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Information Handover Model of China PPP projects from construction to operation: Based on IDEF0 approach

Information Handover Model of China PPP projects from construction to operation: Based on IDEF0 approach

Yubo Guo[1*] and Chuan Chen[1]

[1]Business School, Sichuan University, Chengdu, Sichuan, 610065, People's Republic of China

[*]Corresponding author's e-mail: 1684403347@qq.com

Abstract. In the current practice of PPP in China, the importance of operation is constantly mentioned, and it is significant for the success of operation that the quality of the information transferred from the previous stage of PPP project. At present, researchers focus on risk management, Crucial Success Factors and other aspects in PPP study. Through literature review, this paper obtained the key nodes of information handover from construction to operation and their mutual relations, and established the Information Handover Model with the help of IDEF0 approach. It can militate positive impacts for the design and application of information handover process in practice, so as to enhance the effect of information handover and improve the operational efficiency of PPP projects.

1. Introduction

In the whole life cycle of PPP projects, operation stage is a crucial part. In the PPP Reference Guide Version 3, PPP is described as "A long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility and remuneration is linked to performance"(the World Bank Group,2017). In September 2014, the Ministry of Finance of China identified PPP as "a long-term cooperative relationship between the government and social capital in the field of infrastructure and public services". Immediately following, the National Development and Reform Commission of China has given a similar definition.

Liu and Gao summarized information requirements of facilities management in the transportation industry (Liu and Gao 2017). Becerik-Gerber et al. described information requirements of facilities management based on BIM (Burcin Becerik-Gerber et al. 2012). Anderson et al. studied the challenges in information handover (Anderson et al. 2012). Whyte et al. gave a general description of the handover process (Whyte et al. 2013). Based on the research on information requirements and handover, this paper proposed an Information Handover Model adopting IDEF0 approach, which can militate positive impacts for the design and application of information handover process in practice, so as to enhance the effect of information handover and improve the operational efficiency of PPP projects.

2. Literature review

Shannon gave the calculation formula of information entropy and described the information as "the elimination of uncertainty" (Shannon 2001). It is a revolutionary original definition, with the development of the society, the understanding of information is also expanding. Nowadays, people

usually regard information as the set of things and their attribute. This paper mainly reviews the following two aspects of literature.

2.1. Facility Management and its information requirements

According to the International Facility Management Association (IFMA), the object of facility management is not only the facility itself, but also the surrounding environment of the facility. PPP projects target to supply public products and services, the facilities generated by PPP projects is to serve the public and meet the needs of activities in the public space. Therefore, the operation process of PPP projects is important to the public interest.

Facility management is a comprehensive and systematic process, including the management of people, space, technology, etc., which needs sufficient information. Becerik-Gerber et al. proposed to classify information requirements of BIM-based facilities management into geometric and non-geometric (Burcin Becerik-Gerber et al. 2012). Dias and Ergan studied the expression of information requirements for specific facilities management tasks, and proposed to use customized LOD for presentation (Dias and Ergan 2016). At the same time, the FM Information requirements of HVAC system were divided into Geometry and Location Information, Component Identity Information, Manufacturer and Warranty Information, Building Commissioning Information and Component Specific Information by Dias and Ergan. Liu and Gao studied the information requirements of facilities Management based on BIM in the transportation industry, they divided the information requirements of facilities Management into Asset Inventory, Maintenance Management, Condition Assessment and Space Management (Liu and Gao 2017).

2.2. Information handover

The research on information handover or data handover in construction industry mainly focuses on the process from construction to operation period. Anderson et al. found a series of challenges in implementing COBie and BIM in the process of data handover from construction to operation (Anderson et al. 2012). Whyte et al. summarized some experience in the Best Practice of data handover, mainly including defining data requirements at the beginning of the project, opening handover process as early as possible, forming standards and systems for interoperability, and developing handover process for data inspection (Whyte et al. 2012). William East et al. summarized four steps for construction contractors to create the facility hand-over documents, "The first task is a site survey of the entire building to document the location and serial number of installed equipment. The second is the reproduction, collation, and binding of all previously approved submittals and shop drawings to create a multivolume set of operations and maintenance binders. The third is the production and inclusion of commissioning information such as operational and emergency procedures for building systems into these binders. Finally, an index is created to identify the location of each of the types of building documentation within these binders" (William East et al. 2013). Thabet and Lucas described the working process of asset data collection, pointed out that there was an "information tsunami" in this process and outlined several strategies for information handover, such as the adoption of open data standards, the adoption of IFC, etc. (Thabet and Lucas 2017).

3. Method

This paper used the method of literature review firstly to summarize some key nodes in the information handover process from construction to operation of PPP projects in China. Then IDEF0 approach was selected to draft the node tree diagram and model the information handover process.

3.1. Literature review

PPP, information handover, information requirements, etc. and their synonym were adopted as keywords to retrieve through Web of Science and Scoups in this paper. Those obtained papers then were filtrated by reading abstracts. At last, key nodes and child nodes of PPP project information handover were summarized and shown in the table below.

Table 1. Key nodes and child nodes of Information Handover Model

	Key nodes	Child nodes
Top-Level Information Handover Model	Identifying information requirements	Deconstructing operational scenarios Specifying information requirements Forming a requirements list Verifying the list
	Information handover and verification	Preparations for the handover Proposing the list Receiving the information Checking the information
	Storing information	Determining storage forms and locations Creating indexes

3.2. IDEF0 method

The IDEF method was developed on the basis of the structured analysis method in the 1970s. In 1981, the ICAM (integrated computer aided manufacturing) project published by the US air force used the method named "IDEF" (Chen 1999). The KBSI Company developed the IDEF method from the original IDEF0, IDEF1 and IDEF2 to the IDEF method series with more than a dozen methods. IDEF0 method adopts a series of graphs to represent a model. For a new system, the model can describe its functions and requirements, and then express a realization that can meet the requirements and complete the functions. For an existing system, IDEF0 method can analyse the purpose of the application system, the complete functions and the record of the realization mechanism.

The structure of IDEF0 model is shown in Fig. 1 (Khoo 1999). Boxes stand for activities and become the basic unit of IDEF0 model, which are usually expressed with gerunds. The arrows represent inputs, outputs, controls, and mechanisms to connect activities in the system, usually expressed in terms of nouns.
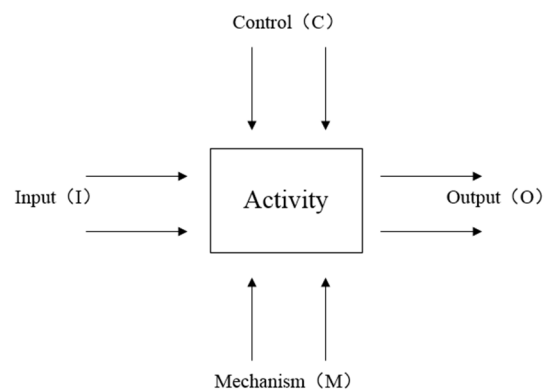

Figure 1. The structure of IDEF0 model.

4. Information Handover Model

Although there were some studies on information handover, most of them started from the perspective of information requirements or considered the participation of BIM. There is no complete description and process decomposition of information handover. This section aims to describe the information handover process and obtain the general process model of information handover.

4.1. Description of information handover process

In the whole life cycle of PPP projects, there are obviously some key parts, such as selecting social capital parties, financing delivery, etc., among which the transition from construction to operation is undoubtedly one of them. In this process of transformation, one of the most important things is information handover. This information handover process consists of three sub-processes:

- Identifying information requirements,
- Information handover and verification, and
- Storing information.

The information requirement list is generated through the first sub-process. According to the list, the facilities management team and the construction team carry out information handover and verification. Finally, the verified information is stored and indexed in a certain way by the facility management team.

4.2. The node tree diagram of the information handover process

As noted above, the information handover process can be decomposed into three sub-processes. According to the features of the top-down decomposition of IDEF0, the node tree diagram of the information handover process was drafted as Fig. 2.
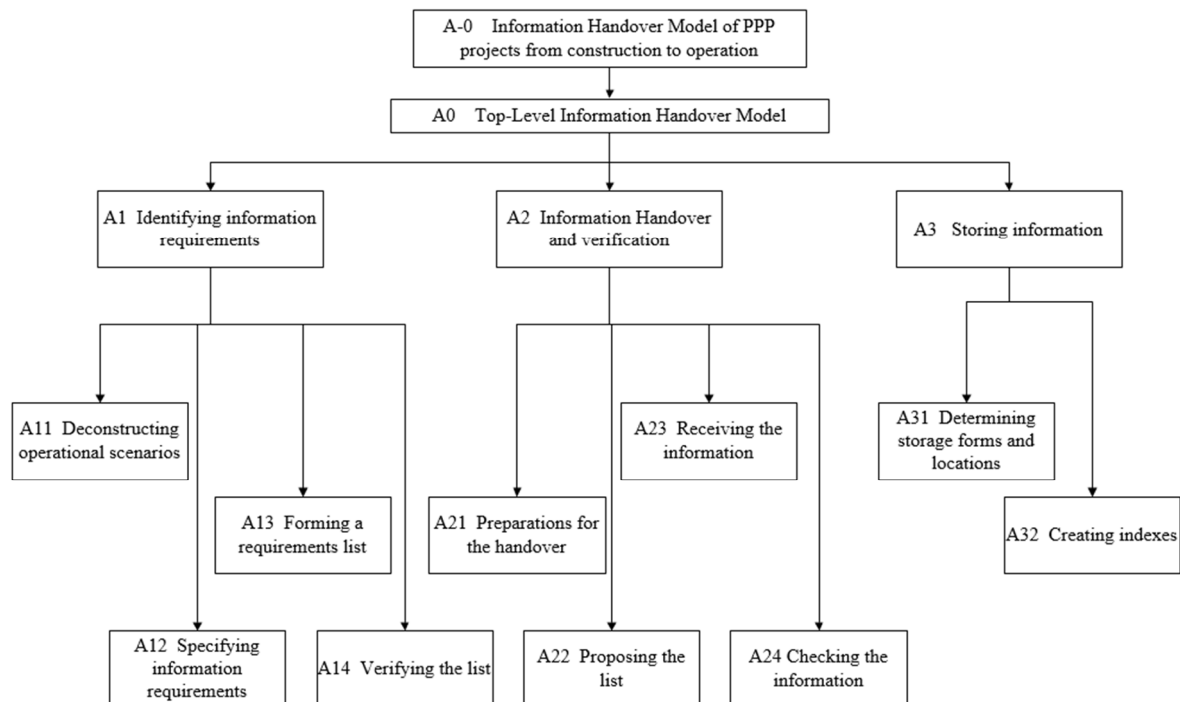

Figure 2. The node tree diagram of the information handover process.

4.3. The Information Handover Model

In this section, the Information Handover Model was established through IDEF0 approach based on the analysis of three sub-processes of the whole process. Those inputs, outputs, controls and mechanisms corresponding to each activity were identified, the connection between each activity was recognized and all of the above was reflected in the Fig. 3.
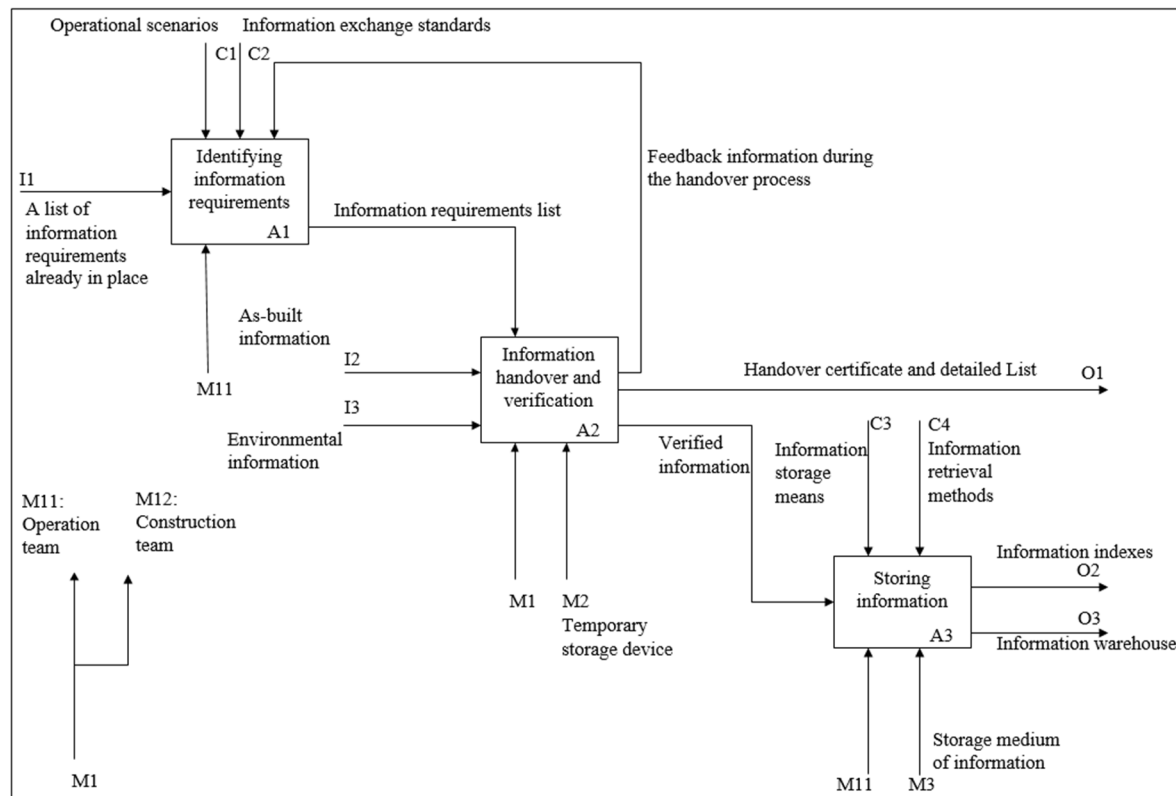
Figure 3. The Information Handover Model through IDEF0 approach.

5. Conclusion

Information handover is one of the key factors to the success of the operation of PPP projects. Efficient information handover can greatly help the operation of the projects. From the operational perspective, this paper adopted IDEF0 approach to establish the Information Handover Model of PPP projects from construction to operation. The research results of this paper can militate positive impacts for the design and application of information handover process in practice, so as to enhance the effect of information handover and improve the operational efficiency of PPP projects.

References

[1]   World Bank Group. (2017) the PPP Reference Guide Version 3. https://pppknowledgelab.org/guide/sections/83-what-is-the-ppp-reference-guide.

[2]   Liu, G., Gao, T. (2017) The Information Requirements for Transportation Industry's Facilities Management Based on BIM. The Open Construction and Building Technology Journal, 11: 136-141

[3]   Becerik-Gerber, B., Jazizadeh, F., Li, N., Calis, G. (2012) Application Areas and Data Requirements for BIM-Enabled Facilities Management. J. Constr. Eng. Manage., 138(3): 431-442

[4]   Anderson, A., Marsters, A., Dossick, C.S., Neff, G. (2012) Construction to Operations Exchange: Challenges of Implementing COBie and BIM in a Large Owner Organization. In: Construction Research Congress 2012: Construction Challenges in a Flat World. West Lafayette, Indiana. pp. 688-697.

[5]   Whyte, J., Lindkvist, C., Ibrahim, N.H. (2013) From projects into operations: Lessons for data handover. Proceedings of Institution of Civil Engineers: Management, Procurement and Law, 166:86-93.

[6]   Shannon, C.E. (1948) A Mathematical Theory of Communication. The Bell System Technical Journal, 27: 379–423.

[7]   Dias, P., Ergan, S. (2016) The Need for Representing Facility Information with Customized LOD for Specific FM Tasks. In: Construction Research Congress 2016: Old and New Construction Technologies Converge in Historic San Juan. San Juan, Puerto Rico. pp. 2563-2572.

[8]   East, E.W., Nisbet, N., Liebich, T. (2013) Facility Management Handover Model View. Journal of Computing in Civil Engineering, 27: 61-67.

[9]   Thabet, W., Lucas, J. (2017) Asset Data Handover for a Large Educational Institution: Case-Study Approach. J. Constr. Eng. Manage., 143(11): 05017017

[10] Chen, Y.L. (1999) IDEF Modelling Analysis and Design Methods. Tsinghua University Press, Beijing.

[11] Khoo, L.P. (1999) An IDEF0 model-based intelligent fault diagnosis system for manufacturing systems. International Journal of Production Research, 37(1): 35-48.