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An Analysis Based on the Manufacturing Architecture of the Computerization of Local Governments in Japan

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Abstract

In this study, we examine the computerization activities of local governments to determine the relationships of architecture. Focusing on the characteristics of the design, development, and operation of computerization, we propose the architecture of computerization based on the manufacturing architecture. Furthermore, we analyze several cases and try to classify the information activities of organizations. We also refer our empirical survey to clarify the actual situation of e-government digitization in Japan. We show the classification of computerized activities in a local government and the future use of computerization based on the above considerations.

Keywords

Architecture of computerization, Empirical survey, Local government, and Manufacturing architecture.

1. Introduction

In 2001, Japan settled on the e-Japan strategy to become an information technology nation (Ministry of Public Management Affairs, Posts and Telecommunication, Japan 2005). Efforts to build an e-government to increase the efficiency of the administration and finance departments are underway (Kubo & Shimada 2007). However, the introduction of information technology in such a situation is not predominantly observed.

It has been indicated that it can be difficult to observe the effect of computerization in local governments. Therefore, the direction of computerization is not clear. Given this background, it is important to analyze the relationship between computerization and organizational activities (Brown & Brudney 2004; Thompson et al. 2005).

In this study, we examine the computerization activities of local governments to determine the relationships of architecture. Focusing on the characteristics of the design, development, and operation of computerization, we propose the architecture of computerization based on the manufacturing architecture. Furthermore, we analyze several cases and try to classify the information activities of organizations. We also refer our empirical survey to clarify the actual situation of e-government digitization in Japan. We describe the general architecture and characteristics of computerization.

2. Questionnaire Survey in Japanese Local Governments

2.1 Survey Framework

The digitization of local governments implies more than the mere purchase of a personal computer, server, and network facilities (Shimada & Ushida 2003). Some examples of additional requirements include organized activity to increase the efficiency of the business process, development of the service model through information communication technology, and improvement of information security for residents' safety and relief.

We consider the framework of e-government as comprising two scales. One is digitization for hardware and software, comprising the introduction of PCs and servers, maintenance of operations structure, education to enhance IT skills, etc. Although these activities are often carried out independently, a combination of them could be additionally effective in achieving an e-government. We focus our attention on balancing these activities.

The other component is the escalation degree of the achievement of digitization. There are differences in budget sizes and population among local governments. The investments of the local governments in digitization have several differences. It is important to describe the achievement of digitization policies to reveal the difficulty in execution.

These two scales should be connected with the framework of the local e-governments. Thus, an e-government that simultaneously achieves financial stability and resident service improvement by attaining these two scales can be organized. For the above viewpoint, we must examine the aspects of infrastructure, use, and its effects. An e-government cannot be organized merely by the automation of administration. The activities that constitute the base of local governments are automated easily, and these must be examined from the management perspective. However, most Japanese local governments mostly lack the perspective of cost-effectiveness. Therefore, we lay emphasis on evaluating and verifying digitization.

We assume that the digitization of local government is implemented in three categories: computerization in offices, services to residents, and information security. Computerization in offices refers to the infrastructure involved in digitization. Services rendered to residents are outputted by means of digitization. Information security is crucial for the operation of digitization. Figure 1 illustrates our vision of the digitization of local governments. These elements are interrelated, and we assume their association with the realization of an e-government. Moreover, the development of each element is believed to exist at several stages. They are considered to constitute a fundamental part of and play an important role in application and interaction.

These three elements are often undertaken and estimated separately. However, the contribution of digitization cannot be measured by merely considering the amount of investment made. We analyze this contribution by considering the activities right from the investments in digitization to its subsequent impacts. Recently, in Japan, there has been a rising consciousness of individual information protection; as a result, it is hoped that activities rendering services to residents with supporting computerization also adopt information security.
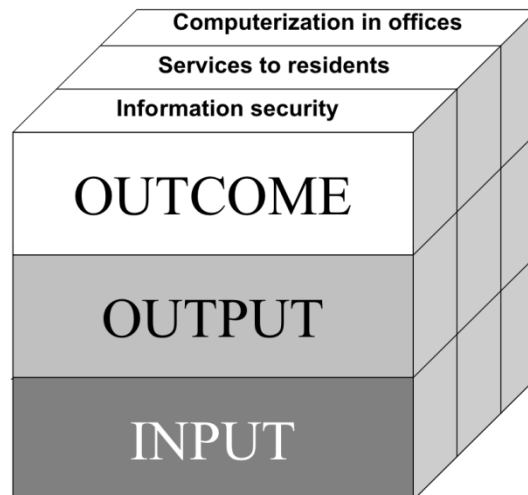
Figure 1: The vision for the digitization of the local governments

2.2 Three Levels of Digitization

Our vision for the progress of computerization involves the following three levels:

- Level 1: The input (budget) level, measured by the extent of the development of or investment in information and telecommunications infrastructure.
- Level 2: The output (work) level, measured by the number of employees capable of using a PC, e-mail, etc., for work, and their working speeds.
- Level 3: The outcome (results) level, measured by the extent of increase in residents' satisfaction toward the services rendered to them.

In short, these levels include invested resources as the input, produced results as the output, and the effect of the input on the output as the outcome. We assume that the fundamental stage of "input" is represented by the infrastructure and the configuration of the rules for an information system. The next stage, "output," is represented by activities for the effective use and planning for the expansion of and compliance with the new situation. The final stage, "outcome," constitutes estimating and verifying the effects by information technology and information systems.

2.3 Survey Results

We verify our proposed progress stages by using our empirical survey. The questionnaire survey was administered in 2007 on 1,874 local governments, 960 of which responded to it. The survey details are as follows:

- Period of survey: From July to August 2007
- Targets: 1,874 local governments in Japan (all prefectures, all government-designated cities, all special wards, all cities, all towns, and all villages)
- Methods: Internet (on a website created using PHP and MySQL on Linux)
- Total number of respondents: 960 local governments (percentage of respondents: 51.2)

The survey questions could be categorized as follows:
1. Computerization in offices
2. Services rendered to residents

3. Information security.

Computerization in offices refers to the infrastructure involved in digitization. The questions in this category were related to the client and server machines, training provided to government employees, use of integrated applications, and appointment of a Chief Information Officer (CIO).

The services rendered to residents are outputted by means of digitization. The questions here included information services provided by the government's website, information exchange with residents, development of original services, and service estimation.

Information security is important for the operation of digitization. These questions focused on the framing of the security policy, management of client machines and the server room, monitoring access logs, and education regarding information ethics.

We calculate the deviations in each category of the survey as well as in the total, which comprises all the deviations. With regard to the answers, the reliability is high because many problems are presented in a multiple-choice form in the electronic questionnaire. In addition, the reliability of the answers is confirmed by checking interview surveys and the contents of local governments' websites.

A part of the results of the survey is shown in the Table 1. This table shows the upper 10 governments in each category of government scale. The governments marked * were researched by our interview survey.

Rank	Prefecture	City	Town and Village
1	Gifu *	Fujisawa	Naganuma *
2	Tokyo	Yokosuka *	Mamurogawa
3	Osaka	Toyonaka	Shiraoi
4	Saitama	Ichikawa *	Shiwa *
5	Kyoto	Kawasaki	Ogano
6	Kumamoto *	Takatsuki	Ninomiya
7	Ibaraki	Itabashi	Tamaki
8	Saga *	Atsugi	Miyashiro
9	Kagawa	Sakai	Taiwa
10	Shiga	Katsushika	Satsuma *

Table 1: The result of the our empirical survey

3. Relationship between Manufacturing Architecture and Computerization

3.1 Product and Architecture

The Japanese industry is one of the best in the world, and manufacturing is regarded as the lifeline of Japan. The knowledge created as a result of manufacturing is the source of Japan's competitive superiority.
According to Fujimoto (Fujimoto 2006), in the automobile industry, the manufacturing architecture is developed from the product design and fundamental design of parts. Japanese manufacturing architecture has integrated all phases from parts design to the manufacturing process.

Therefore, parts and processes are made and adjusted for the final products. In other words, a manufacturer considers the final product as the essence and controls the manufacturing

technique as the method. This architecture can control (1) the effect of new manufacturing technologies that change with time and (2) the characteristics of these technologies.

Thus, manufacturers can consider the architecture of product design and consequently can provide their earnest opinions regarding the quality of the final product. While it is true that information technology and information system change the basic structure of an organization, these aspects are significant to this study's objective of analyzing the ability of organizations. Next, we classify the manufacturing architecture and analyze the relationship between manufacturing architecture and the computerization activities of organizations.

3.2 Types of Manufacturing Architecture

The manufacturing architecture for manufacturing and design involves the following two types.

One is the integral type of manufacturing architecture, focusing on the final products rather than part design, such as cars and small household electrical goods. Most of the Japanese TV game software is manufactured using the integral type of manufacturing architecture.

The other is the modular type of manufacturing architecture, in which the value of the final goods is created by the collection and combination of standardized parts. Examples of this type are personal computers and bicycles. Furthermore, it includes the portal sites that gather information services and provide the electronic commerce function.

Examples combining several web technologies can be found on the Internet. The difference in these architecture types affects the difficulty of imitative learning and duration of competitive superiority.

3.3 Architecture of Computerization

In this study, we consider the computerized activities of a final product in the manufacturing process. We assume that the design, development, and operation phases involve a distinct architecture type.

Based on the characteristics of the computerized activities, all phases between design and development can be stated to involve the modular type. Computerized activities also appear to involve this type; however, the effect of these activities becomes visible only after considering the design, development-related adjustment, and correspondence with operation. Therefore, determining the outcome of computerized activities in relation to both organizations and users is necessary.

Thus, we propose the architecture of computerization, as shown in Table 2. Here, we suppose that the development of the information system and that of a related service implies the final product in the manufacturing process. The manufacturing process involves three phases: design, development, and operation. Similar to the case of manufacturing, these phases are divided based on architecture types.

The integral type of design phase includes the following.
1. Integrating all activities under the computerization process.
2. Setting goals for the organization under the computerization process.
3. Using the information system and information technology to attain the goals.

This phase involves an understanding of the various demands made across a wide range of organizations and users, to successfully execute the computerization activities. An adjustment of demands is also observed in this phase.

Phase	Type	
	Integral	Modular
Design	The definition of the purpose for an organization to engage in computerization activities	The constraint of newer technology
Development	Reorganization and adjustment Cooperation with organizations from outside the area of consideration	Combination with the former information system
Operation	Influence of an introduced organization Interactive effect	Estimation of introduced services and the independent function of the information system

Table 2: Architecture of computerization in each phase

The modular type of design phase includes the following.
1. Introduction of a new information system related to the introduction of new information technology.
2. Application of the demonstration experiment within the national budget.
3. Introduction of a module technology such as IC card and the geographic information system.

Development is the next phase of the process, involving the main phase for building the information system. There is a difference in the number of adjusting activities, which are related to the division using the system for the others.

If the use of enterprise architecture, which can separate these phases, is effective, excessive design adjustment will lead to independent development. In other words, such a development phase becomes a modular type of manufacturing architecture. Thus, we separately define the development phase.

The final phase is the operation of the information system. It is possible that the operation phase may affect the inside and outside of an organization because the introduction of information technology results in changes in organizational activity. For example, although the introduction of the e-mail system is planned and developed as the modular type of architecture, the type of information sharing inadvertently changes to a great extent. This integral type of architecture appears to have an interactive effect on the organization during the operation phase. On the other hand, a modular type of operation involves a partial use of the information system. Based on the above definitions, we analyze computerized activities in actual cases of local governments in Japan and verify the effect by using the differences in various combinations.

4. Case Analysis of Japanese Local Governments
There are various contents and effects of computerization activities carried out by local governments. Hence, the results also vary. In addition, there are various methods of conducting computerized activities.

An example is the demonstration experiment that involved a large national budget to set up an infrastructure. Another example is the use of web technology and open source software for providing service in response to residents' demands.

There are many differences involved in these approaches, although local governments have the same policy and a similar organizational size and structure. Therefore, it is important to classify these approaches to identify the source of effects observed as a result of good practices. Thus, we analyze the cases of Oushu City, Ichikawa City, Sapporo City, Saga City, and Nagasaki Prefecture, which are considered as advanced local governments in Japan.

4.1 Oushu City

Oushu City in Iwate Prefecture is an advanced e-local government that uses the IC card. From 1990 onward, the city has been providing an individual service with a contact-free IC card. Further, it is presently using the basic resident registration card.

Oushu City conducted a demonstration experiment for an IC card; this experiment was funded by the Local Authorities Systems Development Center. The standard IC card services involve automatic operations of certification delivery, creation of applications, reference for health management information, support for emergency, information on evacuees, reservation of public facilities, and the service of a public library. Furthermore, Oushu City provides individual services such as seal registration certificate delivery service, hospital second coming reservation service, book reference and reservation service, and public facilities' reservation service.

The design is of a modular type because the city assumed an individual information technology such as IC card and the basic resident registration card. The city combined the card and service functions in the design phase. This is the one card through which certificates can be issued, hospital rooms can be reserved, and the library can be referred to.

The development of the project is of a modular type because there is an obvious subject created by the demonstration experiment. Advanced technology, such as the IC card, can be used in the new information system with less difficulty.

The operation is of a modular type because the activity comprises combinations of services. The activities of Oushu City, on the whole, are almost of the modular type.

4.2 Ichikawa City

Ichikawa City in Chiba Prefecture is representative of the e-local government in Japan. Since it adjoins Tokyo, many residents do not remain in Ichikawa City in the daytime. Therefore, it is necessary to provide services for a longer period of time in a day and to provide them outside city limits as well.

Ichikawa City began providing the administrative service at convenience stores from 1997 onward. Through this service, residents could obtain their certification at convenience stores by making a simple telephone call and without visiting the city office.
This service also made it possible for residents to reserve communal facilities using the terminal machines available at convenience stores. Furthermore, residents can use these terminal machines to send information related to the activities of the volunteer group working within the area. The administrative service was introduced at convenience stores in response to residents' demands and the actual condition that included the location, lifestyle, and commercial situation. Therefore, service improvement for residents is included in the design phase. The design phase is of the integral type because the design has to consider various demands made by residents.

The development phase involves a combination of kiosk terminals and convenience stores in terms of the location condition. These conditions are independent and cannot be adjusted for other conditions. The development phase is of the modular type.

The operation phase is also of the modular type. In this case, many elements-requesting via the telephone, providing information to residents, and using another organization-are combined and parallel. This process of gathering information on a wide scale provides the basis for the service.

The residents define the administrative service available at convenience stores. It has been recently observed that an increasing number of practices and technology are being set up for new users, and therefore, it appears that expectations from the service will increase as well.

4.3 Sapporo City

Sapporo City was the first to introduce a large-scale call center in Japan. This call center hired specialized personnel from outside the city to answer calls made by customers. On examining the database of the number of inquiries made and answers provided, a satisfaction rate, owing to the answers provided by the operators, of 89\% was found.

The important aspect of this activity is that the various elements involved in it are integrated and designed. The call center structure integrates many elements, such as outsourcing of operations, information service provided by each division of the city office, and system introduction for information provision, from the information creation stage to the information provision stage and request acceptance. Thus, it appears that the design is of a high level integral type.

Sapporo City is currently aiming to establish further successful connections by using the synthetic administrative information system. Therefore, the development phase is related to the integration of systems and divisions and is integral as well.

Users regard this call center as a one-point contact between the city office and residents. However, the operation that is independent of the organization is of the modular type. If calls made to the call center are considered during policymaking, the operation will be of the integral type and will be an ideal model of resident participation.

4.4 Saga City

Saga City established a very important support system for Samsung SDS in South Korea. The establishment of such a large-scale computer system for foreign enterprises was very uncommon. Some mass media reacted on this news redundancy, naming it the "War of Saga."

As a result, it was important to provide a "disclosure of the program source code" and to agree to a "very short development period." A majority of IT Japanese vendors could not cope with these constraints.

Large-scale development requires large-scale integration of developers and users. System conversion, business process reengineering, and office-related adjustment are important for reconstructing crucial support systems. In view of these aspects, and because the mayor at the time was excellent, the design of large-scale developments was of the integral type.

Owing to this, the development phase, too, was of the integral type. On its part, Samsung SDS sent 100 engineers to Saga City. Along with the municipal workers of Saga City, these engineers constructed an integrated communication environment.

Efforts were made to adapt the systems of Saga City to those of other local governments. Since this plan required integral activities to be carried out in the operation phase, Saga City seemed to have an integral operation phase at the time.

At present, the mayor lost in next election and then it stopped this news listened. Although these systems and organizational activities are the property of the government, or that of residents, the systems are not used effectively to gain newer effects.

4.4 Nagasaki Prefecture

Nagasaki Prefecture is presently aiming to reduce the costs related to the information system and to increase the number of vendors in the area. The main aspect of this case is that the office members provide detailed specifications for the design of the information system.

These specifications are the activities carried out for the integration of cost reduction, area activation, and development of staff members' abilities. This resulted in a significant change for IT and area vendors and the office staff in Nagasaki, although major vendors were entrusted with the design.

Regarding the development phase, it is possible for area vendors to combine their activities, provided a detailed design is prepared. It seems that the operation performed by each division becomes a module; however, since the designer is a member of the office staff, the system is used under his supervision. Through our interviews, we also found that the key person provides guidance right from the design phase.

5. Classification of Cases

Using the cases discussed in the previous section, we examine the range of integration from the design to operation phases. Figure 2 shows the classification of the change in the architecture of each phase.
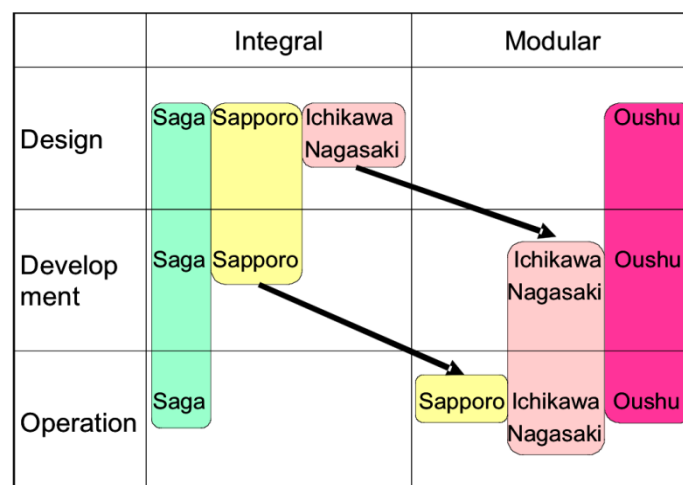
Figure 2: The classification of the change in the architecture of each phase

Since Saga City established a very important support system, it is represented as the integral type in all phases.

Sapporo City, the first to introduce a large-scale call center in Japan, has the integral type of design and development phases; however, the operation phase, consisting of a database related to inquiries and responses as well as several divisions, is of the modular type.

Ichikawa City and Nagasaki Prefecture have the integral type of design phases. These design phases include various constraints and are considered along with these situations. Examples of these constraints are improvement of services, convenience stores, cost reduction, and increase in the number of vendors in an area.

Oushu City provides a service that uses both the integral and modular types of architecture, based on IC card technology and carries out computerized activities by using these advanced services.

These examples show that the direction of type change from integral to modular exists in some cases. It seems that these types also can be used for local government digitization.

6. Four Combination Types of the Architecture of Computerization

In this section, we consider the advantages of and issues in the architecture of computerized activities.

6.1 All Integral type

When one government uses the integral type of architecture from the design to operation phases, the knowledge of computerization is accumulated at each phase. Furthermore, it becomes necessary to reaffirm the purpose, improve the adjustment ability, and so on. Therefore, improvement in the organizational ability connected with computerization and management can be expected. In addition, owing to the accumulation of knowledge pertaining to integration, it becomes easier to implement future changes.

On the other hand, however, it seems necessary to strike a balance between the organization and such computerized activities. Thus, it is necessary to consider a model that takes into account the organizational climate and the surrounding environment in order to ensure a smooth and successful activity transfer to another organization.

6.2 Design and Development Integral

This combination type involves a modular type of operation. For other local governments, it is easy to examine and apply developed systems. It is necessary for vendors and office divisions to cooperate for integrating the design and development phases. It is generally difficult to establish such relationships when business process reengineering is required for many divisions. Therefore, successful cases are expected to have a considerable amount of effective knowledge.

In this type, it is feared that the consideration of information gathering from the perspective of establishing more successful connections is scarcely made during the operation phase. It is very important for the structure of the feedback received from the operation phase to be such

that the comprehensive function is realized along with the services pertaining to the design phase.

6.3 Integral Design Only

When multiple purposes are realized at the same time, the integral design becomes a major issue in terms of managing the development and operation phases. The quality of computerized activities is decided based on the choice of purpose and degree of integration.

The modular type of development can be easily applied to an organization. For a vendor, there exist many advantages of increasing the efficiency of the development process. Furthermore, the development phase constructed as a module can obtain the advantage of reconstructing and improving the information systems.

The viewpoint from which the relationships between an organization and computerization are considered right from the design phase is covered by these activities. Therefore, a smooth operation can be expected if such models are used right from the design to the operation phases.
However, they are not always connected with the overall increase in the efficiency of an organization and ability improvement. It is important to know the methods of teaching the design-related idea and its perspective.

6.4 All Modular Type

The all modular type from the design to the operation phases results in independent computerized activities, with the characteristics of the technical effect becoming easily visible. It is possible for a local government to carry out partial computerization by using the support plan or demonstration experiment that is limited to a specific purpose. The methods employed from the design to the operation phases can be applied to any other organization.

However, it is scarcely adequate to contribute to the improvement in the overall increase in the efficiency of an organization and the value added as a result of computerized activities because the purpose is limited. Therefore, an ascertained range and effect must be included in the long-term plan of an organization in terms of these activities.

6.5 Classification of Advanced Local Governments

Table 3 shows the classification of advanced local governments that are certified by our empirical survey in 2007.

It seems that advanced towns can employ integral activity easily because they do not have large and complex organization. Gifu and Ichikawa, well-known advanced governments, have integral design only. It seems that large government sizes require modular activities. However, integral design has an important power to realize advanced computerization.

Type	All Integral	Design and development Integral	Integral design only	All Modular
Government	Shiwa Satsuma	Kumamoto Saga Yokosuka Naganuma	Gifu Ichikawa	

Table 3: Classification of advanced local governments

7. Relationship between Integral and Modular Types

The combinations of these architecture types result in the characteristics of the activities and the organization. Further, combinations result in the accumulation of the knowledge related to computerization and organizational activities. Following this, it is necessary to strengthen the organization's skill of adapting itself to the reconstructed system and the change in the situation.

However, with regard to transfers to another organization and use, the characteristics of the organization must include the formalization of the included knowledge at the same time.

The activity of all local governments in Japan is almost identical. Therefore, it is expected that clear combinations can be easily applied to other governments. The diversion and transfer of the system are simplified with the modular type in the combination. However, there are parts that need customization corresponding to the area and the scale of local government. It is important to choose and estimate the standard for the modular and integral types.

In the end, we consider the change from modular to the integral type. When the design, development, and operation phases become modular in type, even the phases that follow are modular in type. It seems that the computerized activity is divided after the modular type is chosen.

The feedback from the operation phase has considerable value as assists for integration because there is no end in the computerized activities. The true nature of the organization activities is revealed through integration, and it is important to change the component. It results to the modular as an abstraction of the computerized activities and modeling in the design phase. Additionally, it is important to collect residents' and users' opinions in order to improve the information system. In other words, this is the new integral type of computerized activity. The change in type occurs as a result of improved organizational ability or when computerization is aimed at; this brings about the progression of the computerization activity. This situation seems to be effective not only in the case of a local government but also in the case of each organization.

8. Conclusion

The manufacturing architecture was applied to computerized activities, and the architecture to be focused on during computerization activities was proposed in this study. Next, we analyzed the case of local governments with advanced computerization and discussed the changes between the integral and modular types during all the phases. Moreover, computerization-related characteristics resulting from these changes were mentioned and the issues were argued.

We showed the classification of computerized activities in a local government and the future use of computerization based on the above considerations.

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