



# Bibliometric Computational Mapping Analysis of Publications on Digital Transformation in Business Using VOSviewer

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## ABSTRACT

This study uses a bibliometric approach to computational mapping analysis with VOSviewer to look at the evolution of digital transformation research. The Google Scholar database was queried for the article data. The search is directed by using the keyword "Digital Transformation" in the article's title and abstract. There were 993 items that were deemed to be pertinent. The research period considered for the study is the most recent ten years of Google Scholar-indexed articles. The findings demonstrated that the terms "digital" and "digital transformation" can be used to categorize research on digital transformation. With a total link strength of 997, the word "digital transformation" is linked to by 63 different sources. The link strength of the word "Digital Transformation" is 4107 and it has 220 links. There were 993 items that were deemed to be pertinent. The research period considered for the study is the most recent ten years of Google Scholar-indexed articles (2012 to 2022). The findings demonstrated that the terms "digital" and "digital transformation" can be used to categorize research on digital transformation. With a total link strength of 997, the word "digital transformation" is linked to by 63 different sources. The link strength of the word "Digital Transformation" is 4107 and it has 220 links. The research of the growth of digital transformation publications machines over the past ten years reveals an annual increase. The results of this study will serve as a reference for further researchers in studying the topic of digital transformation.

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## 1. INTRODUCTION

Digital-Digitalization is an application of digitalization techniques as socio-technological process. Even so, people are used to using digital formats in various life processes such as social, economic and business to meet their needs and make their daily work easier (Bican & Brem, 2020). Digital transformation is about adopting disruptive technologies to increase productivity, value creation, and the social welfare. Many national governments, multilateral organizations, and industry associations have produced strategic-foresight studies to ground their long-term policies (Ebert & Duarte, 2016).

One analytical method, bibliometric analysis, can be used to assess the trajectory of research in the area of mechanical engineering education. Researchers can investigate bibliographic content and citation analysis from articles published in journals and other scientific papers with the help of bibliometric analysis, a type of meta-analysis of research data.

There have been many studies on bibliometric analysis, including bibliometrics analysis in social sciences (Pham-Duc et al., 2022), bibliometrics analysis in operation management (Dhamija & Bag, 2020), bibliometrics analysis in market research (Du et al., 2015), bibliometrics analysis in green innovation (Xu & Yu, 2019), bibliometrics analysis in big data research (Yin et al., 2018), bibliometrics analysis in smart home and internet of things (Choi et al., 2021), soil remediation (Mao et al., 2018), green evolution (Tan et al., 2021), food waste (Chen et al., 2017), social media (Noor et al., 2020), smart city (Mora et al., 2017).

However, there has not been any research on computational mapping of bibliometric analysis of published data in the subject of mechanical engineering education that has been done specifically to assess the direction of the research. especially through the VOSviewer application's bibliometric examination of research published in the previous ten years between the years 2012 and 2022.

As a result, this study used VOSviewer software to conduct computational research on mapping bibliometric analysis of publications indexed by Google Scholar. This study was undertaken with the hopes that it would serve as a guide for future studies and help researchers choose appropriate research themes, particularly for studies pertaining to the field of mechanical engineering education.

### 1.1 Theory

Digital transformation (DX) is the process of converting analog form to digital. The process of converting to digital is also called digitization. Digitization requires changes in the system that lead to a level of effectiveness and efficiency. The system in question can be a business system, a government system or a social system. Changes that lead to digitization will be a transformation for the system with the status quo. Digital transformation means changing the system to digital which brings benefits to stakeholders. In the business sector, digital transformation has an impact on changes in business activities such as in business models which include marketing, operational, financial management and human resource.

DX is anticipated to have rapid adoption and significant annual growth (According to H. Demirkan, 2016 to book *Digital Innovation and Strategic Transformation*). However, there are obstacles impeding its spread, including inadequate or excessively varied firm structures or cultures, a lack of DX strategy and ROI (return on investment) visibility, and even the idea

that new businesses are being eaten alive (According to C.M. Christensen, 2013 to book *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*). External obstacles include things like a lack of understanding of how DX can benefit everyone in society, a skills gap in the labor market, inadequate infrastructure, a lack of regulation and consumer protection, and difficult access to capital, especially for small and medium-sized firms.

Business activities will be considered more efficient in order to reaching Key Performance Indicators when implementing digitalization in business processes. One of the differences between start-ups and conventional companies lies in the business model. A successful start-up should have the right digital business model so that it meets consumer needs quickly and on target through databases and artificial intelligence that is applied to digital transforming in business systems.

## 2. METHODS

The research from articles that were published in journals that were indexed by Google Scholar served as the basis for the article data used in this study. In this study, we chose Google Scholar because its database is an open source. A management reference tool called Publish or Perish was employed to gather study data. A literature review on the subject we chose was done with the help of the program Publish or Perish.

The research was conducted in stages, including:

- i. utilizing the publish or perish program to gather publication data
- ii. processing of article bibliometric data collected using the Microsoft Excel application
- iii. using the VOSviewer application, computational mapping analysis of bibliometric publication data, and
- iv. analysis of the findings of computational mapping analysis

Publish or Perish's article data search is used to filter publications using the keyword "digital transformation" based on the title criteria of the publications. The papers that were used were released between 2012 and 2022. Everything was collected in September 2022. Research information system (.ris) and comma separated value (\*.csv) files were used to export the articles that were gathered and met the requirements for analysis in this study. Bibliometric maps were also employed with VOSviewer to examine and assess trends. After that, the article data from the original database was mapped.

Utilizing network visualization, density visualization, and overlay visualizations based on the network (co-citation) between existing items, VOSviewer was used to produce several mapping publications. The frequency of a keyword was specified to be found at least five times while constructing a bibliometric map. As a result, 222 phrases and keywords that were found to be less important were eliminated.

## 3. RESULTS AND DISCUSSION

### 3.1 Publication Data Search Result

Based on the data search, 993 data articles that fit the criteria for the research were found utilizing the application reference manager publish or perish data search. The information was gathered in the form of metadata, which included the name, title, year, journal name, publisher, citation count, article links, and associated URLs for each author. In the VOSviewer examination of this study, several samples of published data are shown in Table 1. The 20 top publications with the most citations were used as the data samples. The

average author of the articles used is 2.46, the average number of citations per article is 73.56, the average number of citations per year is 7304.70, and the average number of citations per article is 73047. Additionally, the average h-index for all the articles is 130, and the average g-index is 237.

**Table 1.** Bibliography paper sequenced by highest to lowest its citation

Authors	Title	Year	Cites
LD Xu, EL Xu, L Li	Industry 4.0: state of the art and future trends	2018	2146
NJ Foss, T Saebi	Fifteen years of research on business model innovation: How far have we come, and where should we go?	2017	1717
S Saberi, M Kouhizadeh, J Sarkis...	Blockchain technology and its relationships to sustainable supply chain management	2019	1639
N Donthu, A Gustafsson	Effects of COVID-19 on business and research	2020	1455
S Erevelles, N Fukawa, L Swayne	Big Data consumer analytics and the transformation of marketing	2016	1256
E Oztemel, S Gursev	Literature review of Industry 4.0 and related technologies	2020	1106
C Loebbecke, A Picot	Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda	2015	1020
PC Verhoef, T Broekhuizen, Y Bart...	Digital transformation: A multidisciplinary reflection and research agenda	2021	982
P Parviainen, M Tihinen, J Kääriäinen...	Tackling the digitalization challenge: how to benefit from digitalization in practice	2017	936
A Moeuf, R Pellerin, S Lamouri...	The industrial management of SMEs in the era of Industry 4.0	2018	837
P Gomber, RJ Kauffman, C Parker...	On the fintech revolution: Interpreting the forces of innovation, disruption, and transformation in financial services	2018	801

P Gomber, JA Koch, M Siering	Digital Finance and FinTech: current research and future research directions	2017	800
E Autio, S Nambisan, LDW Thomas...	Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems	2018	770
V Alcácer, V Cruz-Machado	Scanning the industry 4.0: A literature review on technologies for manufacturing systems	2019	759
N livari, S Sharma, L Ventä-Olkkone n	Digital transformation of everyday life—How COVID-19 pandemic transformed the basic education of the young generation and why information management ...	2020	710
K Storbacka, RJ Brodie, T Böhmman, PP Maglio...	Actor engagement as a microfoundation for value co-creation	2016	684
YK Dwivedi, DL Hughes, C Coombs...	Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life	2020	673
J Karimi, Z Walter	The role of dynamic capabilities in responding to digital disruption: A factor-based study of the newspaper industry	2015	653
M Rachinger, R Rauter, C Müller...	Digitalization and its influence on business model innovation	2018	646
M Ghobakhloo	Industry 4.0, digitization, and opportunities for sustainability	2020	582

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### 3.2 Publication Data Search Result

Figure 1 displays the evolution of research on the topic of digital transformation that has been published in a journal that is indexed by Google Scholar. Based on the information, it is clear that 993 publications related to digital transformation research were published between 2012 and 2022. There were 4 articles in 2012. There were 3 articles in 2013. There were 10 articles in 2014. There were 16 articles in 2015. There were 25 articles in 2016. 2017 saw 63 papers published. 2018 saw 127 articles published. There were 157 articles published in 2019, 238 articles in 2020, 253 articles in 2021, and 95 articles in 2022. It is clear from the number of publications that research on digital transformation was less common between 2012 and 2017 and more prevalent between 2018 and 2022. Its growth continues to accelerate from year to year.



**Figure 1.** Level of Development in Digital Transformation research.

### 3.3 Visualization digital transformation topic area using VOSviewer

The data from the article was subjected to computational mapping. Computational mapping makes use of VOSviewer. 222 objects were discovered from the computational mapping findings. Data mapping divides each thing relevant to digital transformation into 8 clusters, including:

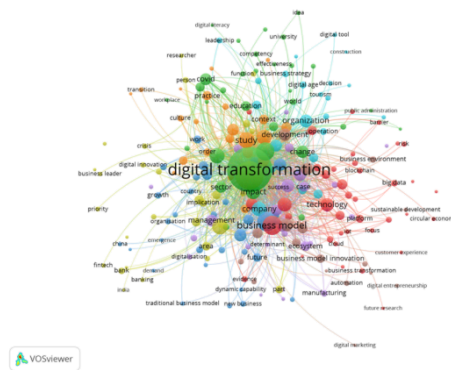
- i. Cluster 1 has 31 items and marked in analytic, application, barrier, big data, blockchain, blockchain technology, business analytic, business model, business transformation, business world, circular economy, cloud, cloud computing, concept, customer experience, digital transformation trend, digital world, era, evidence, focus, framework, future research, goal, information technology, internet, IoT, literature review, marketing, opportunity, platform, research, research interest, risk, supply chain, supply chain management, sustainability, systematic literature review, technology and trend.
- ii. Cluster 2 has 33 items and marked in Challenges, change, competency, covid, digital, digital economy, digital government, digital literacy, digital transformation, education, effectiveness, employee, fourth industrial revolution, function, government, higher education, higher education institution, idea, impact, institution, integration, pandemic, problem, process, prospect, public administration, resource, sector, structure, transformation, university, workplace and world.
- iii. Cluster 3 has 32 items and marked in Age, benefit, capability, challenge, china, country, customer, demand, digital business model, digital disruption, digization, driver, dynamic capability, economy, emergence, factor, field, future, growth,

industry, influence, innovation, innovative business, market, new business, new technology, organization, policy, society, traditional business model, value chain and work.

- iv. Cluster 4 has 29 items and marked in red, the 29 items are area, artificial intelligence, bank, banking, banking sector, business, business leader, business value, case study, consumer, creation, crisis, current digital transformation, digital ecosystem, digital era, digital innovation, digital technology, digital transformation, entrepreneurship, fintech, implication, india, literature, manager organization transformation, part, person, priority and researcher.
- v. Cluster 5 has 26 items and marked in green, the 29 items are analysis, case, determinant, digital maturity, digital platform, digital servitization, digital supply chain, digital transformation era, digital transformation initiative, digital transformation project, digital transformation strategy, digitalization, ecosystem, environment, firm, implementation, information, international business, level, management, manufacturing, performance, quality, review, success and system.
- vi. Cluster 6 has 23 items and marked in blue, the 23 items are business strategy, collaboration, company, construction, decision, digital age, digital business, digital business strategy, digital leader, digital leadership, digital tool, insight, knowledge, leadership, need, new business model, operation, organization, solution, successful digital transformation, tourism and way.
- vii. Cluster 7 has 22 items and marked in orange, the 22 items are adoption, approach, art, business process management, context, culture, dynamic, effect, enterprise, Europe, evolution, healthcare, model, order, paper, practice, role, SMEs, state, study, theory and transition.
- viii. Cluster 8 has 18 items and marked in chocolate, the 18 items are automation, business environment, business function, business model innovation, business process, development, digital entrepreneurship, digital marketing, digitalization, disruption, infrastructure, ongoing digital transformation, product, perspective, service, sustainable development, value and value creation.

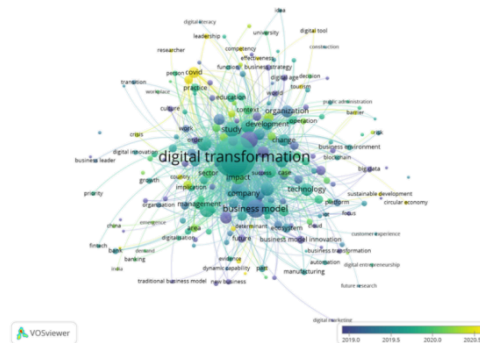
Each existing cluster demonstrates the connections between individual phrases. A colored circle denotes the label for each phrase. The size of the circle varies for each term depending on its frequency. The label circle's size is positively correlated with how frequently the term is used in the abstract and title. As the word is used more often, the label size grows. The mapping visualization that was looked at in this study consists of three elements: network visualization (see Fig. 2), density visualization (see Fig. 3), and overlay visualization (see Fig. 4).





**Figure 2.** Network visualization of digital transformation keyword.

Figure 2 illustrates the connection between the ideas. The link between terms is depicted as an interconnected network. Each area that is often researched and related to the study of digital transformation is clustered together in Figure 2. The clusters in the network visualization show that there are two main areas of research into digital transformation.



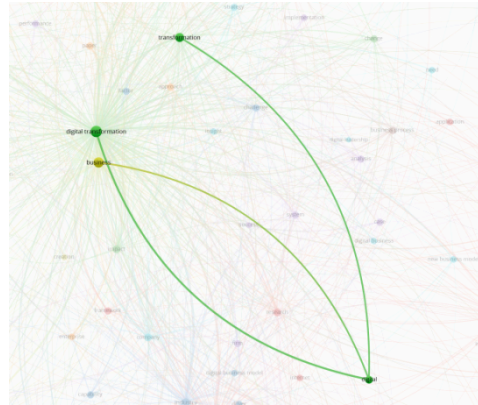
**Figure 3.** Network visualization of digital transformation keyword.



**Figure 4.** Network visualization of digital transformation keyword.

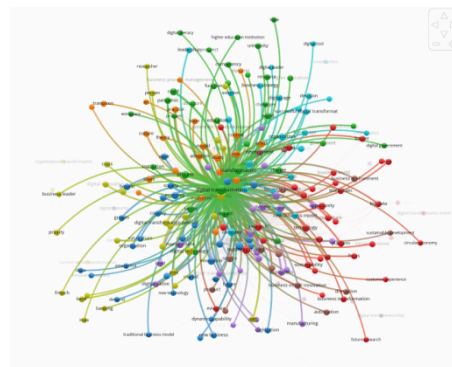
The depiction of density is shown in Figure 3. According to density visualization, a phrase will occur more frequently the yellow color is brighter and the circle that contains its labels is larger in diameter. This indicates that extensive research has been done on the subject. In contrast, there aren't many research on the term if the color of the term fades close to the color of the background. According to Fig. 3, there have been a lot of studies done on the topics of digital transformation, business models, technology, and company changes.





**Figure 5.** Network visualization of digital term.

The first of these is the digital term, which is included in cluster 2 and has 63 total links, 97 total link strength, and 18 occurrences (see Fig. 5). The second term, "digital transformation," is a part of cluster 2, with 773 occurrences, 220 total linkages, and a total link strength of 4107.



**Figure 6.** Network visualization of digital transformation term.

The overlay visualization used in studies on digital transformation is shown in Figure 4. This overlaying graphic demonstrates the uniqueness of research on linked terms. Figure 4, which is made clear in Figure 6, demonstrates that the majority of the study on digital transformation was done from 2019 to 2020. The term "digital transformation" has reached the height of its use in research. As a result, conducting fresh research on digital transformation is simple.

Figure 5 depicts a network of concepts related to digital, including business, transformation, and digital. Figure 6 depicts the network of connections between existing concepts and the digital transformation, including management, process, impact, business process, business model, system, society, economy, sector, adoption, and innovation.

The mapping of the data from the articles that were collected shows that the keyword "digital transformation" has been the subject of the most investigation. The majority of studies have referenced digital transformation or related disciplines. We can seek for more recent and relevant research on digital transformation in the current year based on the findings of this study.

#### 4. CONCLUSION

This study examines the development of digital transformation research using a bibliometric approach to computational mapping analysis with VOSviewer. For the article data, the Google Scholar database was searched using the publish or perish reference manager tool. The article's title and abstract contain the keyword "Digital Transformation," which guides the search. The 993 things that were determined to be relevant totaled 993. The most recent 10 years' worth of Google Scholar-indexed articles are the research era taken into account for the study (2012 to 2022). The results showed that research on digital transformation may be categorized using the terms "digital" and "digital transformation." The term "digital transformation" is connected to by 63 different sources, with a total link strength of 997. With 220 links, the term "Digital Transformation" has a link strength of 4107. A ten-year study of the development of digital transformation publishes machinery demonstrates a yearly growth. 993 elements were determined to be relevant in total. The last 10 years' worth of publications that Google Scholar has indexes are the research era taken into account for the study (2012 to 2022). The results showed that the categories of "digital" and "digital transformation" can be utilized to classify research on digital transformation. The word "digital transformation" is connected to by 63 different sources, totaling 997 links. The term "Digital Transformation" has 220 links and a link strength of 4107. There has been a yearly growth in digital transformation publications machinery, according to studies on the subject during the previous ten years. The findings of this study will be used as a guide by other researchers who are researching the subject of digital transformation.

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