Transition of the Concept of Total Optimization in Japanese Companies

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Abstract: In recent years, there have been many efforts in technology development, supply chain management, and digital transformation aimed at total optimization. This paper analyzes the context in which the terms total optimization and partial optimization have been used in Japanese companies, based on the frequency of their mentions and their trends in newspaper articles. The issue of total optimization has been covered by newspapers since the late 1980s and has been discussed for many years along with its solutions such as supply chain management (SCM), business process reengineering (BPR), and information and communication technology (ICT). The fact that the total optimization issue has continued to attract attention suggests that formal organization has not yet been established. While there has been a focus on promoting communication such as cross functional collaboration and integration, and the introduction and utilization of information technology, there has not yet been enough focus on what optimization is for in the first place, and the establishment
Introduction

Toyota is often cited as a good example of a company that has achieved lean production and total optimization (*zentai saiteki*) of its flow of materials and information. In terms of technological development, the Toyota New Global Architecture (TNGA) has been introduced to a wide range of models since the 2010s geared toward total optimization through cost reductions by customization to individual customer requirements and sharing the common parts, improvement of development efficiency, quality improvements, and high levels of flexibility.

The rise of digital transformation (DX) in Japan also has as its background the expansion of the scope and feasibility of total optimization that has been made possible through rapid improvements in information technology. Hitachi has developed a factory simulator that enables total factory optimization from production to management, and has begun selling it as a software solution. Panasonic has acquired a specialized software system company aiming at total optimization of its supply chain management.

As we can see, Japanese companies are targeting total optimization and are coming up with new ways of architecture development, supply chain management (SCM), and information and communication technology (ICT). However, during empirical research with practitioners about their organization and supply chain requirements for formal organization still have not been sufficiently fulfilled.

Keywords: total optimization, supply chain management, function of management, digitalization, cross functional collaboration
management, it is frequently said that “we are in trouble because we are stuck in a state of partial optimization (bubun saiteki) (i.e., an organizational silo)” and “we should aim for total optimization.” How has the issue of “total optimization” been taken up by Japanese companies? This paper will look for trends in the way the issue is discussed in newspaper articles and discuss how it can be related to the study of business administration.

Method

This paper examines the trends and changes in the usage of the term “total optimization” in Japanese companies based on the frequency of its mention in articles (newspaper and magazine) published by Nikkei Inc. There are limitations in terms of the amount of information and content that this paper can examine as it is based on the contents of newspapers, but it is at least representative of the mass media to which most Japanese practitioners have an access. As such, this is a useful data source for understanding what has been focused on and shared by the practitioners regarding the total optimization issue.

Research was conducted using Nikkei Telecom 21, an article search database provided by Nikkei Inc, with a search period that ran from January 1, 1949 to October 14, 2021, and searched for articles that contained any of the keywords of “total optimization,” “partial optimization,” “local optimization,” and “departmental optimization.” The media included in the search were Nihon Keizai Shimbun (morning and evening papers), Nikkei Business Daily, Nikkei Marketing Journal, Nikkei Financial, Nikkei local economy section, Nikkei Plus 1, and Nikkei Magazine.

The frequency of occurrence of words such as “total optimization” was counted for each article that was found using these search terms. The frequencies of occurrence of other terms for concepts from
the field of business administration that seem to be strongly related to “total optimization” (strategic management, organizational theory, technology) were also counted for each article mentioned above. A Japanese-English correspondence table with further details of the search terms is available in the supplementary materials as Table S1 (doi: 10.50895/data.abas.17048174). Terms that describe similar content were consolidated into a single term. For the frequency of occurrence of these terms, even if the same term was counted more than once in the same article, it was considered to be one count. It was also made sure that there were no overlapping counts of words and their abbreviations (e.g., overlapping counts of “digital transformation” and “DX”). Articles that used terms such as “total optimization” and “partial optimization” but which were related to politics or school education (including university governance) were excluded from the analysis.

Through the above work, trends in the mentions of concepts and important phenomena in the study of business administration in articles that discuss issues related to “optimization,” such as “total optimization,” were identified.

**Results**

Figure 1 shows a time series of the frequency of occurrence of terms related to “total optimization” and “partial optimization.” Table S2 shows the frequency of occurrence of each term by year, and Table S3 summarizes the frequency with which the management-related terms under consideration co-occur with “total optimization” in the same article (in 1997, the number of co-occurrences was zero). Table S4 shows the results of the calculation of the co-occurrence share rates in each year for all terms, and Table S5 shows the top three share rates of the frequency of occurrence in each year for each term, with the first rank in green, the second rank in yellow, and the third
Figure 1. Frequency of mention about total optimization and partial optimization

Source: Author.

rank in blue (there are cases of same share rates, and therefore same rank, so there may be more than one term in each rank). When calculating these co-occurrence share rates, terms related to performance (QCDF) and environmental changes were excluded. This is because performance-related terms tend to co-occur more frequently in conjunction with “total optimization” over the entire period. These relevant tables can be found in the supplementary materials (doi: 10.50895/data.abas.17048174).

Overall trend

Figure 1 shows that the term “total optimization” first came into usage in 1987, and “partial optimization” started to be used slightly prior to that. The frequency of usage of these terms first increased
significantly after around 1998, and has been steadily increasing between the 2000s and 2021.

As a general trend, in the late 1980s and early 1990s, there were a limited number of key words that co-occurred with “total optimization,” with a few dominant terms such as “CIM” (computer integrated manufacturing), “FA” (factory automation), and “information system.” Subsequently, from the mid-1990s onward, a variety of terms began to co-occur with “total optimization.” As can be seen in Table S4, “ICT” (14.2%) was the term with the highest co-occurrence rate across the entire period, followed by “cross functional integration” (9.9%), “information system” (7.3%), “synergy” (7.1%), restructuring” (6.9%), “SCM” (6.5%), and “organizational structure” (6%). This suggests that the development of information technology and total optimization are closely related.

As we can see, there were many co-occurrences of diversification-related words such as “synergy” and “restructuring” that were related to strategy. However, there were few co-occurrence of the terms related to the development of new customers and markets, such as “value creation.” In particular, there was no co-occurrence throughout the entire period with the current strategic concept such as “strategic change,” “resource reallocation,” and “dynamic capability.” In other words, total optimization tends to be discussed from the perspective of looking at ways to streamline and organize existing businesses. However, since the latter half of the 2010s, attention has been focused on new information technologies and business opportunities such as “DX” and “IoT,” and there is a possibility that the topics of new business development and strategy building may be under exploration.

In terms of organization, there were many co-occurrences with the terms related to “organizational structure” such as “divisional system” and “company system,” but these terms were used in the context that they could not make good use of inter-divisional collaboration and
synergy because their independency went too far. In addition, as the mention of inter-departmental collaboration and the creation of cross functional teams (CFT) and their performance results in Nissan’s corporate reforms that began in the late 1990s increased, examples of CFT at other companies also started to be introduced. Thus, the terms “cross functional integration” and “organizational structure” co-occur on a continuous and frequent basis from the 1990s to the 2020s. In addition, “production planning” appears frequently, although not in a large number of co-occurrences, and is discussed from the perspective of integration and collaboration among multiple departments such as manufacturing, purchasing, and sales, which may be considered a kind of “cross functional integration.” Surprisingly, there were very few co-occurrences with “organizational reform.”

The most frequent co-occurrences of “performance” in operations-related area are “cost” and “inventory,” followed by “productivity” and “delivery/lead time.” However, those related to “quality/customer satisfaction” and “flexibility” tended to be of low frequency. As such, in pursuit of total optimization, cost, inventory, and productivity were focused while customer satisfaction and flexibility were relatively less focused.

In terms of environmental changes, there were many co-occurrences of terms related to the “bubble economy” and “depression” in the 1990s, which may also be a factor in the high co-occurrence of “restructuring” in this period. Following this, in the 2000s, there were many co-occurrences, especially related to the “financial crisis” of 2008 and the “depression” that accompanied it, while in the 2010s there were many co-occurrences of “earthquake disaster” and “depression.” Since 2020, there has been a sharp increase in co-occurrences of the term “epidemic.”

As mentioned above, “total optimization” has been discussed by newspapers since the late 1980s, but this does not mean that
Japanese companies first became aware of total optimization at that time. Toyota, for example, has evolved its production system to become highly competitive by focusing on the total optimization of its value flow to customers. Surprisingly, however, there is little co-occurrence of “TOC” (theory of constraints) (Goldratt & Cox, 1984), which is a theory and tool that was built based on efforts to achieve total optimization of information flow in Toyota’s production systems.

The reason that total optimization has been regarded as an important issue by Japanese companies since the late 1980s can be interpreted to be the fact that the development of information technology and computers has brought into focus problems that were not sufficiently visible in the past, and that practitioners have come to expect that these issues can (or must) be solved.

**Transition of the focus about “total optimization”**

The computerization of factories was underway from the latter half of the 1980s to around 1992, and the use of ICT to achieve total optimization (i.e., streamlining the flow) of various tasks in factories, such as “CIM” and “FA”, was attracting attention during this time.

“Restructuring” was the most frequent co-occurrence during the period between 1993 and around 1995, as the word “business process reengineering (BPR)” began to spread as a business reform concept that aims to achieve total optimization by fundamentally reviewing the way individual businesses operate and how they are coordinated using ICT, which was developing at that time. In researches on BPR, the idea of using ICT to fundamentally innovate business processes in a customer-oriented manner has been proposed (Hammer & Champy, 1993), but there is also an evaluation that it has not worked as well as expected (Matsushima, 2015).

From around 1996 to around 2001, the emphasis was on “SCM” and “logistics,” in which purchasing, production, sales, and logistics were coordinated and optimized as a whole. At the same time, the
number of co-occurrences of terms such as “information system,” “ICT,” “ERP,” and “EDI” has increased. SCM is also discussed in some articles as a new management method of achieving total optimization. There were many co-occurrence of “SCM” in the late 1990s and 2000s.

Since the 2000s, the number of terms and variations in the top three most frequent co-occurrence shares has increased, indicating that the total optimization issue is now being addressed in a variety of contexts. In particular, the shares of IT-related terms such as “IT,” “information system,” and “ERP,” as well as terms such as “cross functional integration,” and “synergy” have been consistently high.

Since around 2014, there has been an increase in the co-occurrence of “FA” and “IoT,” and since around 2019, there has been an increase in the co-occurrence of “DX.” It can be seen that with the rapid progress of digital technology, the level of automation in factories increased further streamlining of production activities, and reforms that look at the supply chain and business model in total are under way. At the same time, co-occurrence of the term “platform” is also increasing. This is mainly due to the development of automotive architecture (such as Toyota’s TNGA).

As discussed above, the emphasized focus on the total optimization issue that emerged in the late 1980s began with the integration of activities in the factory through computerization, and with the development and spread of ICT, it expanded in scope to achieve coordination and optimization of the various activities that make up supply chain management. “Cross functional integration” has also been emphasized as an organizational effort.

Discussion and Conclusion

The total optimization issue has been continuously discussed in
newspapers at least since the late 1980s, but if organizations with division of labor and specialization were created as instrument to overcome the limitations of human rationality (Kuwashima & Takahashi, 2001; Takahashi, 2000, 2016), it can be argued that this is an issue that we have to confront as long as organizations are there. We could say that we continue to face the problem of “differentiation and integration,” as it was termed by Lawrence and Lorch (1967). As discussed by Cyert and March (1992), in a situation where there are multiple coalitions with different objectives in an organization, consensus on a single objective cannot be achieved, so problems are never completely resolved and a quasi resolution of conflict occurs.

The fact that the total optimization issue has been taken up in this way suggests that the formal organization proposed by Barnard (1938) and explained in Takahashi (2000) has not yet been established. While the establishment and continuation of the formal organization is regarded an important role of management, it is (1) when the current division of labor and collaboration system is dysfunctional, or (2) when management is trying to adapt to changes in the environment by taking proactive actions to change the current division of labor that total optimization is considered to become a key problem.

As we have seen in this paper, poor coordination among departments has long been regarded as a problem and total optimization is seen as a way to overcome it, and various ICT and management methods have been developed and implemented as effective solutions. This focuses on communication among the establishment requirements of formal organizations by Barnard (1938) (communication, willingness to serve, and common purpose) that Takahashi (2000) discusses. With the development of ICT, attenuation and denaturation of information may be minimized, but certainly cannot be reduced to zero. Furthermore, even if we become
able to acquire larger and larger amounts of information, there is a possibility that the human ability to process it and make decisions will not be able to keep up. Simply saying “Let’s improve communication” and introducing the most advanced ICT for that purpose does not satisfy the establishment requirements of a formal organization, which means that calls to do so result in “empty slogan” without actions.

This “empty slogan” cannot achieve total optimization by simply introducing information systems without also changing actual work processes. The use of such techniques alone will not achieve the desired total optimization, nor will it lead to the realization of improved efficiency of the operations (Fukuzawa, 2020; Fukuzawa, Sugie, Park, & Shi, 2020). The important thing is to strengthen organizational competencies and change them according to the surrounding situations, but this takes time and effort and any measures taken will not be effective immediately. Managers who are exposed to time and competitive pressures are disappointed at this, and make a long journey expecting to quickly and easily find tools and management techniques that can achieve total optimization and to implement measures that seem to work, but only find themselves falling into the same cycle again and again. The same process is repeated in response to the “empty slogan” of total optimization that is pleasant to the ear. In situations in which the coordination and integration of the entire organization has not been given sufficient consideration and members of the organization work hard to “optimize their own work,” partial optimization (organizational silo) advances while generating a new total optimization issue. If this happens, the total optimization issue will be never solved.

What makes the problem even more difficult is that the meaning of “total” changes depending upon to which degree the management is looking (or is trying to look). In other words, the goal of the optimization is to the degree of the “total as far as it can currently be
seen” to which management can pay attention (Ocasio, 1997). In reality, since total optimization is only performed within a limited range, if total optimization is highly adapted to a particular environment, this means that the possible degree of adaptation may be low when that environment changes. For example, as discussed in Christensen’s (1997) innovator’s dilemma, total optimization can be successful if it is promoted as a business system that offers high value to existing major customers, but it will not be successful when dealing with business systems and customer needs that are not geared in this way. When solving the total optimization issue, it is important to envision what the “desired state” should be as a common goal, and doing so is a crucial function of management. This needs to be unique and is something that can survive competition in the market. Otherwise, as pointed out by Porter (1996), management will fall into the trap of “optimizing operations without strategy.”

After all, what kind of total optimization will increase the viability of a company? Ideally, it might be thought that all relevant elements should be optimized exactly so that the desired state can be achieved. However, rather than seeking total optimization as a golden rule, it may be better to leave room for a variety of variations to occur, and then taking the approach of selection, retention, and integration among them in order to increase the likelihood of their long-term viability and growth potential.

For example, as argued in the historical study of Intel by Burgelman (2002), the direction and extent to which one attempts to optimize a company may determine its destiny. According to Burgelman (2002), at Intel there were three epochs in which three different optimization actions were taken: (1) When it was better to set a simple rule and then promote the development of autonomous behavior in the field; (2) When the company achieved great success by intensely vectoring and optimizing the entire company for the PC market, although this resulted in less autonomy, which inhibited the
development of both human resources and the new business; and (3) When these lessons were taken on board and kept intact aiming for both the business execution process of strengthening existing business and new business creation process. What are the advantages and disadvantages of these three optimizing behaviors, and what are the rules and principles that guide them?

Further, Fujimoto (1999) clarified that total optimization of Toyota’s manufacturing system has been realized under a policy of thorough customer orientation and a field-oriented approach. It is said that they are always aware of who their customers are and that it functions as an internal selection mechanism.

A wide variety of ICT and management tools and theories for achieving total optimization have been developed over the past few decades. To what extent do the various reforms and initiatives implemented under the banner of total optimization improve the survival rate and adaptability to environmental changes of the organization, what is the purpose of optimization in the first place, and what kind of rules and principles are effective for optimization? Exploring these issues are important themes for future research.

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