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A Method of Digital Transformation Toward Effective Institutional Research

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Abstract

We discuss the problem of data collection in Institutional Research (IR) and issues in Digital Transformation (DX) at Japanese universities and report our solution for both. IR conductors have faced the difficulty of data collection for a long time. Lack of data and low quality of data are crucial problems in data analysis. We have found that the root of the problems is hidden in administrative work and introduced the method of Business Process Management to overcome the problem. Investigating and analyzing the current working process leads us to understand the data set and flow. We suggest the improved process after the analysis and implement it into a web-based workflow system which allows us to aggregate and store well-defined data sets automatically and advances the efficiency of work. The improvement of working processes is considered digitalization in the phase of DX.

Keywords: Institutional Research, Business Process Management, Digital Transformation, Data aggregation.

1 Introduction

Data gathering and collecting is a longstanding problem in Institutional Research (IR) in Japan [1, 2]. Although data especially university internal data are fundamental ingredients of IR, many IR conductors have faced difficulty in gathering internal data. The difficulty is caused by some reasons for example; diverse data formats such as Word, Excel, PDF and paper-based; undefined data structure; data scattered among several sections and departments. The problem with the data format and structure can be solved by data warehouse or lake systems and ETL (Extract-Transform-Load) tools, but the last one should be resolved by another approach. We have suggested the essential solution is to change administrative work and build a mechanism of data flow structure to aggregate a database system [3].

Administration staff usually focus on the immediate handling of tasks and do not pay attention to the reuse of the result of the task, and this makes low-quality of outcome data. The result of the task usually is used by the next work as an ingredient. Low-quality of outcomes will make a decrease in the quality of the next task or further effort the person

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in charge of the next task to improve the quality of the task. Accumulation of this chain of outcome data will finally lead to low accessibility and availability of data and thus IR conductors face the difficulty of data gathering. The origin of the chain is a convention of the work style of Japanese administrative work, which can be considered a result of the advancement of the division of labor. Quality assurance of the work outcomes is key for the solution of inaccessibility of internal data and data gathering problems in IR.

On the other hand, Digital Transformation (DX) is a significant factor in Japanese business and public organizations including educational institutions in the past half-decade. Ministry of Economy, Trade and Industry (METI) of Japan has released a report series titled "DX Report" in 2018, 2020, 2021 and 2022 [4–7]. The report is based on a sense of crisis of the use of outdated ICT systems and the cost of its maintenance and requires organizations to change to catch up with the fast-evolving global business. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the cabinet office of Japan starts to make policies for the advancement of DX in education and research [8, 9] and the trend of DX has advanced after the COVID-19 pandemic in 2020. According to the trend of DX, utilization of various data especially internal data and restructuring of administrative work are discussed as important topics of DX. The problem in IR mentioned above is also a problem in DX at present.

Tokyo Institute of Technology has launched "Institute Transformation Section" to ensure data accessibility and reformation of administrative work in the university. To improve the data flow structure, we analyze a workflow of administrative work and identify the data set and flow based on the methodology of Business Process Management (BPM) [10]. Through the analysis, we suggest an improved workflow and implement it into the web-based workflow system [11]. All the data in the workflow is stored in the system automatically, and it has high accessibility for IR analysis since the data structure and metadata are well-defined. Workflow analysis and implementation of the web-based workflow system cover both overcoming the IR data-gathering problem and reformation of administrative work as an advancement of DX. This manuscript reports the framework of our methodology and the current situation. A detailed discussion of the IR work cycle and the origin of data are described in Section 2. A problem of Digital Transformation in Japanese universities is discussed in Section 3. The concept of Business Process Management is reviewed in Section 4 and our method based on BPM is introduced in Section 5. Section 6 is devoted to the summary and conclusion.

2 Origin of IR Data

The definition of Institutional Research (IR) widely accepted is "Institutional research is research conducted within an institution of higher education to provide information which supports institutional planning, policy formation and decision making" [12]. There are many understandings and interpretations of IR because it depends on the type of each higher education institution such as university or college, national, public or private, and the situation such as budget scale, management policy and key stakeholders. The mission of IR in many Janapese universities focuses on education quality assurance.

As we mentioned in the previous section, information and data are the central roles in the IR cycle. Figure 1 shows a typical cycle of information support according to IR and decision-making. "Broker" who corresponds to IR conductors receives data and restructures and analyzes and then creates a report to the manager to support decision-making.

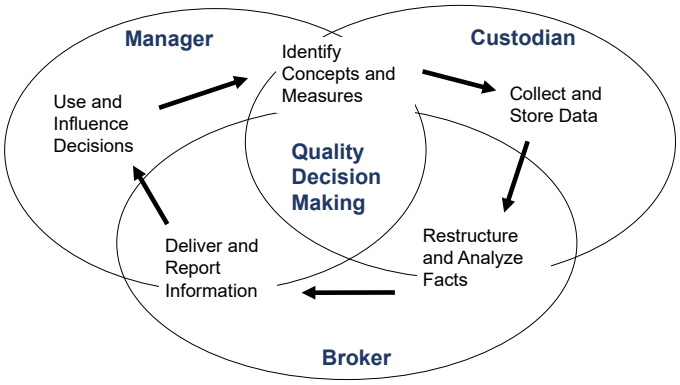

Figure 1: Information support cycle cited from [13]

"Custodian" who corresponds to administrative staff provides stored data to the broker. The figure also assumes that the necessary data is collected and stored, and can be provided to the broker as needed. However, the lack and scattered data is the problem, and the process between "Collect and Store Data" and "Restructure and Analyze Facts" is failing.

An example of data flow to an IR conductor is shown in Figure 2. The original forms of the data are;

Questionnaire: Taken as needed like student surveys,

Printed/electric files: Specified format and file,

Data management systems: Stored basic personal data etc.,

and these data are stored in a data warehouse system after data cleaning. The IR conductor uses the stored data to analyze and creates a report to provide to the manager (executive of the university). Data cleaning techniques and data storing systems have been discussed in IR studies [1, 2]. However, the problem happens in the first phase of collecting and storing the original data through questionnaires, printed/electric files and data management systems on

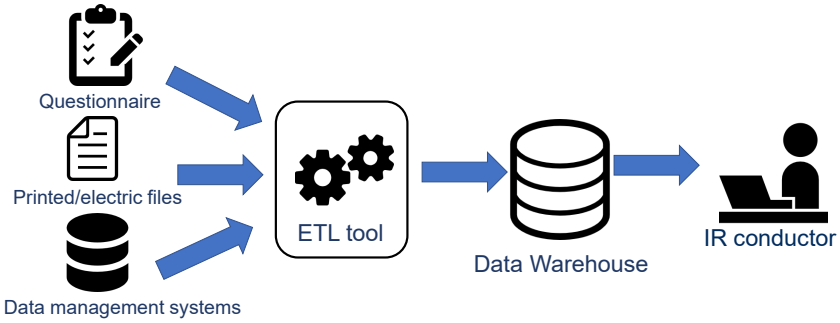

Figure 2: Data flow from the original form to reaching IR conductor

paperwork in Japanese university administrative work and printed or electric (Word and Excel) files are circulated inside the university. The administrative staff in charge has the central role in the process as below:

1. An applicant fills in the application form and submits it to the staff in charge.
2. The staff checks the content of the application and passes it to the decision-makers to get approval.
3. The decision-makers review the application and approve it, then return it to the staff.
4. The staff confirms the approval and finally returns the form to the applicant and informs the result of the application.
5. Some of the data will be recorded in a data management system by the staff if needed.

When some mistakes are found in the application during the approval process, the staff returns the form to the applicant and instructs the modifications. The data is directly submitted to the staff in charge from respondents and stored without checking and approval of the content in the case of questionnaires. The origin of data is usually concentrated in the adminis

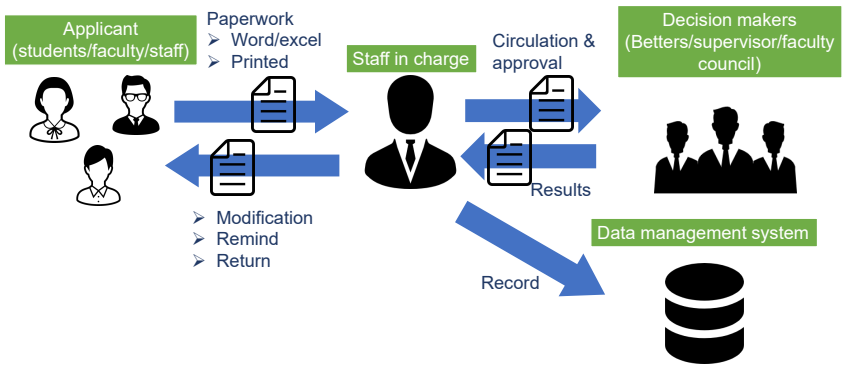

Figure 3: The process of data generation. Files are circulated inside the university and the staff in charge acts as a hub for the files.

Figure 4 shows the combination of Figure 2 and Figure 3, which gives us the whole image of data flow beginning from the data generation to the utilization by the IR conductor. While the previous studies [1, 2] focused on the phase of data cleaning and storing, this figure suggests that the central role of data flow is the administrative staff. Thus, the root of the prob strative staff. W ocess.

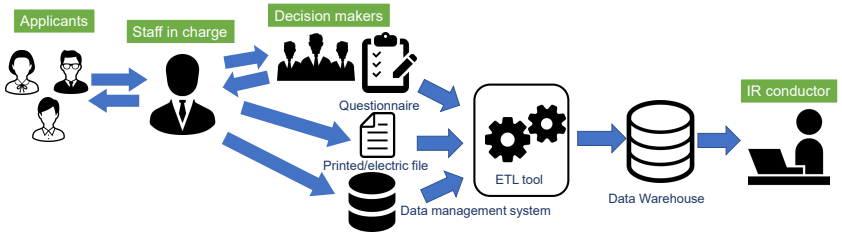

Figure 4: The combination of Figure 2 and Figure 3. This figure provides the image of the whole data flow structure from generation to utilization by the IR conductor.

3 Digital Transformation in Universities

METI defines Digital Transformation (DX) as "companies establish a competitive advantage based on the needs of customers and society using data and digital technology to adapt to the rapid changes in the business environment with the process by which the company transforms its products and services, business models, and even its organization, processes, and corporate culture," (author translated) in [14]. METI's DX seems to only focus on business companies according to the definition, but [4] is constructed based on the economic crisis so-called "2025 cliff" and it is the strong alert of aging ICT systems and huge cost and risk of the system maintenance. The alert of the 2025 cliff pressures not only business companies but also public organizations including educational institutes. DX in education is a plan for the utilization of educational data using the tool of online learning systems [8], and DX in research is a plan for data-driven research using big data and the advancement of open science [9]. These projects are new and innovative for education and research, but restructuring organization, processes and corporate culture is less discussed.

Reference [15] surveys the situation of administrative staff in Japanese universities. We do not review the survey result in detail but focus on some important facts. Around 60 % of respondents answer they have too many tasks (Figure 2-7-3 on page 57), around 65 % of respondents answer their tasks are increased due to the COVID-19 pandemic (Figure 3-5-1 on page 105) and around 45 % of respondents answer efficiency of work is advanced by the pandemic (Figure 3-5-4 on page 107). This fact suggests they have a lot of tasks and it is increased by the pandemic but improvement of efficiency is less advanced. Chapter 5 reports issues in the work environment such as increasing tasks, efficiency, shortage of human resources and work-life balance through free descriptions survey.

The report suggests a potentiality of the reformation of administrative work and the administrative staff seems to be left behind the trend of DX in universities. The series of DX report [4–7] suggests some examples of ways of DX for organizations to change the work environment. Reference [5] shows the steps toward Digital Transformation (Figure 5-8 on page 34);

Digitization: Converting analog and physical data to digital,

Digitalization: Digitalizing individual services and processes,

Digital Transformation: Digitalizing cross-sectional/whole services and processes and transforming operations and business models to create customer-centered values.

It is worth mentioning that these steps can be applied to administrative work in universities since the fundamental functions and processes are the same as administrative work in companies. Therefore, we report the case for the application of a DX methodology to the university administrative work in the following section.

4 Business Process Management

4.1 Concept and Framework

Reference [5] suggests a redesign of processes as a first step of DX. This redesign of the process should be reevaluated continuously and sustainably because the process quickly becomes obsolete and the organization easily loses its competitive advantage in the rapidly

changing world. We introduce a method to redesign the working process and a web-based workflow system [11] to store internal data, especially for data generated by paperwork. If the process of administrative work and the data set treated in the process are well-defined and it is implemented in the workflow system, the data necessary for IR is automatically aggregated and stored in the system. Restructuring the processes and introducing an ICT system for supporting the process is a good way for both DX and IR.

Business Process Management (BPM) is a systematic methodology of management of the business process and is defined as "Business Process Management is a discipline management approach to identify, design, execute, document, measure, monitor, and control both automated and non-automated business processes to achieve consistent, targeted results aligned with an organization's strategic goals," in [10]. The word "business" may lead to a misunderstanding that BPM is used only in businesses and thus we use the word "working process" or just "process" instead of "business process."

4.2 As-is Analysis

We visualize a working process to analyze it and suggest an improved process. The investigation of the process is done with the administrative staff in charge. The improvement of a working process begins with the investigation of the current process. We focus on the points below in the as-is analysis:

1. Visualizing the current working process step by step as it is.
2. Confirming the actors of the process and its roles and authorities.
3. Checking the content of the application form and data set on the form.

Then, we discuss and list problems in the current working process for example so many returning to the previous actors for modifications and taking a long time because of circulation among many actors and/or late approval. These problems naturally arise during the visualizing process. As-is analysis is the most important step in the restructuring of the working process. The staff is not conscious of the working process usually and it becomes implicit knowledge, hence the step is good training of the staff for implicit knowledge to be explicit knowledge. The staff begins to understand the limitations of the current process and the way to improve the working process.

While there are some ways of visualization of a working process in BPM, we accept the way called Event-driven Process chain (EPC) defined in [16] and use the web service named Ranabase [17] to visualize. Figure 5 shows a typical structure of EPC writtein in [17]. One column describes an actor and time flows up to down. A task is described at the central square in the figure and inputs of the task are put on the left side and outputs are put on the right side. There are some types of icons of inputs and outputs according to the form of input and output. The task icon must involve event icons on the top and down. The top event means the opening trigger of the task. The actor must have a reason to start the task such as receiving an application document (event-driven task). The task has a condition for finishing, but usually, the closing condition corresponds to the opening trigger of the next task. Thus, the closing condition is put on top of the next task as the opening trigger (see Figure 6). Since each task is connected in this manner of events (chain of events), the way of visualization is called Event-driven Process Chain. According to the definition, the process must start from an event and end with an event.

The structure of EPC is good for analyzing university administrative work because;

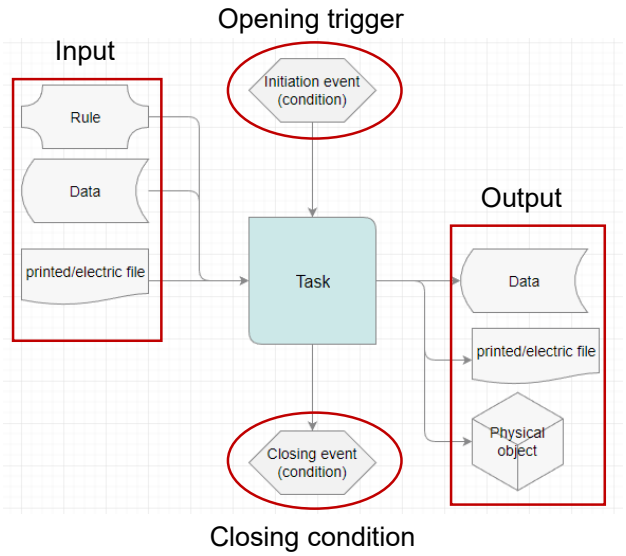

Figure 5: The minimum strucure of EPC dran in [17].

1. The process is advanced according to the actor. Almost university administrative works are done in a non-automated way and the staff in charge handles tasks:

2. The picture forms chains of not only events but also inputs and outputs. Outputs of a task are usually used in the later task as inputs. If an output created by a task is not used for later input, the task may be unnecessary. It is useful to check the validity of the task:

3. EPC describes all branches such as “AND,” “OR” and “Exclusive OR (XOR).” University administrative work is a chain of branches and the staff in charge always judges the condition and situation of the branches in many cases. The number of branches and complexity of conditions are remarkable points of improvement in the working process.

4.3 To-be Planning

After listing the problems of the current working process, we start to plan the improved working process (to-be process). The to-be process should overcome the problems of the as-is process ideally, but it depends on the difficulty and complexity of the problems. If the problem is not deepened to its root, the solution is superficial and the to-be process does not reach essential improvement. The listed problem at the beginning is usually superficial and the solution seems to be just introducing a new ICT system such as RPA (Robotics Process Automation). Although introducing new ICT systems is a strong solution actually, it can lead to a typical misunderstanding of DX that “DX is just a replacement of aged ICT systems to newest,” reported in [5]. When we investigate the problem deeper, we finally reach old and obsolete organizational culture and regulations in many cases. A final goal of DX is to change and restructure the organization such as aged culture and regulations, but it is difficult to change rapidly. Therefore, [5] suggests steps toward the goal. Our stage of digitalization (digitalizing individual processes) is a key step toward the goal.

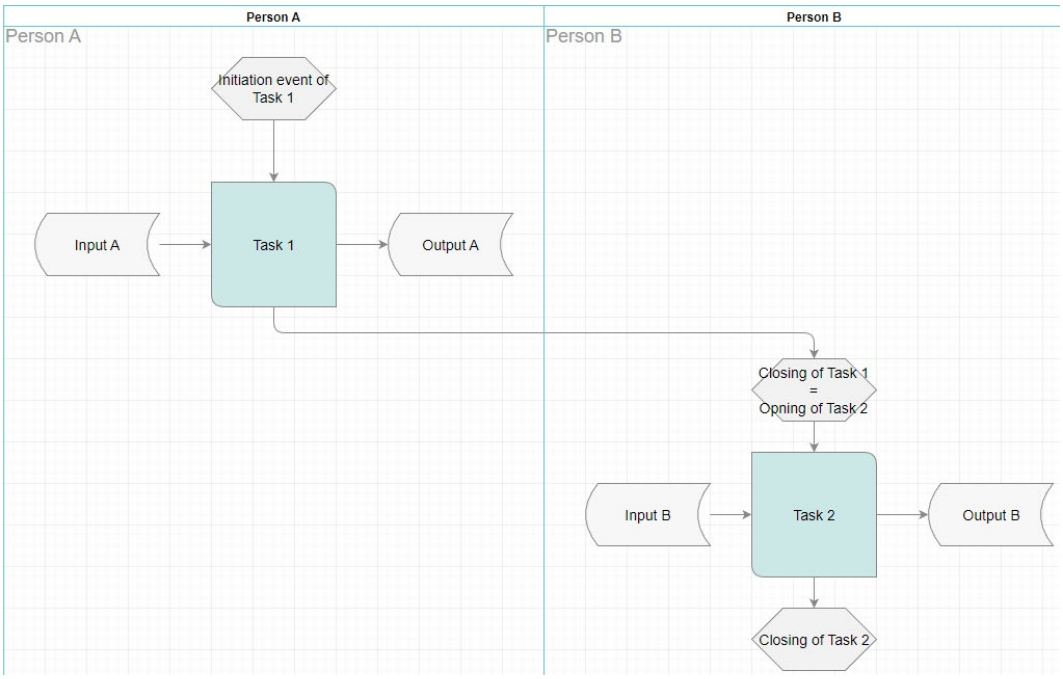

Figure 6: A sample of event chain in EPC

We plan the to-be process to overcome the deepened problems as far as possible and should proceed cautiously. During the process of to-be planning, we need to explain our plan to all of the actors as necessary because the process and tasks are changed and they should understand and agree with the new process. If we decide on the to-be process without agreement with all of the actors, they would become resistant and the reformation of the working process would be failed. Thus, knowledge of stakeholder management (a part of project management [18]) is crucial for the to-be planning process.

5 Our Methodology

We have been establishing our methodology for the improvement of administrative work and data aggregation based on BPM, which is still under development but we report the current achievement. Our basic policy of solution is the implementation of the web-based workflow system [11]. The system intercedes the working process among the administrative staff in charge, applicants (students, faculty and other staff), decision-makers (chief, supervisor, faculty council, etc.) and any other actors. The system receives an application through the web submission form, circulates and gets approval for the application, and then stores the approved data automatically. While these functions are common with workflow systems generally, we adopt [11] because it can fit Japanese organizational and/or university cultures, for example, a tree structure of organizational hierarchy (subordinate often asks approval of superior), multiple steps of approval and information sharing with related staff and many faculty depute secretary and administrative staff to take charge of the paperwork. In addition, it is a no-code platform and thus we expect the implementation of workflow to be done by the administrative staff in charge. There are a few hundred applications and paperwork in the university and it is impossible to implement all of the work with the limited

staff in Institute Transformation Section.

We create the document named "work specification document" during the planning process, which consists of the result of the as-is analysis, problems of the as-is process, and the design of the to-be process such as:

1. Role and data access rights of each actor,
2. Organized application form and data set,
3. Circulation and approval process,

which are the ingredients of the blueprint of implementation. The administrative staff in charge implements the to-be process into the workflow system based on the document and we help them, especially with technical support. The document is continuously revised when the implementation is upgraded and the working process is renewed. Since personnel transfer is one of the serious issues in Japanese universities, especially in national and public, which is mentioned in [15] as well, documentation is an important quality assurance for handover and sustainability of work.

5.1 Facilitation and Management of Improvement Project

The facilitator who performs BPM with the staff in charge is also an important factor of advancement DX. He or she needs specialty not only BPM but also knowledge and skills of facilitation, coaching, and project management. Facilitation and coaching skills provide psychological safety, which assures the staff can tell the current working process and problems on it. The facilitator must create an atmosphere of safety and build a relationship of trust. This relationship is useful to perform IR as well if the facilitator is also an IR conductor because the staff kindly cooperates with IR activity according to the relationship.

The knowledge of project management [18] is also important for the facilitator, especially scope management and stakeholder management. The facilitator needs to lead the staff to effective improvement of the working process, to which he or she needs to handle the scope of the project. As well-known in project management, scope creep easily occurs and it makes delays in schedule and losing the trust of the staff. Careful stakeholder management is necessary as well. As we discussed in the previous section, a working process can involve many actors and the to-be process requires changing the process to them. The facilitator and staff must explain the to-be process to them carefully. However, the problem is a facilitator needs wide specialties and experiences. We have been providing a lecture course on BPM and PM for the improvement of a working process from 2022, which is reported in [19] but the systematic training method is still under development.

5.2 Assessment of Improvement

The way of assessment of improvement of work is still under development but we report ideas. Through the as-is analysis and to-be planning, we have two EPC pictures with the same working process. We compare these two to assess the effect of improvement. Reducing the number of tasks and/or actors is a simple effect. Reference [17] has the function to input the required time for finishing a task. During as-is analysis, we input the required time for each task. Almost process has branches, so choosing a typical path and summation of the required time of the process leads to a time for the one cycle of the process. After the implementation and operation of the to-be process, we can evaluate the required time.

A comparison of these two represents the numerical result of improvement. If we know the number of submissions per year, which corresponds to the number of iterations of the process, we calculate the total spent time for the work per year. Furthermore, we can converse the spent money for the work per year by using hourly fees of staff. The calculated time is just a representative sample number because we choose the path intendedly.

6 Summary and Conclusion

We have discussed a longstanding problem in IR data collection, issues on DX in universities, the basic concept of BPM, and our solution. We have pointed out that the root of the data collection problem is the data flow around the administrative staff. The staff usually focus on the handling of their task and do not pay attention to the reuse of the data generated by the task. We need to reorganize the administrative working process and data set to be well-defined. High availability and accessibility of data are essential to sustainable IR workflow. As for the issues on DX in universities, we have pointed out that university administrative staff seems to be left behind the trend of DX based on the report [15]. University administrative staff are suffering from the increased number of new projects and tasks. Recent Japanese university is continuously imposed new expectations from society such as globalization, diversity and inclusion, high-quality human resources with specialty, and high-quality research outcomes. The pressures on administrative staff continuously increased because new tasks were continuously imposed with the remaining prior tasks and operations. We must think that the advancement of efficiency of prior tasks by digitalization to prepare for new expectations.

Business Process Management (BPM) is a powerful knowledge and skill for the improvement of working processes and the identification of data sets tread in the process. The working process is analyzed and improved using [17] and the improved to-be process is implemented in the web-based workflow system [11]. The project on the improvement of a working process is a good example of “Digitalization” as a step of DX. The important point toward sustainable DX is in collaboration with the staff in charge because the staff experiences and understands the way to improve his or her work. The staff is expected to apply this experience to other working processes voluntarily and spontaneously. Through the accumulation of improvement of individual and small-scale processes, we slowly cultivate changing atmosphere and train the staff in the skill and knowledge of BPM.

We have introduced the present idea of our methodology. The documentation of the project is a solution for the handover and sustainability of work. A facilitator is a key person for performing BPM and reformation of administrative work, which is an important part of DX in universities. The necessary skills and knowledge of the facilitator have not been investigated enough and it can be future studies of the university management.

Our solution for data collection in IR is to create the total system of data flow which begins with administrative work. BPM is useful knowledge to understand the data flow during the working process. Improvement of the working process is helpful for both IR and the efficiency of the work, and it leads to the reformation of administrative work. Therefore, the advancement of DX with BPM can be a part of the advancement of IR.

Finally, we point out the future problems of our solution. The assessment of the effect of the improvement of work is not performed enough. We have done a test estimation of the effect using the calculation method discussed in the previous section. According to the test, the required times of some working processes are reduced by 40% to 50 %, but it is based on

the expected time of both the as-is and the to-be processes. Development and establishment of a good index for the effect can be a research theme of IR. The reduced time can be used for other tasks such as a new project and supporting students and faculty. The quantification of efficiency will lead to the total optimization of university management. The shortage of facilitators is another problem. We perform the project based on our experience and it is dependent on individual skills. We have to establish the education method and cultivate trained facilitators. Prevalent knowledge of BPM and the way to the improvement of work is the key to the advancement of DX in universities and it leads to high accessibility and availability of internal data and finally sustainability of the IR cycle.

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