Factors That Hinder Digital Transformation: 
A Comparison of Japanese and American Companies

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Abstract

In the field of business, “Digital Transformation (DX)”—which creates new value by utilizing digital technology and big data—is rapidly progressing. While Japanese companies understand the need for DX, its companies’ DX is not as advanced as that of other developed countries. The purpose of this study is to clarify the factors that prevent DX from progressing in Japanese companies by comparing Japanese and American companies’ “people” and “information systems” in terms of their roles in DX. This study reveals that the factors that prevent DX in Japanese companies are their lack of in-house IT personnel and their use of scratch-developed information systems.

Keywords: Digital Transformation (DX), Information System, Information Technology (IT) Personnel, Scratch Development, Automate and Informate

1. Introduction

In recent years, advanced digital technologies such as artificial intelligence (AI) and cloud computing have been rapidly advancing. In addition, it is becoming relatively easy to collect big data through the Internet of Things (IoT). At present, such progress in information and communication technology (ICT) has penetrated all aspects of society, making it possible to create new value.

In the field of business, “Digital Transformation” (DX), which creates new value by utilizing advanced digital technology and big data, is rapidly progressing. As an example of DX, Amazon collects purchase history as big data and analyzes it with AI to create a purchase forecast model for each customer and implement highly accurate recommendations. The reason why companies are paying attention to DX is because gaining a competitive advantage is an urgent task for companies from rapid changes caused by digital technology that are destroying traditional business models.

However, according to a survey by IDC Japan, many Japanese companies’ efforts in advancing DX are individual and short term, and about 60% of Japanese companies only make conventional business processes more efficient [1]. Against this background, if the factors behind the delay of DX in Japanese companies are clarified, it will be possible to work toward accomplishing DX. Therefore, the purpose of this study is to clarify the factors that prevent DX from progressing in Japanese companies.

2. Literature Review and Research Questions

There are several previous studies on DX in companies. Kawai posits that, as a mechanism to promote DX in companies, upper management should nominate a dedicated middle manager to exercise leadership [2]. This study focuses on the “human” who drives DX and shows that, while DX cannot proceed without the leadership of middle management, it is not clear exactly what kind of leadership is required. Furthermore, only middle management is considered. In addition, the information technology (IT) skills necessary to realize DX are not included in this analysis.

Japan’s Ministry of Economy, Trade and Industry (METI) observed that the informational system inside a company has become a “legacy system,” which is a stumbling block for DX. Legacy systems have problems such as technological deterioration, system enlargement and complexity, and “black box” that impede management strategy and create high costs. Furthermore, about 80% of a company’s total IT total budget is spent on the operation and maintenance of legacy systems, so that it cannot invest in new information systems that promote DX [3]. Since DX needs to utilize digital technology and big data and requires advanced and large-scale information processing, this previous study provides an important “information systems” viewpoint.

However, existing information systems are collectively considered to be a legacy system, so it has not been possible to determine specifically what kinds of information systems pose a problem.

According to a Japan Users Association of Information Systems (JUAS) survey, 14.4% of the respondents, when asked about the advantages of existing businesses due to the progress of digitalization, were “already affected” and 31.3% thought they had “a destructive effect.” Further, compared to American companies, 45.5% of the respondents from Japanese companies stated that their efforts toward digitalization were “overwhelmingly behind” and 35.6% of them deem them to be “a little
behind” [4]. These studies demonstrated that, when compared to American companies, Japanese companies’ DX is still limited.

Therefore, in this study, I consider that “human” and “information systems” both play an important role in DX by focusing on human and information systems. In addition, since there is a large difference in the progress of DX between Japanese and American companies, I will conduct a comparative analysis of Japanese and American companies. Accordingly, this study’s research questions are as follows:

RQ1: What are the human issues that hinder DX in Japanese companies?

RQ2: What information systems issues present obstacles to DX for Japanese companies?

By answering these two questions, I intend to identify the factors that prevent DX in Japanese companies.

3. Digital Transformation (DX)

DX was defined by Stolterman and Fors as “changes that the digital technology causes or influences in all aspects of human life” [5]. METI defined DX as follows. “In response to the drastic changes in the business environment, companies will utilize data and digital technology to transform products, services, and business models based on the needs of customers and society, and establish a competitive advantage by transforming operations, organizations, processes, corporate culture” [2]. IDC Japan defined DX as “the use of a 3rd platform technology to create value and establish a competitive advantage through new products and services, new business models and new relationships.” “The 3rd platform” is an information system centered on the cloud, composed of mobile and big data. Incidentally, “the 1st platform” is an information system centered on a mainframe and “the 2nd platform” is an information system centered on a client/server system [6].

From previous studies, this study defines DX for companies as creating new value by changing the business processes of companies through the use of digital technology and data.

4. Human Resources Required for DX

4.1 Issues with IT Personnel

Since the workforce is shrinking along with Japan’s declining population, there is concern that, in the future, companies will lack the required number of IT personnel. According to a survey by METI, the shortage of IT personnel in 2015 was about 170,000 but it will increase to 590,000 by 2030 [7].

According to Japan’s Information-Technology Promotion Agency (IPA), the percentage of IT personnel for specific technology is 5.6% and with planning and business knowledge is 3.8% [8]. DX requires human resources who can comprehensively utilize both hardware and software for advanced IT technologies such as AI, IoT, and big data. Therefore, it is an urgent task for each company to secure IT personnel who are able to advance DX despite the chronic shortage of IT personnel.

With the sophistication required for IT personnel increasing, a company can either train the required to IT personnel internally or hire them externally. Regarding internal training, according to a METI survey, respondent’s satisfaction with their company’s educational/training and self-study support systems is quite low and the percentage of respondents who “voluntarily study” advanced IT technology is only 19%. This is because IT personnel salaries in Japan are generally low [7]. Regarding external hiring, 39.9% answered “to be unable to hire mid-career candidates” and 33.8% answered “want to hire good IT personnel for new graduates but can’t hire” [7]. As a result, companies lack the required IT personnel to be responsible for and advance DX.

4.2 Comparison of Japanese and American Companies

The reason why there is a shortage of IT personnel can be illuminated by comparing Japanese and American companies. There are about 1 million IT personnel involved in ICT in Japan; in contrast, approximately 4.2 million in the United States (US). The percentage of people who are ICT industry employees is 1.8% in Japan and 3.0% in the US [9].

In addition, the ratio of IT personnel in the ICT industry to employees of IT companies is 72% in Japan and 34.6% in the US [9], indicating that Japanese companies rely on outsourcing to IT companies rather than hiring their own IT personnel for system construction and operation. Conversely, in the US, IT personnel are more commonly in-house employees, enabling systems to be built and operated internally.

Therefore, the reason why there is a shortage of IT personnel to promote DX in Japanese companies is because there is a fundamental problem: the percentage of workers engaged in the ICT industry is low and companies do not hire in-house IT personnel, instead, they depend on external IT companies for system construction and operation.

5. Creation Value of Information Systems

5.1 Automate and Informate

In a previous study, Zuboff coined the terms “automate” and “informate” to describe the value created by information systems [10]. “Automate” denotes the automation of business processes performed by people, such as processing large amounts of data and creating forms that improves productivity. “Informate” is the visualization and sharing of information through member
information exchange that provides useful information within an organization and enables effective decision-making.

The value created by the previous information system can be concentrated on “automate” and “informate”. Historically, these effects were first realized by automation and then by information. Next, I will examine previous studies on the value creation of each.

5.2 Automate

The “automate” of information system aims to improve productivity by automating operations and most previous research on this topic has taken the system investment approach. System investment represents the cost a company spends on information systems to improve business performance. Since it is necessary to find a business effect commensurate with the system investment, there have been many studies on the relationship between system investment and productivity improvement.

Brynjolfsson posits that system investment improves productivity. He concludes that when business processes shift from analog to digital, there is a correlation between IT introduction that enables digital business processes and productivity improvement [11]. Motohashi pointed out that, during the latter half of the 1990s, IT capital stock contributed greatly to the improvement of corporate value in terms of information investment and productivity. He also mentioned that productivity increased due to the degree of in-house computerization and networking [12].

According to some studies, system investment in businesses takes time to produce results. In the 1980s, the US pioneered Japan’s computer networks, but despite the increase in system investment, productivity did not increase as a result. Solow called this situation the “productivity paradox” [13].

In these studies, there is not a unified view of the time it takes produce results, but the “automate” of information systems can be regarded as a productivity improvement due to the automation of operations enabled by system investment.

5.3 Informate

The “informate” of information systems aims at effective decision-making by sharing information and knowledge, and many studies using a resource-based approach have been conducted.

The resource-based approach focuses on a company’s internal resources, which become the source of its competitive advantage. This originated in Wernerfelt [14] and was later established by Barney [15] and Hamel and Prahalad [16]. The resource-based approach is a management strategy theory, but since information systems are incorporated into management strategy, it is possible to rely on the resource-based approach when explaining the creation value of an information system.

Andrea and Ciborra argued that learning activities by working with information systems will improve organizational capabilities [17]. Similarly, Matsushima stated that information systems do not directly improve financial performance but that internal capabilities can be improved by utilizing information systems, which explains their effect of improving business performance [18].

From these studies, the “informate” of the information system can be understood as the effective decision-making enabled by the strengthening of internal resources, such as organizational capability, by information systems.

5.4 DX

In this study, company DX is defined as creating new value by changing business processes through the use of digital technology and data. The creation value of the information system by Zuboff is captured by “automation” and “informatization” [10] and does not include the value created by DX.

Therefore, it is necessary to consider the value created by DX as a new value. The value created by the information system from Zuboff’s previous research is added to the value from DX and arranged chronologically in Figure 1.

![Figure 1 Creation Value of Information Systems](image)

6. Selection of Information Systems

6.1 Packaged Software and Scratch Development

Information systems are generally introduced by packaged software and scratch development. Packaged software is a completed software product that features standardized functionality that can be used by a wide range of companies. It has the advantage of being relatively inexpensive and requiring a short time period for introduction, but has the disadvantage of having to be adapted to the business processes of the company. Global companies that produce packaged software include Microsoft, Oracle, and SAP, among others. Packaged software programs are rapidly evolving and many are equipped with the latest IT technology such as cloud computing, AI, etc. Packaged software programs are able to change business processes to create new value, thus facilitating the implementation of DX.

Scratch development is the development of a new information system from scratch according to a company’s business requirements. Although it requires more time and investment to develop, scratch development has the benefit of being easily differentiable because it makes it possible to build company-specific information systems. However, since it is assumed that it will be used for a long period of time, one disadvantage is that it is difficult to change their specifications once introduced.
According to Mowery, the scratch development ratio in the software market in 1985 was about 25% in the US while it was almost 90% in Japan [19]. According to Tanaka, analysis of the sales share of large-scale software companies in Japan and the US in 1985 shows that the scratch development share is 24.9% in the US, while it is about 91% in Japan [20].

From these studies, it can be said that most Japanese companies’ information systems use scratch development while American companies prefer packaged software.

6.2 Differences between Japanese and American Companies

There are two reasons why there are major differences between Japan and the US in terms of information systems selection. According to Tanaka, Japanese companies focus on scratch development because workers resist changing their business processes to suit packaged software and prefer to maintain their competitiveness through proprietary know-how [21].

In the case of packaged software, it is necessary to change business processes to accommodate the software. In that case, if worker IT literacy is high, the business process transformation will proceed smoothly. However, if IT literacy is low, it will not progress easily because workers will resist changing business processes to accommodate packaged software, making scratch development the only choice.

Until now, Japanese companies have employed their employees for a long time, so companies usually have their own know-how. This makes it possible to establish business processes that differ from those of other companies, which is a source of competitiveness. To maintain their business processes based on their unique know-how, scratch development is used. In contrast, in the case of American companies, changes in the allocation of human resources using short-term employment are often the source of competitiveness, so they do not rely on the accumulation of unique know-how. Therefore, they adopt packaged software.

It can be seen that worker IT literacy and the form of employment greatly influence a company’s information system selection.

7. DX Issues

7.1 Human Issues

Until now, in Japan, the percentage of workers engaged in the ICT industry was low and most companies did not have in-house IT personnel, instead relying on outside IT companies for system development and operations. This is due to the mobility of human resources. In the US, IT personnel can be hired on a project-by-project basis and it is relatively easy to dismiss them. However, in Japan, because of their low worker’s liquidity, companies adjust to fluctuations in human resource demand by outsourcing to IT companies. Therefore, many IT personnel are employed by IT companies, creating a situation in which companies employ very few IT personnel. The low percentage of workers in the ICT industry can be explained by the following.

DX uses digital technology and data to transform the business processes of companies and create new value. It is necessary to employ IT personnel who are familiar with the strategy and business processes of a company, propose a system that utilizes data that can be acquired by the company.

Therefore, the human resource issue for DX is that there are few IT personnel employed by companies, it is not possible to build a system for DX based on the company’s strategy and business process.

7.2 Information System Issues

Until now, many Japanese companies have developed scratch information systems to employ workers with low IT literacy and maintain business processes based on the unique know-how accumulated within the company. Japanese companies have introduced information systems to make them easier for workers to use, streamline existing business processes, and make more effective decisions. From this, it can be seen that a company’s information system is what realizes “automate” and “informate”.

Conversely, American companies have difficulty in accumulating IT know-how due to short-term employment, so they choose packaged software. This enables them to introduce the latest and most optimum packaged software with which DX can be easily implemented.

DX uses digital technology and big data to create new business processes. Thus, DX cannot be realized if business processes have been maintained to improve efficiency and effective decision-making. So, to realize DX, it is necessary to renew information systems to maintain and improve the efficiency of business processes and construct a new information system that utilizes advanced IT.

Therefore, information system-related issues for promoting DX are positioned as maintaining and streamlining business processes based on a company’s unique know-how and they are retained until they create “automate” and “informate” value.

8. Conclusion

In this study, I have tried to clarify the factors that prevent DX in Japanese companies by comparing human resources and information systems in Japanese and American companies. The following two points were revealed by this study.

First, a human issue in DX is the lack of in-house IT personnel. A comparison between Japanese and American companies that employ IT personnel shows that Japanese companies rely on external IT companies while the US employs internal IT personnel. Because of this, DX and system construction based on a company’s strategy and business processes in Japanese companies is more difficult to realize.
Second, the value created by the information system is limited to “automate” and “informate” by scratch development. By comparing Japanese and American companies’ selection of information systems, Japanese companies maintain their unique know-how accumulated through long-term employment and establish business processes based on it. In Japan, information systems are developed from scratch because they tried to improve “automate” and “informate” by utilizing this business process. Therefore, scratch-developed information systems enable optimization of the business process but the creation value is only in automation and informatization, which hinders DX.

In conclusion, the factors that prevent DX in Japanese companies are their lack of in-house IT personnel and their use of scratch-developed information systems. These are deep-rooted issues because both are related to Japan’s form of employment.

For Japanese companies to promote DX in the future, they need to hire in-house IT personnel and fundamentally change their thinking about information systems from “automate” and “informate” to creating new value. Instead of sticking to existing business processes, Japanese companies must utilize advanced IT technology to create new business processes.

This study focused only on two perspectives—“people” and “information systems.” It is necessary to consider generalizing the factors that prevent DX in Japanese companies. In the future, I would like to broaden the scope of this analysis to conduct more in-depth research on the factors that prevent DX in Japanese companies.

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