ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645
Indian Journal of Science and Technology, *Vol 8(S8), 180–190, April 2015*
DOI: 10.17485/ijst/2015/v8iS8/70525

DBR-Based Process Management for Local Government

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Abstract

Over the past few years, the Korean government and its subunits have attempted process redesign with little success and failed to see notable improvement in managing the process. Notably, operational process embedded in the local government is mostly constrained by laws and regulations, which implies that the process is not easily changed unlike those in private entities. The objective of this research, therefore, is to propose some fundamental approaches to process management based on 'DBR (Drum-Buffer-Rope)' originally developed by Goldratt for his 'Theory of Constraints'. This study extracts 4 types of local government' administration process and discusses the unique attributes of each type of the process in terms of design and management. Particularly, the present paper elucidates how to apply the concepts of DBR (Drum-Buffer-Rope) and their implications.

Keywords: Drum-Buffer-Rope, Local Government, Process Management, TOC

1. Introduction

Today, the public administration sector borrows the management approaches from private organizations more often than not[1–3]. In this context, the Korean government has recommended the implementation of Business Process Redesign and exerted efforts to build e-government since the 1990s with intent to embody a 'small but efficient government'[4]. Yet, according to the 2014 Government 3.0 Initiative Report, 40,000 units of administrative functions (based on BRM), 18,000 items of silo system and 80,000 servers add to complexities and budgets, whilst the use of e-government is no higher than 56.9% ('13) and the satisfaction with e-government drops (91.2% , '12→83.7%, '13), which falls short of expectations[5]. Public administrative organizations are distinct from private ones in respect of their standards of values, atmospheres, organizational structures and operational principles[6]. Nonetheless, administrative organizations employ private entities' approaches without filtering or adapting them to suit the specificities of the public sector. Regarding this, concerns have been raised by some scholars including[1]. Particularly, in view of process management, some expressed skepticism over whether relatively less competitive administrative organizations should take the risk of making radical and innovative changes and argued that constant process management would be a better option[7–10]. Moreover, it is challenging to transform organizations' operational principles, e.g. legal system, or organizational structures into process-based ones. In particular, that is the case with local government whose organizational structures directly reflect the central government's interest and whose departments mostly deal with cross-functional process[11]. Within the Korean administrative system, local government' autonomy is granted to a limited extent, and their authority to make fundamental changes in administrative process and organizational structures is rare. Therefore, BPR, which is a process management technique presuming innovation in organizational structures and operational principles, and BPM advocating automation at the operational level for persistent management of business units are at odds with each other even in their conceptual application[3].

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This study proposes a process management method in the view of information flow using 'Drum-Buffer-Rope (DBR)' which is part of the Theory of Constraints (TOC) to guarantee transparence of information flow, or to guarantee clear flows of information in local government' process. Specifically, the present study analyzes the perspective on information flow and the administrative process of local government to build a model for a constant and continuous process management and to demonstrate the usefulness of DBR.

2. Theoretical Foundation

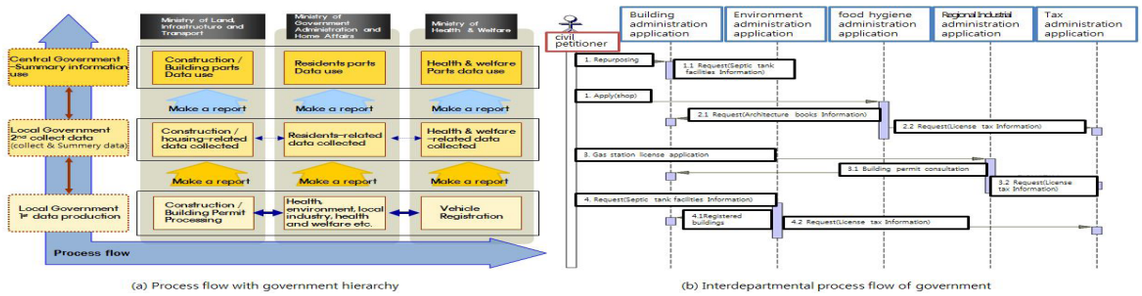
2.1 Organizational Characteristics of Local Government

Most administrative organizations in Korea are bureaucratic ones drawing on the departmentalization principle6. Local government is administrative organizations serving as contact points for citizens. Each local government is characterized by its distinct atmosphere, does not necessarily share a vertical system, and provides a bit different administrative services. The common denominators between upper-level and lower-level local governments are the established vertical close report system to the central government, and the bureaucratic organizational structures reflecting characteristics in accordance with the statuses within respective administrative tier systems[11]. Also, the horizontal network is as important as the vertical system for an organization's internal process. The central government is characterized by strong silo selfishness due to the clear-cut descriptions and characteristics of job responsibilities of organizational members. Likewise, different interests may exist in local government where different departments report to different superior organizations within the central government. Yet, a previous study on local government reported that as most civil servants in local government can be transferred to and from departments, conflicts of interest between departments are not substantial[4,6]. Most of jobs in local government are supposed to undergo departmentalization. Yet, civil servants are transferred within organizations, which leads to relatively well-established collaborative relationships unlike the central government. Horizontal ties beyond departmental boundaries matter in local government mostly in charge of civil services for local areas and residents[6].

Korea has been exerting extensive efforts in tandem with investment to establish information systems in administrative organizations. Above all, since the 1990s, lots of business support systems have been deployed, reflecting the results of the emphatically recommended process redesign. However, the information systems deployed from the perspective of the central government have caused functional segmentation and stratification to local government, reinforcing the vertical relationships while breaking off the horizontal communication paths, which adverse effects are illustrated in government agencies' reports on the Information Systems Planning and prior studies[5,12–14]. The 2014 Government 3.0 Initiative Report points out the difference in values between e-government and government 3.0 and alters the direction of information-based administrative process. Unless the information flow indispensable for local government to proceed with administrative process is identified and the interests in relation to the central government are illuminated, full-fledged information systems cannot be undertaken. To that end, the administrative process need be established first. But Previous studies shed light on the need for management options to enable seamless information flow by minimizing the changes in structures or operational principles and by providing information processing capabilities meeting the demand for information processing required in the process[3,17,18].

2.2 Drum-Buffer-Rope

DBR (Drum-Buffer-Rope) is a resource - materials or information, services - flow in the whole of point view oriented modeling rather than partly resource oriented and it is used in physical product process that traces most of physical material flow15,16. DBR maximizes the effects of improvement by identifying and using constraint resources most efficiently as well as by proposing alternative plans to control the flow of production via constraint resources. As the scheduling is made based on CCR (Capacity Constraint Resources), the global interest, rather than local efficiency, is valued whilst process dependency and variation are accepted, so that the process can be carried out as planned16. Thus, as selecting constraint resources enables efficient organizational management, identifying and continuously managing constraint resources is highly important. In modeling the process, one is to identify the CCR of the process, or work units, based on which the points for Drum,



(a) Process flow with government hierarchy (b) Interdepartmental process flow of government

Figure 1. Administrative Process flow characteristics of the local government flow.

Buffer and Rope are set, so that logical flow is managed for simultaneous control over variation due to uncertainties and dependent relations. In DBR, the 4 steps are iteratively performed to establish the process and identify the operational principles: find the CCR → Match the Drum→ Set up the Buffer → Connect the Rope[15,17]. The most significant issue in a function-centered organization is that its capacity of information processing should meet the increasing demand for information processing. That is, organizational performance depends on the extent to which the information is processed by the organizational process. The DBR in the theory of constraints is a technique to support organizations with information processing by controlling and managing its constraints of process in a way that organizations can make the most of its capabilities. In using DBR, the overriding factor is to identify CCR. Any procedure with the longest queues ensuing becomes the very CCR. Upon the CCR being found, the process management for a DBR-based global optimization starts[18].

3. DBR-Based Process Management

3.1 Things to Consider when Applying DBR

The present study proposes an alternative for administrative process management in local government based on DBR, a technique for process modeling and scheduling. To establish the administrative process based on DBR, this study saw the administrative process from the perspective of information processing as the flow for global optimization, and derived different types of process in light of the causes of CCR present in the process. That is, identified CCRs are classified in line with the causes constraining the seamless flow of information processing so as to propose a process management method using 'D', 'B' and 'R'.

Administrative process refers to all activities performed to provide the best administrative service for citizens, which is one of the goals of administrative organizations. CCR is defined as the work units where delays arise due to the discontinuance of information flow in any administrative process. Drum in any administrative process is defined as the plan for work processing. That is, Drum is a plan to deal with works based on the information about their queue status, which is gained through the Rope. Drum supports the estimated time taken for a citizen to receive a service as requested or the information about current progress. Drum facilitates the processing capabilities to the maximum by placing the information at a point requested and by providing the just-in-time information needed to carry out a given work unit. Therefore, Drum is based on the CCR. In the administrative process, a tool serving as a storage like a database is needed to make sure information flows seamlessly even when any variation occurs. In the DBR-based process modeling, the role is given to the Buffer. The Buffer is linked to the CCR in regard of logical flows. Logical flow management involving the authority to access the information storage and to define relational process is more important for the Buffer in the administrative process in the sense that the logical storage Buffer should support continuous performance as the CCR is a work unit that should acquire necessary information from external sources.

3.2 DBR-Based Administrative Process Model

It is meaningless to find a constraint resource for an instance randomly arising externally. Therefore, identifying the causes of delaying the flow of information processing is fundamentally important for carrying out requested administrative services. The first step in the DBR-based modelling is to find out the CCR.

From the perspective of global optimization, the constraints on the flow of information processing are the presence of knots where the flow is stagnating, congested or delayed. The delays in time due to the knots are associated with the CCR.

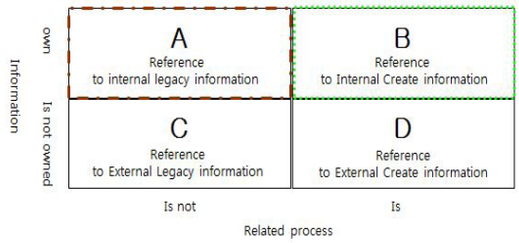


Figure 2. Lattice model of process classification.

The present study is to derive different types of CCR based on two criteria, i.e., the presence or absence of a process relevant to the possession of information. A lattice model is defined in line with the criteria. Here, the possession of information refers to the authority to create, read, update and delete any necessary information in carrying out the administrative process. The failure to possess information refers to having the authority to read only. That is, the possession of information means being authorized by a person in charge of managing the information related to other process or being allowed to access the information by law. Another factor determining the types of CCR is the presence or absence of a process relevant to carrying out the administrative process. Administrative service is provided at the request of clients, i.e., residents or internal members. Here, a reference process is synchronized with another process to get the resultant output, which is provided as part of the administrative service. A relevant process is synchronized and performed to get the output and thus to update the information in possession as part of administrative services. Or, a relevant process is synchronized, followed by a series of information processing, and refers to the output information created as part of the administrative service. The DBR-based administrative process management ensures a seamless flow speed to prevent any delay in the flow of information processing, with a view to minimizing the cost of information processing while maximizing the efficiency and effectiveness of the administrative process. Reference to internal legacy information (A type) process holding information ownership and standing alone independent of other process is classified as type A. The role of CCR of process type A is only to refer to information. This type includes administration that the local government has the authority to delete, make, and modify data for the cases of birth/death notice, resident registration number assignment, and barber/hair shop licenses etc. With normalization and standardization of the process, CCR can be relaxed into unrestricted resources. Thus, it is more effective to computerize for the process type A not by local government but by the central government through standardization.

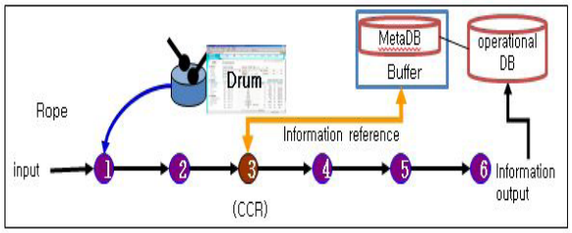


Figure 3. DBR-based Process Management Model A type (Reference to internal legacy information).

Reference to Internal Create information (B type) is same as the type A in that it refers to information created by other process. This type has the authority to delete, make, and modify data for financial process. It is distinct in that it asks other related process to obtain the information for reference.

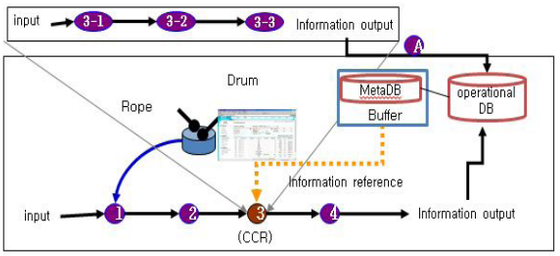


Figure 4. DBR-based Process Management Model B type (Reference to internal create information).

Reference to External Legacy information (C type) which is referring to information created and managed by other process without information ownership is classified as type A. The CCR of process type C is relaxed into unrestricted resources only by introducing the buffer, as it has no authority to manipulate data. This type includes administrations pertaining to authorization process such as land plans, medical facility renovation, and

Table 1. Process characteristics for reference to internal legacy information

	Model A type details
Specificity	• Mostly, this type of process manages register information and provides other process with information.
Variation Control	• The status information about civil service works is identified through the Rope and delivered (Messing). By sharing the information, the time for queue while calling the unique attribute information is reduced in the CCR. • The rate of variation is not high.
Availability of Resources	• As this type of process has both unique and reference attributes information, it is necessary to view the information, including that about register management, using the Buffer.

Table 2. Process characteristics process for reference to internal create information

	Model B type details
Specificity	• This process is performed in collaboration with other process. • The information required to perform this process is newly created, stored and managed, e.g. condo application management and summary reports.
Variation Control	• To control any variation using the Rope, the information about the time taken to complete other units which provide new information is important. • As the Rope is used to deliver the information about the progress of work units in the process, a real-time management of Drum scheduling is supported. • Information sharing is expected to reduce uncertainties and lead time. • The person in charge can manage the reception of requests for civil service, which is equivalent to the stock reduction effect in VMI. The person in charge can actively control the queue for civil service.
Availability of Resources	• As resources are operated and managed in the form of meta database through the logical storage Buffer, necessary information can be provided in the right place.

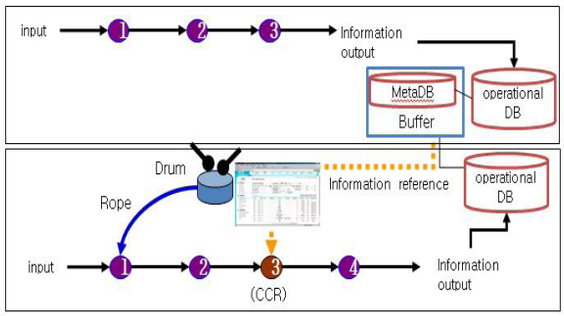


Figure 5. DBR-based Process Management Model C type (Reference to external legacy information).

confirmation process like local taxation. Delays mostly occur due to the spatial constraints in referring to information managed by other process. Therefore, to relax this type of CCR, online access to database has to be allowed by laws.

Reference to External Create information (D type) is similar to type B in that it refers to information created and managed by other process without information ownership, whereas it is different from the latter in that it asks other related process to actuate and handle information which it needs to refer to. A typical example of this type would be the building permission, which is possible only after referring to information about sewage facilities and stand-alone septic tanks. As for this type of process, both Buffer and Rope have to be installed in order for CCR to be relaxed into unrestricted resources. That is because duration of this process is not determined by itself, but significantly affected by related process providing information in response to requests made by the process. Therefore, both constraints of control and discontinuance should be resolved. The role of buffer is the same as that in the process type B.

Table 3. Process characteristics process for reference to external legacy information

	Model C type details
Specificity	• No collaboration with other process. • Administrative information managed by other process need be referred to for verification. • Delays can be reduced significantly thanks to the availability of information.
Variation Control	• Rope is used to view any queues in civil service requests, or Drum, in real time, ensuring consistent application of business process guidance in referring to information. • Uncertainties and lead time are expected to decrease through information sharing. • Persons in charge manage the reception of requests for a civil service, which is equivalent to the effects of stock reduction in VMI, and actively control the queues for a given civil service.
Availability of Resources	• Required administrative information can be used promptly by managing process-related information and the operating system database and building the meta database supporting relevant formats.

Table 4. Process characteristics process for reference to external create information (D)

	Model D type details
Specificity	• This type is mostly based on collaboration including most of complex civil administrative process. • This type of process is most prone to variations resulting from collaboration.
Variation Control	• Rope is used to control variations covering from the starting point of a relevant process to CCR (including all work units in collaborative process). • Persons in charge can manage the reception of civil service requests, which is equivalent to the effects of stock reduction in VMI, leading to less uncertainties and lead time. • Real-time information is received from the Rope regarding any possible variations that might arise in collaboration process and can be viewed through the Drum in charge of managing the work queues. Persons in charge can apply the work guidance to the queues for civil services, actively controlling the process. • In particular, when any request is received from relevant process of this type, efficient performance is supported in a way that a series of procedures can be processed en bloc, e.g. the internal consultation that need be done per case based on the information about the received requests for civil services.
Availability of Resources	• The freshness of information is highly important as the information about the time taken for relevant process providing newly created administrative information to complete is referred to. • As resources are operated and managed in the form of meta database through the logical storage, or the Buffer, information can be supported as necessary in the right place.

4. Case Analysis of DBR-Based Process Management Model

4.1 Overview

The present study is targeted administrative process for local government. Thus, to examine local government' administrative process, the civil service administrative process specified in the Ministry of Government Administration and Home Affairs' Standard Civil Service Processing Table and Civil Service Innovation Initiative (G4C) were investigated. Also, 3 out of 245 local governments were randomly selected that had established information strategy plans in order to analyze the collected data of administrative process carried out within the organizations. The administrative process

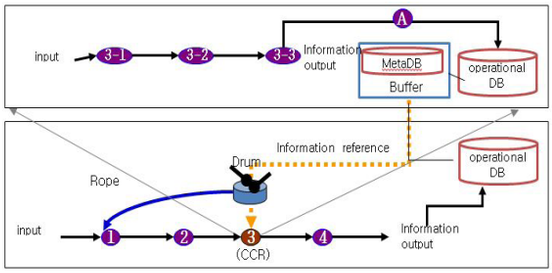


Figure 6. DBR-based Process Management Model D type (Reference to external create information).

information analyzed here were collected by interviewing and surveying those in charge regarding the time taken to process requests, time spent on interface interactions, relevant information and collection methods12–14. As proposed here, typical cases were selected based on the types of CCR causing the discontinuance to information flow to draw a conceptual flow chart of the DBR-based administrative process and thus to show the management mechanism. The quantitative and qualitative effects of process modeling are explained here in terms of the implementation of Buffer and that of Rope and Drum, respectively. The Buffer shows the quantitative effects visibly by increasing the accessibility to information through the shared information about unique attributes, whereas the Drum and Rope are tools for scheduling and synchronization, enhancing the convenience in dealing with services and enabling active process management based on a 'pull' paradigm.

4.2 Case Analysis of Each Type of Administrative Process

Reference to internal legacy information (A type): This type of process starts when a petitioner notifies some changes to the process for managing the register information and asking for updates. Accordingly, after a consultation with the person in charge regarding whether it is a request for any revision, the petition is received. Here, the time for checking relevant data is defined as the CCR in the DBR-based process management. The process for the building register electronically managed by the building administration information system is a typical case of this type. The person in charge receives the information transmitted upon the receipt of a petition through the Drum linked to the Rope, and searches the building registry holding the unique attribute information for the building area information. Upon the receipt of the petition, it is delivered to the person in charge so that the person can view the information at work and proceed with the process seamlessly. Here, the Drum visualizes the estimated time for processing and the progress from the receipt of the petition to the verification of information so that the person in charge can see any variation that may arise in reading the unique attribute information up to the point of time estimated based on the information transmitted from the Rope. In this type of process, another important role of the Buffer is to support the freshness and integrity of information Therefore, to meet the demands of other types of process intended to refer to the up-to-date information, and to provide quality, reliable and transparent administrative services, a prompt execution of this process is a very important factor for improving the internal efficiency across the board in local government. The proposed DBR-based Buffer reduces the time spent on verifying documents, eliminates any redundancy of information and guarantees the freshness of information, all of which cannot be supported by the registry-based information sharing system. Reference to Internal Create information (B type): This type of process has all authorities over information. Yet, it calls for collaboration with other process in creating management information for the perfection of information. Mostly, press releases are managed by supporting departments, not the department of general affairs or planning. Still, press releases are often created in relation to the outcomes of administration services fulfilled by first-line departments or announcements on those services to be provided. Therefore, the process for managing press releases is based on some new information created by first-line administrative process. This model comparatively visualizes the process for managing press releases before and after the adoption of the Buffer concept. Once the information examined was fed into the model, the time for queuing and processing markedly decreased thanks to the information sharing. As a consequence, the total lead time for the process dropped. Reference to External Legacy information (C type): The process for local tax exemption and reduction involves the receipt of a petition, relevant administrative services, issuance of confirmation documents concerning tax exemption and reduction and the overall management. The administrative information requested in the process consists of 10 items including the register of tax exemption and reduction that manages the outcomes of the administrative services fulfilled. The person in charge reviews the attached documents and

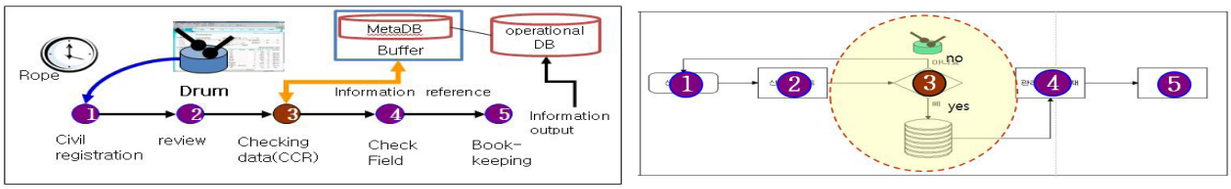


Figure 7. Model A type Case (L) DBR-based Modeling conceptual diagram (R) Apply simulation.

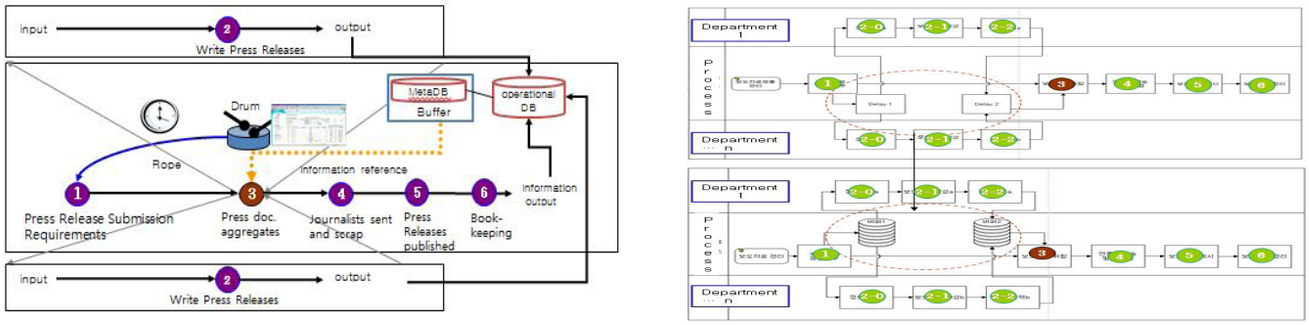


Figure 8. Model B type Case (L) DBR-based Modeling conceptual diagram (R) Apply simulation.

examines the legitimacy before proceeding with the exemption and reduction of local taxes. The other 9 items of administrative information excluding the register of tax exemption and reduction are managed by other process. Administrative information should be supported as necessary in real time. Yet, as the person in charge does not possess the information, he or she should consult with others in charge of relevant administrative information and send official documents asking for the reference to information or use other methods including phone and personal contacts to collect the necessary administrative information. In this process, the information flow discontinues. As interfaces should interact with one another, an average of 6 days is taken to verify the information and complete the service. The concept of Buffer significantly differs from that of the legacy information sharing system. The legacy system for information sharing is based on registry-centered databases. Thus, even when one is authorized to access the information, delays occur in referring to relevant information as the information is provided on a registry basis. That is, although all of the nine interfaces associated with the third(3) work unit are managed by the administrative information sharing system, the sequential events are iterated 9 times, assuming it takes 10 minutes on average to access and view the information.

The Buffer proposed here manages the metadata of unique attribute information extracted from the operating system databases such as the resident network, the building information system, the Saiol, the land network (KLIS) and so on. Therefore, each process is supported by the extraction of information as necessary from the meta databases managing the unique attribute information. Here, the person in charge sees the information provided by the Rope upon instances occurring, and then the Drum is used for work management. There is no need to wait more than 6 days for reference to information thanks to the Buffer. The effects of the Buffer on the reduction of process lead time can be visualized by modeling the process. Upon entering the time in the model for virtual operation, the time for queue dropped to '0', whereas the time spent on viewing and processing the information changed a bit, which is attributable to the increase in the minimal amount of time taken for the GUI-based screen outputs and for checking. Therefore, it is the Buffer among the concepts of DBR that can visualize the quantitative effects. The Buffer secures the prompt availability of information and provides the time for reference to information in real time, guaranteeing the information flows without discontinuance. Reference to External Create information (D type): The process for building permission (relevant to the Article 8 under the Building Act) represents the cases of complex petitions.

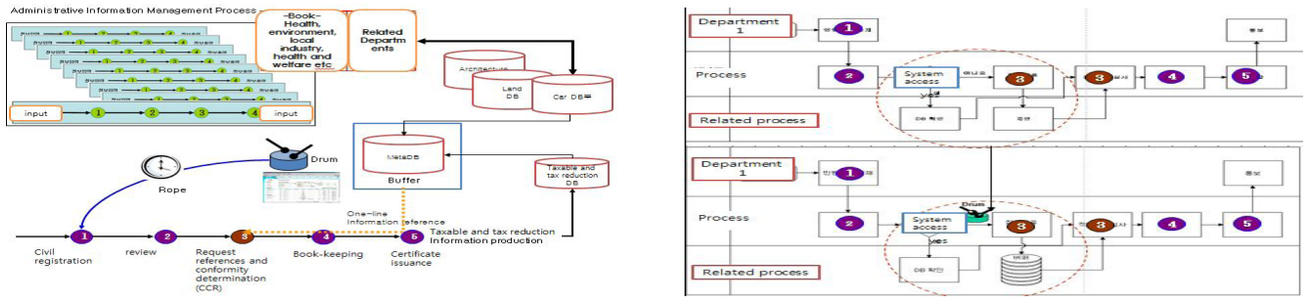


Figure 9. Model C type Case (L) DBR-based Modeling conceptual diagram (R) Apply simulation.

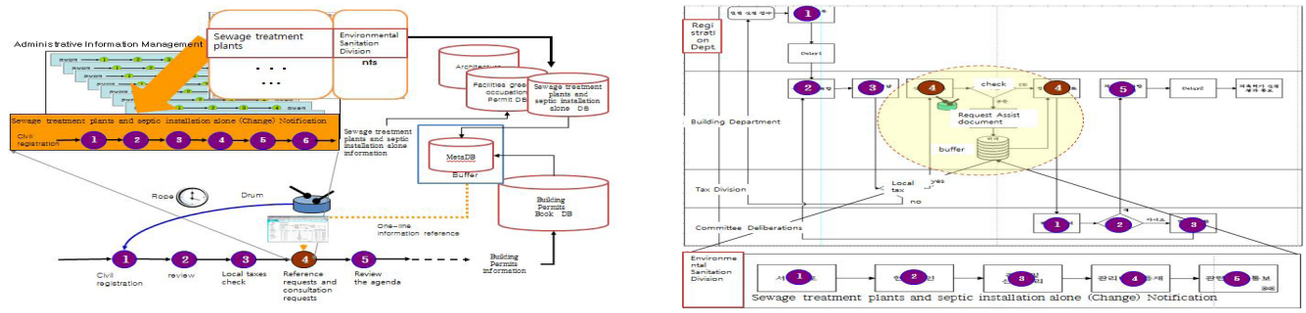


Figure 10. Model D type Case (L) DBR-based Modeling conceptual diagram (R) Apply simulation.

The administrative information required for the instances of building permission varies from case to case. Diverse process may be called depending on whether the target sites for building permission are associated with cultural treasures, adjacent to air force bases, or contiguous to water protection zones. The difference between the reference to external create information (D) and the reference to external legacy information (C) lies in the fact that the former is far from any simple reference to current administrative information under control. As the present study is intended for a case of the reference to external create information, it is outlined here in relation to the process for reporting the installation (replacement) of sewage treatment facilities and stand-alone septic tanks. The CCR in the building permission process is the process of referring to newly created information, or the content consulted in the relevant process such as the one for reporting the installation of sewage treatment facilities and stand-alone septic tanks, which constitutes the fourth (4) work unit. The Drum supports the functions for monitoring the progress of the process in parallel with the estimated time for processing. Thus, it enables controlling the variation that may arise in relevant consultation process. The person in charge of building permission proceeds with the process upon the receipt of newly created information about an instance. The process is comparatively visualized in relation to the process for building permission before and after the adoption of the Buffer concept. Following the virtual operation with the information input from the specific analysis of works performed in local government after the adoption of the buffer concept, the time for queue dropped from '3.10' to '0.10', with the time for processing the service decreasing from '17.86' to '14.89'. After all, the lead time is reduced. In the process for the reference to external legacy information, the time for queuing is mostly attributable to the reference to information. In contrast, in this process, relevant process is carried out before the reference to information. Therefore, the extent of reduced time for queuing is not significant. Still, as the relevant process constitute the type for reference to external create information or other types, the time spent on the reference to information in the process is simultaneously reduced, which contributes to the reduced time for service fulfillment. As seen in the case of the process for building permission, the DBR-based process management is applicable to all process in local government. Furthermore, if the DBR-based process management applies to the administration system across the board, it is likely to produce synergy effects because the building permission registry information has unique attribute information, which is frequently referred to in the process for the reference to external legacy information.

5. Conclusions

To the disappointment of administrative organizations intended to solve internal challenges rooted in the bureaucratic structures from the process-based perspective, the BPR-based information system deployed across local government has been reported to fail to facilitate the seamless information flow. On the contrary, the information system manifests the central government's interest more explicitly, adding to the complexities. The present study started by raising critical questions about this phenomenon and focused on the following attempts. First, the present study examined the challenges to be addressed in order to increase internal efficiency through the management of administrative process in local government, and proposed an alternative approach to process management. Second, the present study introduced the DBR as a way to manage process, reflecting the manifestation of stability, transparency, public interest and legal and regulatory principles that characterize local government, as well as the flow of information from the perspective of analyzing process design. Third, the present study demonstrated the DBR's usefulness for administrative process management, and proposed a DBR-based model for local government' administrative process design from the perspective of information flow. In addition, this study shed light on the CCR as the point for controlling the overall flow of process, and extracted 4 types of the causes of CCR in terms of possession of information and its relation to process. Then, this study showed how to manage such process by applying the Drum, Buffer and Rope to each. In the proposed DBR-based administrative process management, the Drum was set as the reference for controlling the flow. Also, the Buffer was created as a concept for a system that enables sharing administrative information as one of the factors causing bottlenecks in information processing. Finally, the Rope was defined to support control functions for synchronizing relevant process and thus preventing any discontinuance of the flow. In addition, to show the feasibility of the proposed model for local government' administrative process, 3 local government were selected as the cases to be analyzed with reference to the business process analysis, which is the outcome of the information strategy plans and BPR project performance. In short, the analysis verified the feasibility and usefulness of the DBR-based management of administrative process in local government. The framework proposed in this paper will provide some ideas and directions for further studies regarding the management of administration process. Hopefully, the findings in this paper will be a useful alternative to process management. This study derived 4 different types of local government administration process, discussed the unique features of each type and considered them in regard of design and management. In particular, how to use the concepts of Drum-Buffer-Rope and their implications were discussed in detail.

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