gilpress/2015/12/27/a-very-short-history-of-digitization/#44ce5dc649ac

Probst, L., Lefebvre, V., Martinez-Diaz, C., Unlu Bohn, N., PWC, Klitou, D., Conrads, J., & CARSA. (2018). *Digital Transformation Scoreboard- EU businesses go digital: Opportunities, outcomes and uptake*. European Union. DOI 10.2826/821639

Reis, J., Amorim, M., Melão, N., & Matos, P. (2018a). *Digital Transformation: A Literature Review and Guidelines for Future Research*. 411–421. https://doi.org/DOI: 10.1007/978-3-319-77703-0_41

Reis, J., Amorim, M., Melão, N., & Matos, P. (2018b). *Digital Transformation: A Literature Review and Guidelines for Future Research*. 411–421. https://doi.org/DOI: 10.1007/978-3-319-77703-0_41

Resego, M., Audrey, G., & Philip, O. (2017, June 18). *Conceptualizing Digital Transformation in Business Organizations: A Systematic Review of Literature*. 30th Bled eConference - Digital Transformation – From Connecting Things to Transforming Our Lives, Bled, Slovenia.

Rogers, D. (2016). *The Digital Transformation Playbook: Rethink Your Business for the Digital Age*. Columbia Business School Publishing.

Ross, J. W., Beath, C., & Mocker, M. (2019). *Designed for Digital How to Architect Your Business for Sustained Success*. Management on the Cutting Edge.

Sánchez, M. (2017). A framework to assess organizational readiness for the digital transformation. *Dimensión Empresarial*, *15*(2), 27–40. http://dx.doi.org/10.15665/rde.v15i2.976

Sánchez, M. A., & Zuntini, J. I. (2018). ORGANIZATIONAL READINESS FOR THE DIGITAL TRANSFORMATION: A CASE STUDY RESEARCH. *Revista Gestão & Tecnologia*, 70–99.

Schallmo, D., Williams, C. A., & Boardman, L. (2017). Digital Transformation of Business Models—Best Practice, Enablers, and Roadmap. *International Journal of Innovation Management*, *21*(8). https://doi.org/DOI: 10.1007/978-3-319-72844-5_2

Schroeck, M., Kwan, A., & Kawamura, J. (2019). Digital Transformation as a Path to Growth: Capturing New Market Oppurtunity. *Deloitte*. https://www2.deloitte.com/content/dam/insights/us/articles/6287_path-to-growth/DI_path-to-growth.pdf

Sebastian, I. M., Ross, J. W., Beath, C., Mocker, M., Moloney, K. G., & Fonstad, N. O. (2017). How Big Old Companies Navigate Digital Transformation. *Mis Quarterly Executive*, *16*(3), Article 3.

Singh, A., & Hess, T. (2017). How Chief Digital Officers Promote the Digital Transformation of their Companies. *MIS Quarterly Executive*, *16*(1), 1–17.

Spiridon, D., Marciniak, T., Novac, J., & Purta, M. (2018). *The rise of digital challengers: Perspective on Romania*. Mckinsey. https://www.mckinsey.com/featured-insights/europe/the-rise-of-digital-challengers-perspective-on-romania

Steiber, A., Al€ange, S., Ghosh, S., & Goncalves, D. (2020). Digital transformation of industrial firms: An innovation diffusion perspective. *European Journal of Innovation Management*. https://doi.org/DOI: 10.1108/EJIM-01-2020-0018

Storlterman, E., & Fors, A. (2004). Information technology and good life. *Information System Research: Relevant Theory and Informed Practice*, 687–692.

Tabrizi, B., Lam, E., Girard, K., & Irvin, V. (2019). Digital Transformation Is Not About Technology. *Harvard Business Review*, 118–144.

Teixeira, M. L. M., Midori Iwamoto, H., & Medeiros, A. L. (2013). Bibliometric Studies (?) in Business Administration: Discussing the Transposition of Purpos. *Administração: Ensino e Pesquisa*, *14(3)*, 423–452. https://doi.org/doi:https://doi.org/10.13058/raep.2013.v14n3.57

Thorniley, D. (2019). *DIGITAL TRANSFORMATION IN RUSSIA: KEEPING COMPETITIVE*. DT Global Business Consulting. https://www.bakermckenzie.com/-/media/files/insight/publications/2019/05/digital_transformation_in_russia_keeping_competitive.pdf?la=en#:~:text=Notwithstanding%20the%20impact%20of%20sanctions,own%20large%2C%20competitive%20digital%20players.

Trantopoulos, K., Krogh, G. von, Wallin, M. W., & Woerter, M. (2017). External knowledge and information technology: Implications for process innovation performance. *Mis Quarterly*, *41*(1), 287–300. https://doi.org/10.25300/MISQ/2017/41.1.15

ULAS, D. (2019). *Digital Transformation Process and SMEs*. *158*, 662–671. https://doi.org/10.1016/j.procs.2019.09.101

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*, 523–538.

van Nunen, K., Li, J., Reniers, G., & Ponnet, K. (2018). Bibliometric analysis of safety culture research. *Safety Science*, *108*(248–258). https://doi.org/DOI: 10.1016/j.ssci.2017.08.011

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *Journal of Strategic Information Systems*, *28*, 118–144. https://doi.org/10.1016/j.jsis.2019.01.003

Vogelsang, K., Liere-Netheler, K., Packmohr, S., & Hoppe, U. (2019). *A Taxonomy of Barriers to Digital Transformation*. 14th International Conference on Wirtschaftsinformatik,.

Yang, B., Li, H., Wu, M., & Zhang, R. (2013). A Novel Method for Camera Calibration Based on Micro Plane Grid. In S. Hu & X. Ye (Eds.), *2013 21st International Conference on Geoinformatics (geoinformatics)*. Ieee.

Zupic, I., & Čater, T. (2015). Bibliometric Methods in Management and Organization. *Organizational Research Methods*, 429–472.