Trends in IT Strategy Implementation: A Systematic Review Across Education and Industry (2000–2022)

Varuliantor Dear[1,2] , Nandang Dedi[2] , Annis Siradj Mardiani[2] , Heru Nugroho[3*]

[1] School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung 40116, Indonesia
[2] Space Research Center, National Research and Innovation Agency, Bandung 40135, Indonesia
[3] School of Applied Science, Telkom University, Bandung 40257, Indonesia

Corresponding Author Email: heru@tass.telkomuniversity.ac.id

ABSTRACT

The rapid and global development of digital technology or digital transformation has encouraged various business sectors to adapt to the field of information technology. The education and industrial sectors are interrelated and need to adapt to developments in digital technology where the eduacton sector is the supplieer of human resources and the industrial sector is one of the purposes of the education sector. The balancing prepareness of thos both sector on IT starategy whoulld be conducted for the optimum of busnis process otuput. One of the indicators of the digital transformation adaptation process is the implementation of the information technology (IT) strategy plan. In this paper, a bibliometric analysis is carried out from database Scopus on IT strategy implementation in the industry and education sectors published within the last two decades to get an overview of the responses of these two sectors to the dynamics of digital transformation. Bibliometric analysis" refers to the quantitative assessment of scholarly publications and research activities within a specific field or discipline. The analysis is based on the papers' growth trends and the thematic maps' evolution over each decade. The compilation comprises a total of 41 journals and 23 proceedings. To enhance our comprehension of thematic evolution, the two articles have been categorized into distinct decade periods: 2000–2010 and 2010–2022. The results show that the industrial sector has more publications with an earlier productivity peak than the education sector. The peak productivity of paper in the two sectors occurred before the COVID-19 pandemic. The productivity rate of papers during and after the COVID-19 pandemic was at a reasonably low value, which can be interpreted as an indicator of readiness for the pandemic events that occurred and their effects. The distribution of the thematic maps of the two sectors is different, with the industrial sector having more variables than the education sector. Industrial thematic objects are scattered in all quadrants, while the education sector has been concentrated in quadrants 2 and 3 in the last decade. The thematic objective's distribution indicates the dynamics of the challenges in implementing the information technology strategy for both sectors over the next two decades.

1. INTRODUCTION

Industry must overcome several technical issues to deliver renewable energy in significant quantities. Control is one of the key enabling technologies for the deployment of renewable energy systems. Solar and wind power require the effective use of advanced control techniques. In addition, smart grids cannot be achieved without extensive use of control technologies at all levels.

The rapid development of digital technology demands an adaptation of digital transformation in various business sectors [1-7]. This needs to be done to maintain the continuity of business processes and survive the dynamics of changes that occur. Furthermore, the COVID-19 pandemic phase, which had an impact on drastic and global changes in various activities, forced the adaptation process to the development of

digital technology to be carried out more quickly [8-10]. During the COVID-19 pandemic phases, all sectors were forced to adopt digital transformation to maintain their business process due to the limitation of physical interaction.

The education sector and the industrial sector have a reasonably close relationship. The education sector is the central pillar that produces the human resources that the industrial sector needs [11]. For the education sector to produce adequate human resources in the industrial sector, adaptation to changes in information technology is a must, both in business processes and in the substance of education [12]. The inability to adapt to the developments in information technology implies that the output products from the education sector do not meet the qualifications needed in the industrial sector. On the other hand, the industrial sector cannot adapt to developments in information technology, causing business

processes not to run correctly and implying the capability to survive the changes that occur even though supported by competent human resources [13-15]. Therefore, the education and industrial sectors need to adopt digital technology developments in line with the changes occurring to obtain balance and synergy. Adoption of digital technology between the two sectors or one sector will result in disharmony in the output relations between both sectors. Therefore, information on digital technology adaptation from the educational and industrial sectors will be useful for evaluating current conditions. The application of Information Technology (IT) strategies, in education and industry is extremely important in todays world. This is because technology is advancing rapidly and causing changes across sectors. By understanding the reasons and motivations behind implementing IT strategies we can gain insights, into how these fields are evolving.

One indication of the adaptation process of information technology development dynamics in business processes is the implementation of an information technology (IT) strategy [16-19]. The implementation of the information technology strategy is a sign and direction of the process of adapting the development of information technology systematically and measurably. To see global trends in awareness of the industry and education sectors, one of the analytical metrics that can be used is to look at the productivity of publications that discuss these topics [20]. Studying the implementation of IT strategy, in both education and industry holds importance for reasons. Firstly it allows researchers and professionals to understand the approaches and potential challenges that come with adopting IT in contexts. Secondly it provides a foundation for creating policies and frameworks that can guide successful integration of IT. Thirdly gaining insights into the implementation of IT strategy contributes to building a workforce of utilizing the advantages offered by emerging technologies. In essence studying IT strategy in education and industry plays a role, in shaping a future where technology empowers us drives innovation and ensures growth in the global knowledge economy.

The main contribution of this paper is a systematic literature review of the implementation of information and technology strategy in the industrial and education sectors based on the number of publications available over the past two decades. To the best of our knowledge, the paper that discusses the trend of IT strategy implementation in the educational sector together with the industrial sector using bibliometric analyses could not be found. There are only some papers that discuss the implementation of IT strategy partially in the educational and industrial sectors which are also used as databases in this study [10-15]. This study aims to determine trends in utilizing information technology strategies, which indicate the response of information technology development to business process activities. Analysis was carried out using the bibliometric method to answer the following research questions (RQ):

- **RQ-1.** Research trends in information technology strategy implementation from both sectors within the next 20 years
- **RQ-2.** The implementation of the information technology strategy after the COVID-19 pandemic is an indication of the response of the two sectors.
- **RQ-3.** object priority of the information technology strategy's implementation and its evolution.

To get a comprehensive description, the structure of this paper is written as follows: Chapter 2 briefly describes the information technology strategy. In Chapter 3, data and methodology are presented. In Chapter 4, the results obtained, and their discussion are presented. In the last chapter, the conclusions of this paper are presented.

2. INFORMATION TECHNOLOGY STRATEGY

Informa Information technology strategy is the initial step of an organization's or company's awareness response following the development of digital technology or digital transformation [21-25]. The information technology strategy aims to optimize the functions and roles of the information technology division in the business process activities of a company or organization. Furthermore, the information technology strategy is also expected to provide added value through the resulting business products. It is even likely to be able to become the initiator of business product expansion. Without an information technology strategy, the very rapid adaptation of digital transformation has the potential to not be followed correctly, so it can disrupt existing business processes. The steps in the information technology strategy are divided into three stages, namely:

(1) Review and evaluate the current condition of the information technology division based on business objectives.

(2) Preparation of an information technology strategy in accordance with business processes based on the results of the gaps at the review stage, and

(3) Management and implementation of information technology strategy, which is structured as a form of digital transformation

Documents such as COBIT 5 [19] and TOGAF [21] are available to develop an IT strategy. The document can be a guide that can be adapted to the challenges and uniqueness of each form of business. COBIT is a framework specifically designed to help organizations govern and manage their information and technology processes. In the context of IT strategy, COBIT provides a set of guidelines and best practices for aligning IT goals with business objectives. It ensures that IT activities support the organization's overall strategy and that risks are effectively managed. TOGAF is an enterprise architecture methodology and framework used to improve business efficiency. In the context of IT strategy, TOGAF provides a structured approach to creating and implementing an enterprise architecture that supports the organization's objectives.
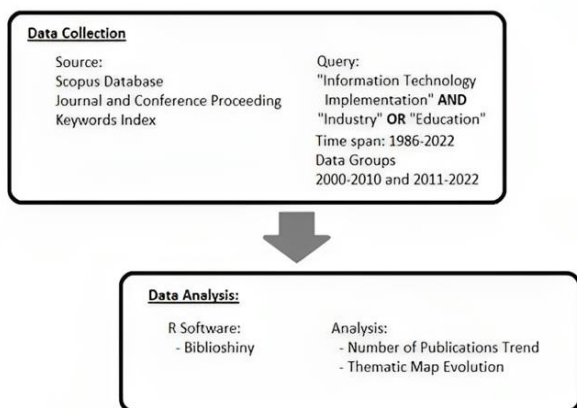
In education, strategy formulation extends beyond technology adoption; it involves crafting a comprehensive plan for integrating technology into the curriculum. This includes defining objectives for enhancing student engagement, improving assessment methods through technology, and providing professional development for educators to effectively leverage new tools. Strategies could also focus on fostering a technology-driven learning environment that prepares students for the digital challenges they will face in the workforce. The strategy formulation stage in industry involves creating a roadmap for adopting and leveraging technology to optimize operations, improve efficiency, and gain a competitive edge. This could include defining how data analytics will be used to inform decision-making in manufacturing processes or developing a cybersecurity strategy to protect sensitive information. The formulation process is industry-specific, considering the unique demands and goals of the sector.

However, challenges in implementing IT strategies have

also evolved along with information and communication technology development dynamics. One indicator that can be used to view these dynamics is the growth of papers discussing implementing IT strategies in the public domain [20]. These papers' development reflects how IT strategy implementation trends are applied to various sectors. In the education sector, effective IT strategy implementation is imperative for adapting to the evolving landscape of learning technologies. In the industrial sector, where technology is integral to operational efficiency and innovation, the stages of IT strategy implementation follow a strategic trajectory. In both education and industry, the stages of IT strategy implementation are tailored to the specific challenges and objectives of each sector. Successful implementation ensures that IT initiatives not only align with strategic goals but also contribute significantly to the advancement and competitiveness of the respective domains.

3. RESEARCH METHODOLOGY

The framework for the study's examination of the published articles is shown in Figure 1, and it comprises of two stages of work: data collecting and data analysis. Finding pertinent articles and extracting useful data are the first steps in the process. The gathered data is next carefully examined and categorized in accordance with predetermined criteria. A thorough examination of the retrieved data is then conducted to find patterns, trends, and linkages.

Data Collection

Source:
Scopus Database
Journal and Conference Proceeding
Keywords Index

Query:
"Information Technology Implementation" **AND** "Industry" **OR** "Education"
Time span: 1986-2022
Data Groups
2000-2010 and 2011-2022

Data Analysis:

R Software:
- Biblioshiny

Analysis:
- Number of Publications Trend
- Thematic Map Evolution

Figure 1. Framework for data colleting and analysis process

3.1 Data collection

The first stage, namely data collection, was carried out based on the keywords "information technology implementation" and "industry" used in search queries on the Scopus website database to obtain articles on information technology implementation in the industrial sector. Meanwhile, to get reports on implementing information technology in the education sector, the keywords used are "information technology implementation" and "education." Keywords are based on the objectives of the study and are taken from keywords that are widely used in previous studies. The Scopus database contains various types of documents. Still, in this study, the papers used are limited by the kind of journal and proceedings used to understand the data better. The use of the journal paper as a database is based on the peer review process, which guarantees the data is valid. Meanwhile,

the use of the conference paper was based on the consideration of scientific promotion phases in the academic public domain, although without a tight peer review process as in the journal paper. Utilizing sources beyond the two categories of publications as databases is aimed at circumventing the inclusion of unverified material.

The number of publications obtained for the industrial sector consists of 28 journals and 17 proceedings. At the same time, the number of publications obtained for the education sector consisted of 13 journals and five proceedings. The total of all documents is 41 journals and 23 proceedings. To understand thematic evolution better, the two articles are divided into two decade periods, namely the 2000–2010 and 2010–2022 groups.

3.2 Data analysis

Data analysis was performed using the Bibliometric analysis tools provided by Aria and Cuccurullo [26]. Bibliometric is a method used to measure and evaluate published results [27]. There are two methods of bibliometric principles for analyzing and evaluating a research activity, namely performance analysis and scientific mapping [28]. The performance analysis aims to assess the research implementing group, such as personnel, countries, agencies, and the impact of the research activities. Meanwhile, the scientific mapping method aims to find information precisely from the conceptual structure of research themes [29]. In this study, a general analysis was carried out to see the growth in the number of publications, and the scientific mapping method was used to see the thematic changes in the publication of papers in the industrial and educational sectors.

4. RESULT DAN DISCUSSION

Despite occurring during the COVID-19 pandemic, the number of publications tended to be stable and decline after the growth peak. The results also show that the object of the IT priority implementation strategy in the industrial sector has more variables than the education sector. The evolution of thematic objects from the two sectors is also different; the industrial sector looks more dynamic than the education sector. Figure 2 presents the number of publications with the keywords "information technology strategy implementation" produced in 2000–2022. The productivity rate of articles in the industrial sector has been higher than in the education sector since 2000. The industrial sector has experienced a significant increase in articles from 2011 to 2015. However, publications produced from 2015 to 2018 have a downward trend, whereas in 2018, no publications were generated. In the early phase of the COVID-19 pandemic in 2019, IT strategy publications in the industrial sector remained unchanged from 2018, but in 2020, IT strategy publications began to appear and persist in one paper per year until 2022. The trend in the number of papers is thought to be influenced by many factors, one of which is the readiness of the industrial sector since 2011, so that during the pandemic period, the industrial industry was ready and only required adjustments. In 2012, the industrial sector can also be affected by global social issues that affect preparation from aspects of information and communication technology, such as the 2012 doomsday issue [30].

In the education sector, the growth rate of IT strategy implementation publications is quite different from that in the

industrial sector. From 2000 to 2016, the publications produced had the highest score of 2 and tended to average 1 publication per year. In 2017, there was an increase in publications, which reached three articles, but in the following year, the value decreased again, with one publication per year. No publications were produced during the initial period of the COVID-19 pandemic until 2021. However, in 2022, there will be one IT strategy publication in the education sector. The growth trend of publications in the education sector, which tends not to change and is at a low level, is thought to be caused by several factors, including (i) the implementation of the IT strategy in the education sector, which has been prepared with the development of information and communication technology since 2017, or (ii) the unaffected educational business processes from the dynamics of IT technology development. The trend in the number of publications obtained in the past twenty years indicates that awareness of IT strategy implementation in the two sectors has a different period, where the industrial sector is earlier than the education sector.

Figure 3 presents a thematic map of the IT strategy implementation research in the Industrial sector, which can be used to identify the priority classification of the object. The priority object of IT strategy implementation in the industrial sector leads to Business Analysis Activities, Data warehouse, Information Technology, Information Services, Company and, Budget control which in the Quadrant-1 group (Q1). In Quadrant-2 (Q2), which is a group that has not yet been developed but is a priority centralization, the object activities are leading to Management information system activities, Strategic planning, Industrial construction, Decision making, and Human resource management. In Quadrant 3 (Q3), namely, objects that are not a priority or principal and have been developed consisting of electronic mail, IT strategy, and Hardware. Several objects from the Q3 group also overlap with the Q1 group, meaning these components have been and are still being developed. In Quadrant 4 (Q4), which is not major and not developed, there are components of outsourcing and computer software.

Along with the dynamics that have occurred in 20 years, the evolution of thematic maps can also occur. In Figure 4, a comparison of the Thematic maps of Information Technology Strategy implementation research in two different decades is presented. In the first decade, from 2000 to 2010, the components in Quadrant 1 include Information Technology Strategy, Budget control, and Company resource planning. In the first decade phase, there were two activity objects that

intersected between Quadrant 2 and Quadrant 3. However, in the following decade, the subject of activity from the intersection of the two quadrant groups evolved totally into Quadrant 1, which means that the object becomes important and stated as a priority objective to do. In addition to shifting to Quadrant 1, there is also a shift in activity subject to Quadrant 4, which means that the object is no longer needed and is not a priority. The evolution of thematic maps over the past two decades is an indication that there are dynamics in the implementation of the Information Technology Strategy.

Figure 5 presents a thematic map of IT strategy implementation research in the education sector. The main focus and priority of the IT strategy implementation paper in the education sector consists of information technology, curriculum, and engineering research, which are in Quadrant 1. Meanwhile, in Quadrant 2, the activity object that is a priority but has not yet been developed and needs to be developed is the information system. Quadrant 3 consists of personal objects and the Internet, which are not priorities but have been developed. In Quadrant 4, personal training is the object activity that does not need to be developed because it is not the primary object. The thematic map of the education sector looks more straightforward than that of the industrial sector, which is thought to be caused by differences in core business values. In the education sector, the product is to produce human resources, so the primary focus is on the curriculum to improve human or personnel competence. Those primary focuses differ in the industrial sector, where the products are in the form of goods or services and many objects are prioritized to be developed.
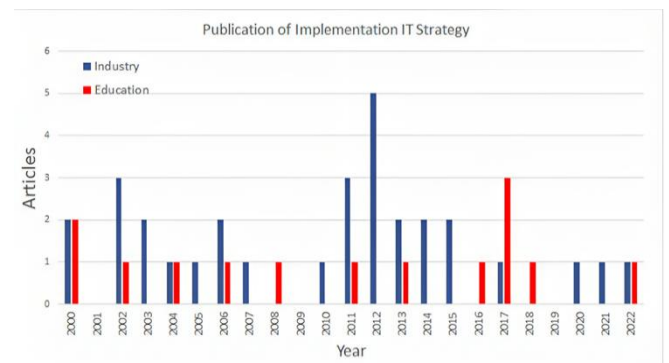

Figure 2. Number of publication of implementation of IT strategy in industrial and education sector from 2000 to 2022
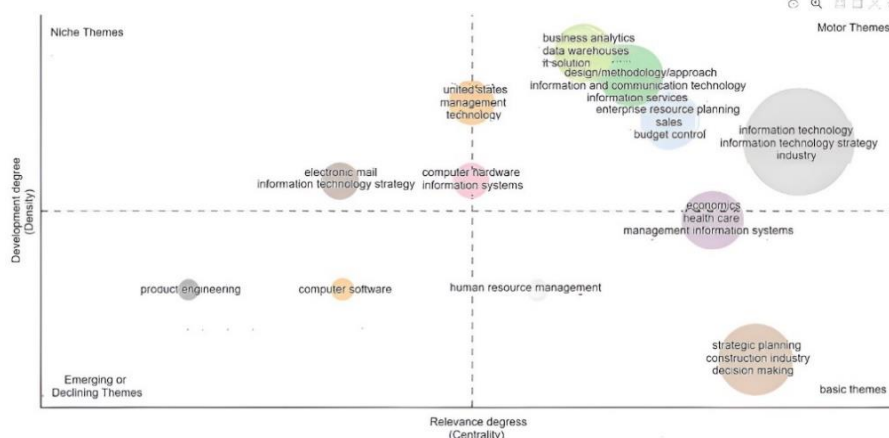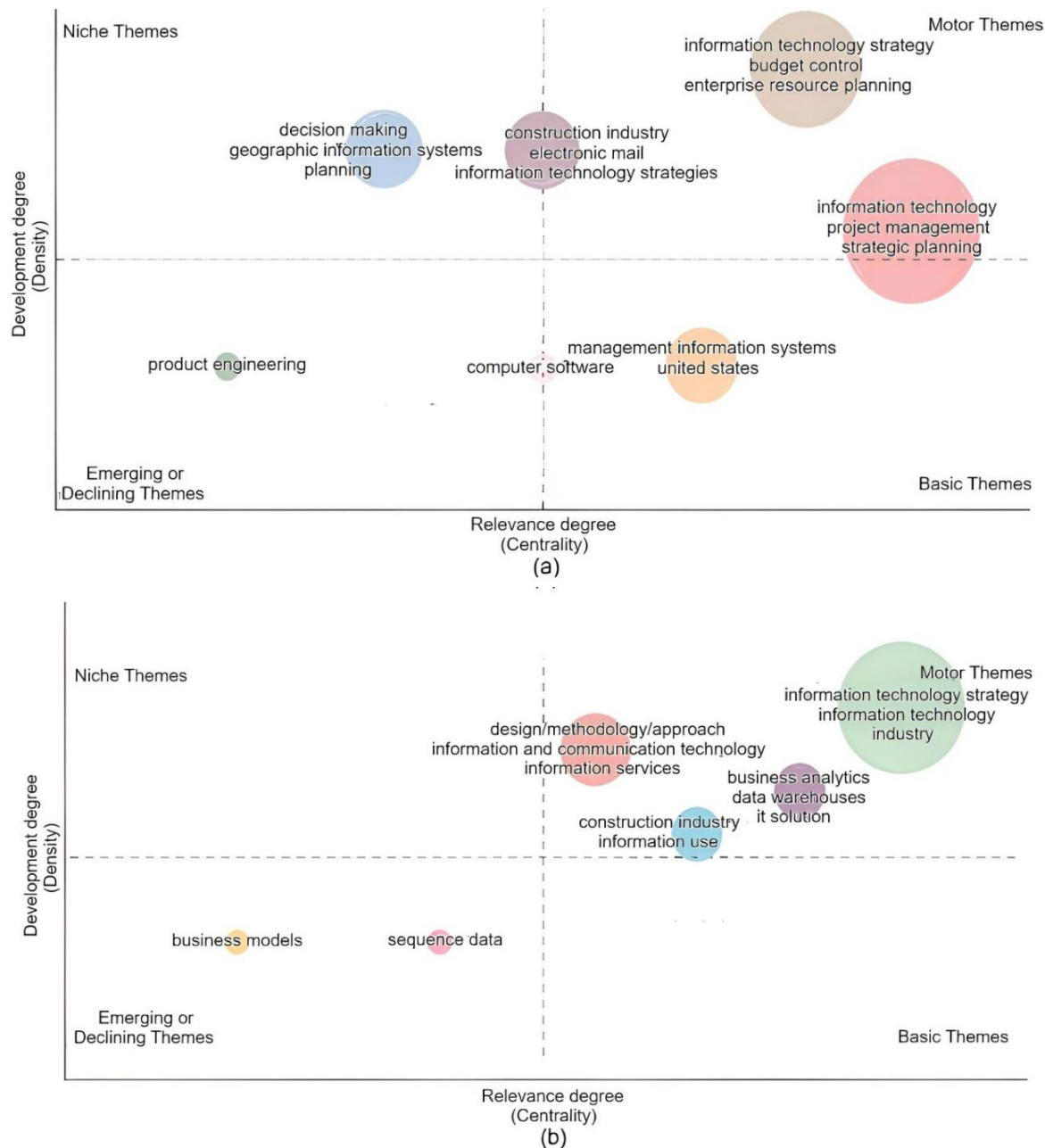

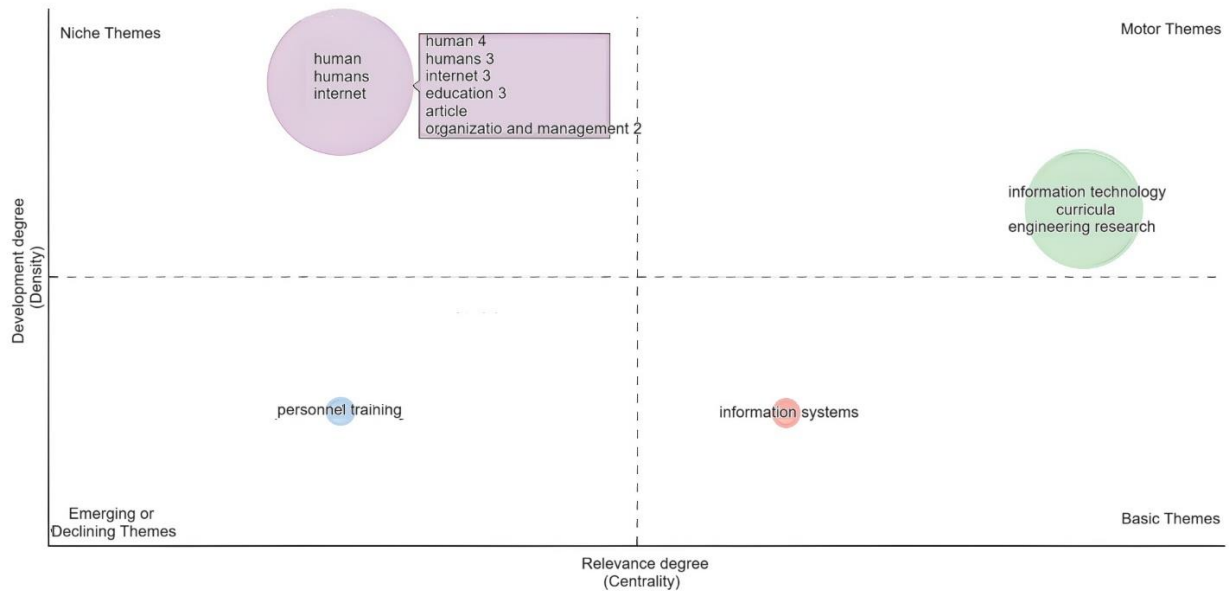**Figure 3.** Thematic map of implementation information and technology strategy in industrial sector

Figure 4. Evolution of thematic map in indusrial sector from (a) 2000-2010 and (b) 2011-2020

Figure 6 presents a thematic map of two different time-decade groups in the paper on the implementation of IT strategies in the education sector. In the early decades, research subjects were distributed in Quadrant 2 and Quadrant 3. However, the research subjects shifted in the next decade to become part of Quadrant 1 and Quadrant 4. Subjects in Quadrant 1 in the second decade only consisted of information technology and curriculum that shifted from Quadrant 3. While objects that are in Quadrant 4 in the second decade consist of humans, which are the contents of Quadrant 2 in the first decade. Based on this thematic evolution, the education sector has a relatively small IT strategic priority.

Figure 7 presents an analysis of multiple correspondence analysis (MCA) from papers on the implementation of IT strategies in the industrial sector and the education sector. MCA reflecting the aspect or parts that focused to be analysed which reveal what points that focused. Comparing two eperiod of MCA anayls will reveal the key points or concern of the

problems in IT startegy implementation in both sectors.In the industrial sector, the MCA analysis obtained shows that there are two main groups of keywords, namely information systems and information services. The information system keyword group dominates the similarity of the concepts in each paper. Meanwhile, the "information services" keyword group was only found in a few papers. The distribution of the similarity of concepts based on these keywords shows that the objects in the implementation of strategies in the industrial sector are quite varied. MCA in the education sector shows different results; namely, there is only a single group of related keywords in all the papers used. The distribution of the objects in the group is not widespread, which means that the object variants are not sufficiently developed. The results of the MCA analysis in the two sectors reflect how the trends in information technology implementation have changed in the last two decades.

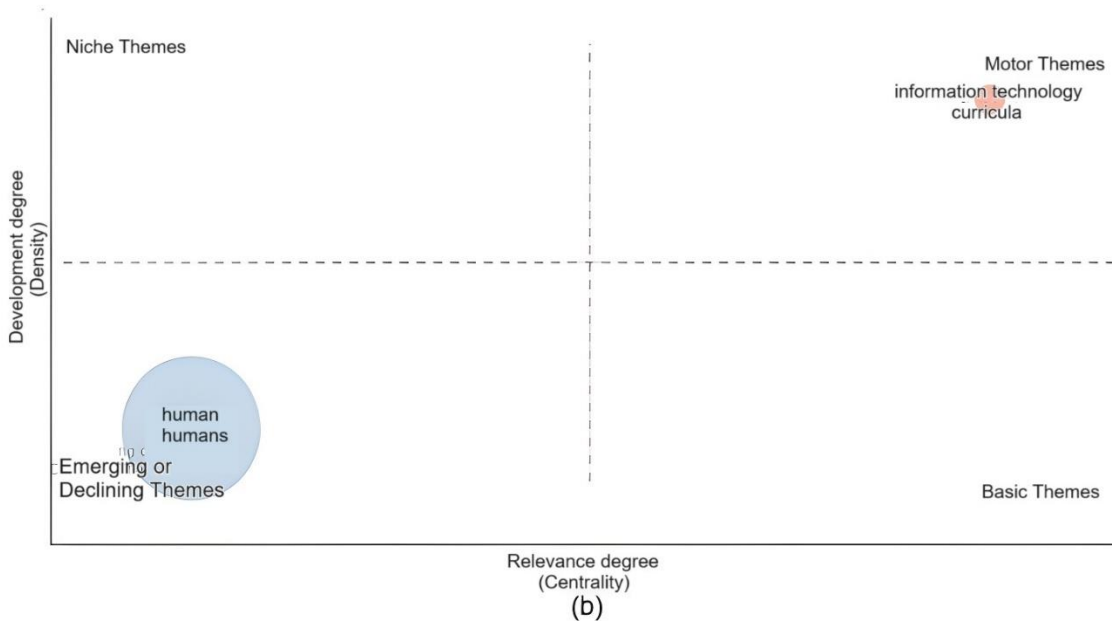**Figure 5.** Thematic map of implementation information and technology strategy in education sector

(a)

(b)
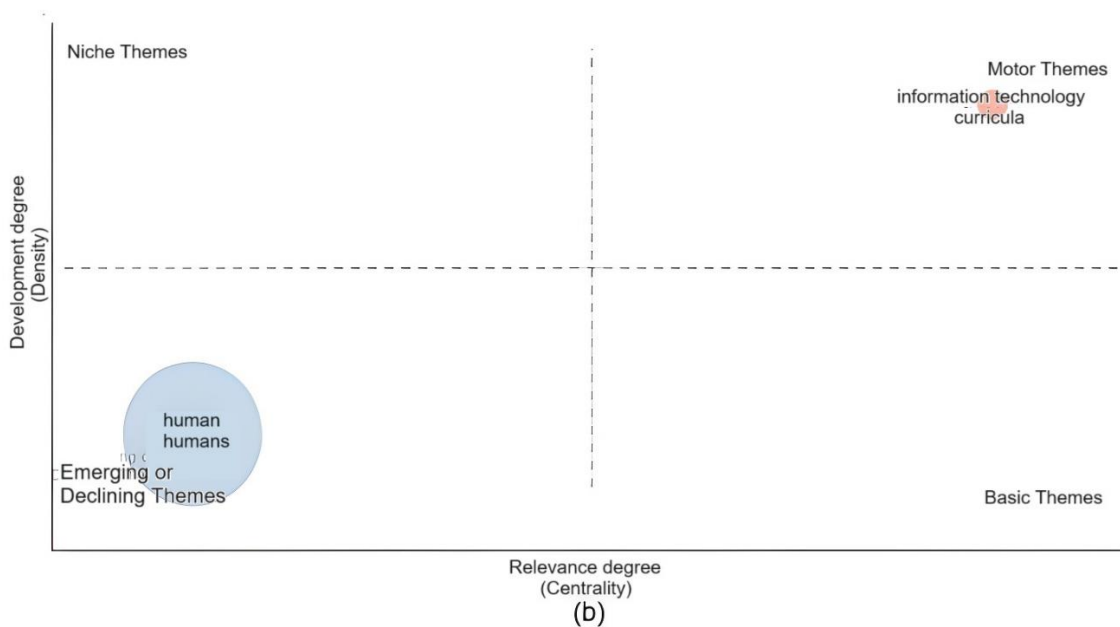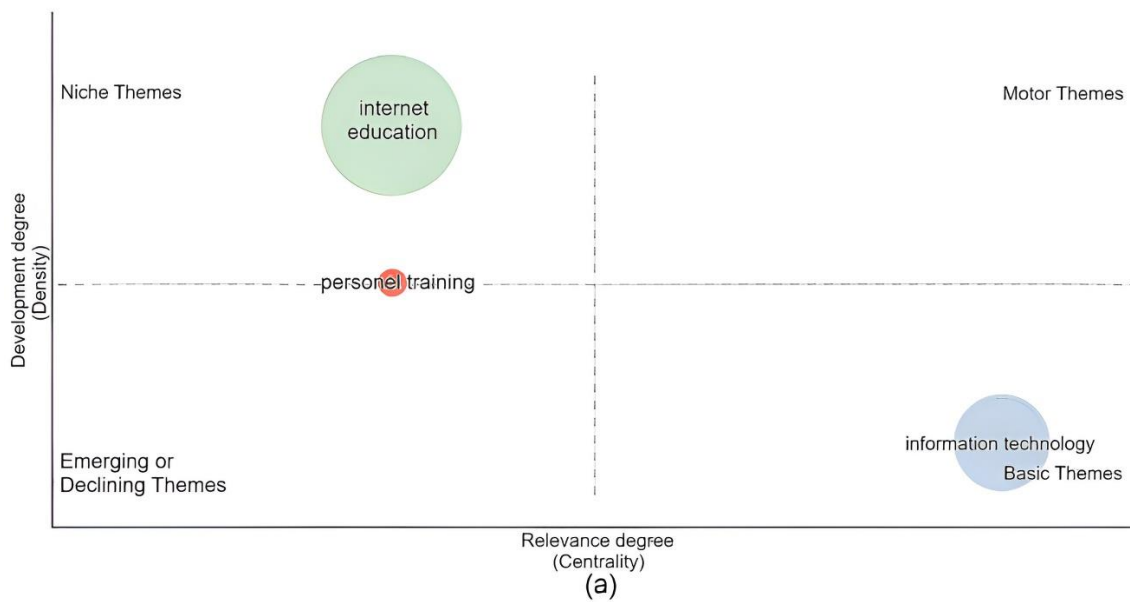
Figure 6. Evolution of thematic map in education sector for (a) 2000-2010, and (b) 2011-2022
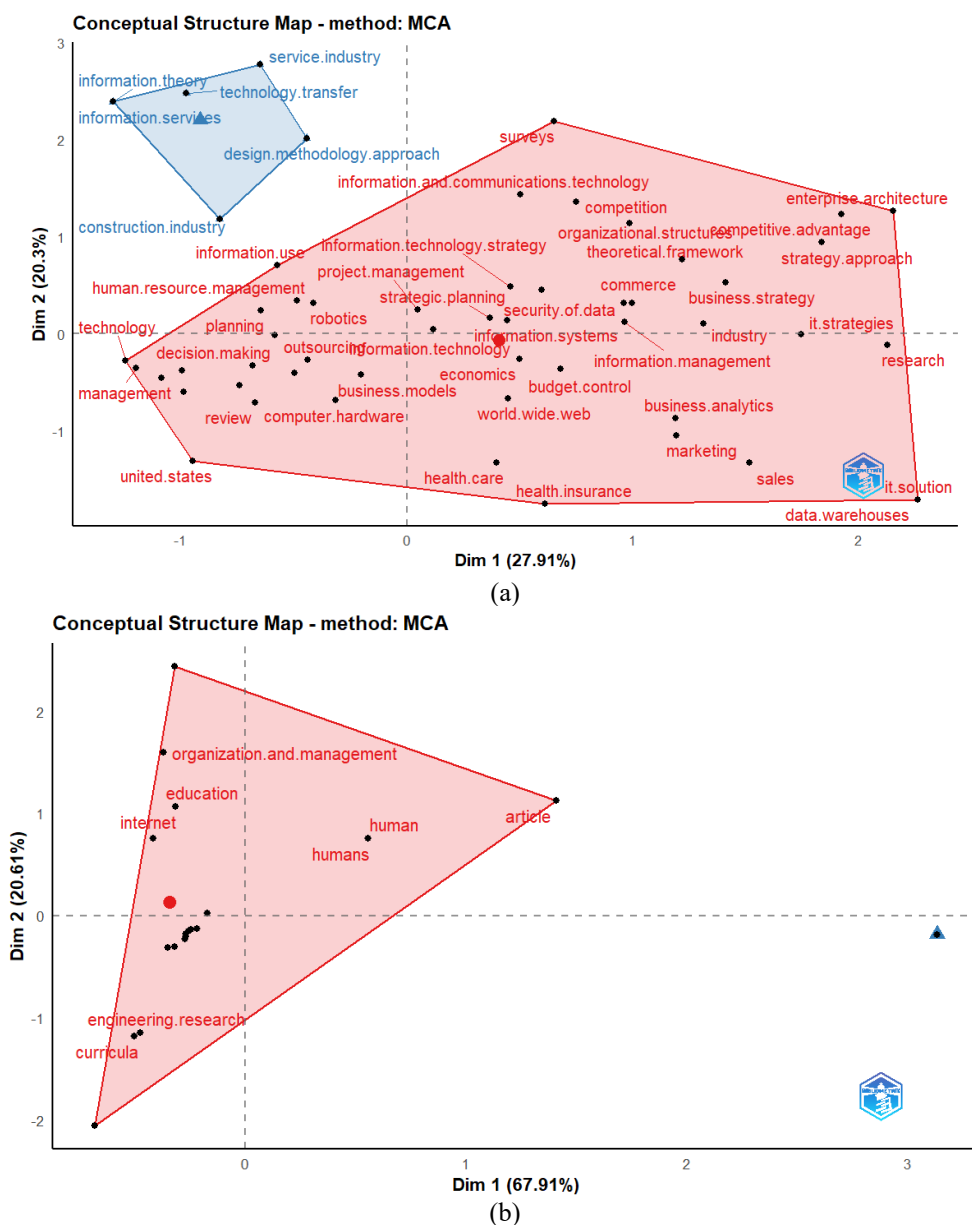

(a)

(b)

Figure 7. MCA map for (a) Industrial and (b) Education sector

5. CONCLUSIONS

A literature study on IT strategy implementation in the education and industrial sectors based on the number of publications could be used as an indicator of how both sectors respond to the digital transformation. In the industrial sector, the peak of paper growth occurred in 2012. Meanwhile, in the education sector, 2017 The number of publications after the growth peak tended to be stable and decreased, even though it was during the COVID-19 pandemic. The growth trend in the number of publications reflects that both sectors responded to the dynamics of information technology before the pandemic. The results also show that the object of the IT priority implementation strategy in the industrial sector has more variables than the education sector. The evolution of thematic objects from the two sectors is also different; the industrial sector looks more dynamic than the education sector. This information generally indicates how the education and industrial sectors respond to digital transformation in business processes.

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