Transition of Japanese Technical Cooperation with Developing Countries for the Capacity Development of Infrastructure Management

Yusuke YOSHIDA[1] and Michael HENRY[2]

[1]Member of JSCE, Master Student, Graduate School of Engineering, Hokkaido University
(Kita 8-jo Nishi 5-chome, Kita-ku, Sapporo 060-0808, Hokkaido, Japan)
E-mail:yoshiyu-4649@eis.hokudai.ac.jp
[2]Member of JSCE, Assoc. Professor, Dept. of Civil Eng., Shibaura Institute of Technology
(Toyosu 3-7-5, Koto-ku, Tokyo, 135-8548, Japan)
E-mail:mwhenry@shibaura-i.ac.jp

This research investigates transition of Japanese technical cooperation with developing countries for the capacity development of infrastructure management in terms of the challenges for the future project reported in the project research papers published by Japan International Cooperation Agency (JICA), using text mining, word co-occurrence, coding and categorizing which allow to analyze the contents of these papers. The results of these analysis show that Japanese technical cooperation have to keep updating itself, while dealing with various challenges emerging year by year.

Key Words : *Technical cooperation, Infrastructure management, Developing country, JICA, Text mining, Word co-occurrence, coding*

1. INTRODUCTION

(1) Research background

As one of the goals in SDGs regarding infrastructure management, Goal 9 has a target (Target 9.1) which focuses on developing quality, reliable, sustainable and resilient infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access. However, according to the project research papers published by Japan International Cooperation Agency (JICA) in 2009 and 2019 (i.e., Report_2009[1] and Report_2019[2], called in this research), developing countries are struggling with deterioration of infrastructure because of the small capacity of infrastructure management (e.g., budgetary issues, malfunction of administrative organization and lack of human resources, lack of skills and knowledge to maintain infrastructure, etc.). Therefore, JICA has given some technical support to developing countries to deal with these problems via their project, on the other hand, new challenges have emerged at each project. Hence, Japanese technical cooperation should be continuously updated and improved to address these challenges by reviewing their past activities and scheming effective approaches.

(2) Objective

Japanese technical cooperation has carried out various projects in developing countries due to transitional challenges emerging at each project. Therefore, this research catches up this transition of Japanese technical cooperation in terms of challenges at each project by analyzing Report_2009 and Report_2019 which summarize their past activities until each published year, challenges and future plan.

2. RESEARCH METHODS

(1) Text mining and word co-occurrence network

First of all, the text data describing the challenges needs to be filter out of the whole text data in each report, thus text mining is effective method to extract target information from whole text data. In addition, word co-occurrence is applied to observe distinctive topics at each paragraph of the extracted text data, which shows words with similar appearance patterns in a paragraph, and can be visually observed in the network diagrams (i.e., word co-occurrence network). The diagram shows the connection of bubbles categorized in various colors, representing words with similar appearance patterns at each paragraph and giving some information regarding each distinctive topic.

Table 1 Categories

Categories	Description
Budget	Dealing with budgetary issues
Organization	Managing administrative/private sectors and human resources
Skill Development	Developing skills for the infrastructure management
Standards	Installing manuals and standards for the infrastructure management
Data	Creating and managing database of the infrastructure
Equipment	Procuring and managing the equipment for maintenance
Countermeasures	Dealing with overload, illegal occupation and illegal quarry

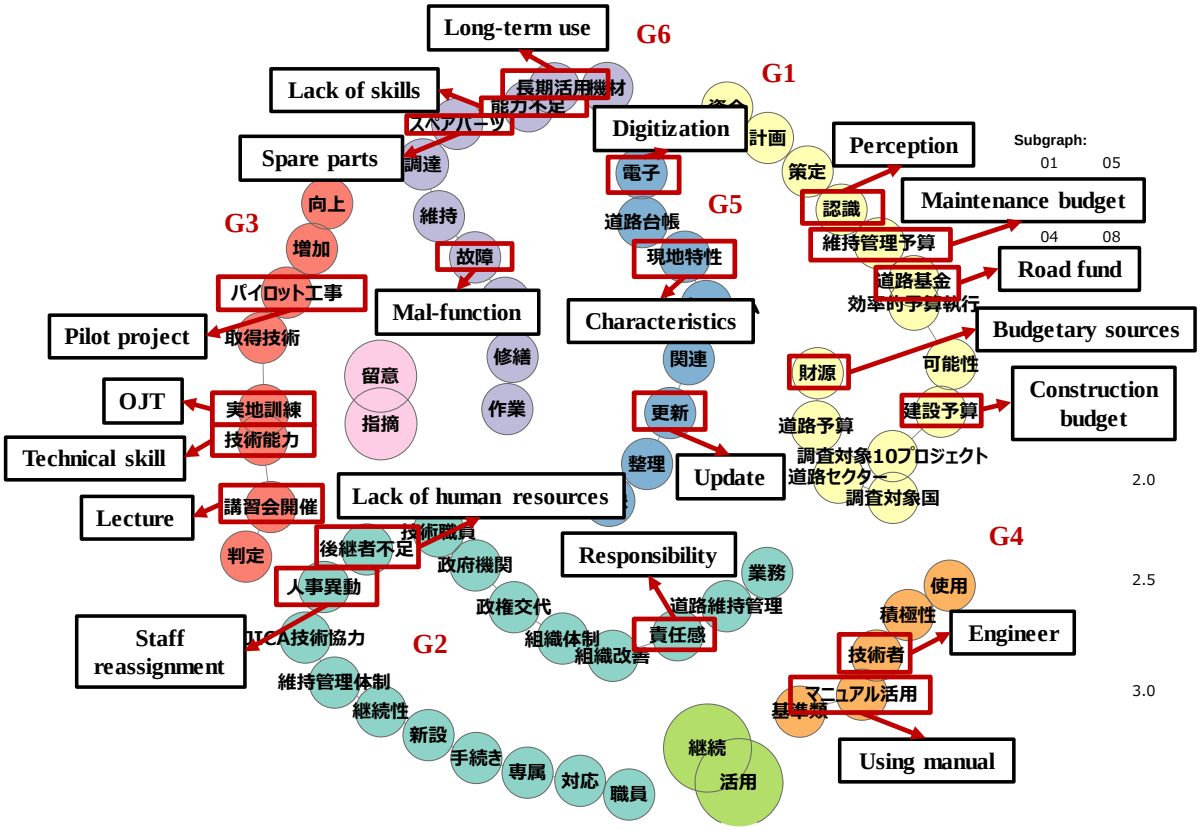

Fig.1 Word co-occurrence network (Report_2009)

(2) Coding and categorizing

Some text data describing the challenges at each project are summarized on the list or the table in both reports. However, they can be analyzed by neither text mining nor word co-occurrence due to too short sentences to apply these methods. Therefore, Coding is effective process to put the label on the pieces of text data regardless of its length, which can attach the meaning to text data and summarize its contents. In addition, the labeled text data are categorized into seven categories based on its topic (Table 1). These categories are referred from the categories described in both reports. This categorizing process facilitates the observing and comparing of challenges at each category between 2009 and 2019.

3. RESULTS AND DISCUSSION

(1) Word co-occurrence network of Report_2009

Fig.1 is word co-occurrence network diagram of Report_2009. The group of yellow bubbles (G1) gives information that something wrong with securing budgetary sources were caused by insufficient amount of budgetary sources, ineffectively use of budget for new construction and maintenance, and little awareness of the necessity of maintenance. The group of green bubbles (G2) shows the factors causing mal-function of organization is frequent staff reassignment, lack of human resources and lack of responsibility. The group of red bubbles (G3) shows the challenges that lecture, seminar OJT and pilot

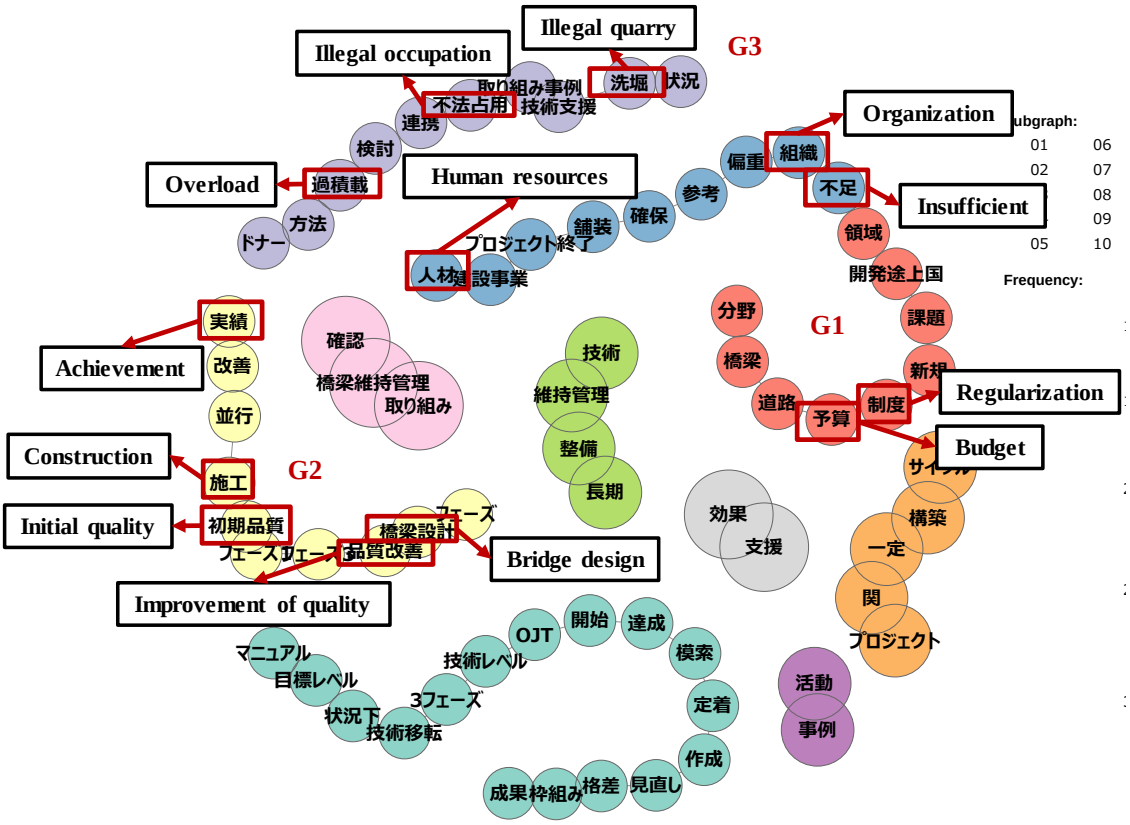

Fig.2 Word co-occurrence network (Report_2019)

project should be continuously held to realize skill development of international engineers. The group of orange bubbles (G4) shows that the skills of engineers are not as much as being able to use the manuals for infrastructure management. The group of blue bubbles (G5) represents the problems regarding data management, which data have been neither managed in light of the characteristics of each country nor digitized to facilitate the arrangement, update and maintenance of data. The group of purple bubbles (G6) represents the problems regarding equipment such as difficulty to procure equipment and its spare parts, frequent mal-function of equipment and degradation of longevity of equipment due to insufficient management system.

(2) Word co-occurrence network of Report_2019

Fig.2 is word co-occurrence network diagram of Report_2019. The group of blue and red bubbles (G1) represents the problems regarding budget, organization and human resources, that the amount of budget have been insufficient for the infrastructure management, the infrastructure management haven't been regularized, and it's been difficult to secure human resources who have specific skills for infrastructure management in developing countries. The group of yellow bubbles (G2) shows the challenges of Japanese technical cooperation regarding initial

Table 2 Labeled text data of each report

Budget	
Report_2009	Securing budgetary sources
	Scheming the budgetary application
	Establishing road fund committees
	Optimizing the method and application for budgetary execution
Report_2019	Securing budget for maintenance
	Setting reasonable cost for maintenance
	Improving maintenance plan
Organization	
Report_2009	Separating and regularizing the responsibility of organizations
	Cooperating with private sectors
	Establishing the maintenance system
Report_2019	Separating the responsibility of organization
	Cooperating with private sectors
	Improving the maintenance system
	Managing and training human resources
	Sharing information among organization
	Optimizing the system of order
	Improving the organization managing database
	Installing the qualification system

quality of infrastructure, that there are few cases that the improvement of initial quality has been achieved, thus further activities regarding this topic should be carried out for the future. The group of purple bubbles (G3) shows the challenges of countermeasures that few activities have been carried out to deal with these issues in 2010s, thus further approaches should be taken into account in cooperation with other international organizations (e.g., World Bank, ADB, etc.).

(3) Labeled text data at each category

Table 2 shows the labeled text data at each category. According to the category of budget, organization and skill development, it must be long-term challenges to secure budget, separate the responsibility of organization, cooperate with private sectors and develop skill of engineers in developing countries because these challenges remained until 2019. Labeled text data in the category of standards at each period shows that the manuals for infrastructure management should be continuously updated and improved in light of the characteristics of each country and the capacity of engineers. According to the labeled text data in the category of data at each period, database of infrastructure should be arranged to be manageable and normalized in entire country. Furthermore, the necessity and utility of BMS (Bridge Maintenance System) should be discussed in light of the capacity of engineers to manage this system. Both labeled text data in the category of equipment represents that equipment and its spare parts should be managed beside procuring them in developing country. Finally, the activities regarding countermeasures have been newly carried out in 2010s, thus there weren't any challenges emerging until 2009, but instead only basic challenges came out in Report_2019. According to the labeled text data, the activities in this category should be optimized by discussing its necessity, cooperating with various sectors and organizations, and regularizing these countermeasures.

4. CONCLUSION

According to the results of the analysis, Japanese technical cooperation has carried out various new activities in 2010s, focusing on the initial quality of infrastructure and countermeasures, and they have spent long time to deal with issues regarding budget, organization and skill development. Therefore, Japanese technical cooperation should update and improve their project, whereas dealing with long-term challenges, with focus on tangible aspects (e.g., offering technics) and intangible aspects (e.g., regularization and human resource development).

Table 2 Labeled text data of each report (continued)

Skill development	
Report_2009	Considering the characteristics of each country
	Holding lecture and seminar by developing countries
	Securing the maintenance skills via OJT and pilot project
	Managing various the maintenance work
	Popularizing the maintenance method
	Cooperating with private sectors
	Developing skills to manage data and equipment
Report_2019	Developing skills for inspection, diagnosis and repairment
	Cooperating with private sectors
Standards	
Report_2009	Creating practical manuals
	Updating and popularizing the maintenance manual
Report_2019	Improving the manual of planning and repairment
Data	
Report_2009	Summarizing basic information of infrastructure and maintenance data
	Establishing data system
	Updating, managing and using data
	Checking, updating and using road data
	Fixing the maintenance system
	Improving PMS and BMS
	Normalizing the data system
Report_2019	Making references for planning
	Digitizing and managing input data
	Discussing the utility of BMS
	Installing manageable database
Equipment	
Report_2009	Preventing equipment from mal-function
	Cooperating with private sectors
	Sharing information with organization for effective use of equipment
	Establishing system to manage equipment
Report_2019	Managing the spare parts of equipment
Countermeasures	
Report_2009	No challenges emerging
Report_2019	Discussing the necessity of the activates
	Optimizing the activities in cooperation with other organizations

REFERENCES

1) JICA : 道路・橋梁維持管理の技術協力に関するプロジェクト研究最終報告書, Feb. 2009.
2) JICA, CTI Engineering International Co., Ltd.: 開発途上国における橋梁維持管理にかかる支援に関する調査(プロジェクト研究)最終報告書, Feb. 2019.

(Received October 10, 2020)