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A Study of Concept Structure of PMBOK Based on Graph Theory

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Abstract: One especial characteristic of the PMBOK fourth edition is that the data flow between processes is defined with the definition of individual processes. Based on relations of input and the output during an adjacent management process, we can visualize the network structure of 42 project management processes analytically.
The author showed that we could estimate the density of the process flow from the network structure based on the relations during the process of the first proximity.
However, this network structure based on relations of first proximity is not including the indirect relationship among management processes. Therefore, it is necessary to extract a cross-sectional data flowchart on knowledge areas by expanding analysis range of the management pass in consideration of a highly advanced proximity element (process).
Based on this cross-sectional data flowchart, it is able to visualize a complicated management processing flow. As a result, it is found that there were complementary relations between the flow by way and by no way of the project integration management knowledge area. This suggests that network analysis technique is effective as method to visualize the flow of the management process of project.
In this paper, I would like to report the example of visualization of the management processing flow of some project management knowledge areas.

Keywords: PMBOK, Project Management Process, Graph Theory, Network Analysis

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INTRODUCTION

One characteristic of PMBOK [1] is that data flowcharts corresponding to the each management process are described. This data flow chart of the each process is renovated in PMBOK 5th edition [1]. The data flowchart corresponding to the five process groups (a setup, a plan, practice, monitoring and control and end) was macroscopically described before the second edition [2]. In the third edition [3], it was changed to the data flowchart for every the project management (PM) knowledge area and it came to easy to look the flow of the management in each knowledge area.

There are two characteristics of the data flowchart. One is what is described by a viewpoint of the delivery of input and the output of the process concerned. The second is that the mutual relations between process of the knowledge area and process of the outside of the knowledge area are described. This characteristic was succeeded to in the PMBOK fifth edition, and brushing up was planned more.

In the previous paper, it has reported that it is able to visualize the flow of the PM process so far by describing the data flow between all processes based on the graph theory [5].

In this study, I visualize a management process of the PMBOK fifth edition and consider the positioning of the project stakeholder management knowledge area added newly.

VISUALIZATION OF THE MANAGEMENT PROCESS

We can visualize the implicit structure such as an organization or the procedure by graph theory explicitly. Network graph is one of visual view graphs by graph theory, and formed only with nodes and lines. The node of the network corresponds an active point of action (e.g., the people in the organization) that information or an object goes by way of. If or action is connected with a node between nodes, I draw a line. I call a diagram provided in this way a network graph. When action is accepted between a node and nodes, it is able to link the node to the node in a line. A diagram provided in this way is called as a network graph. It is possible to express various structures by thus network methodology.

In this research, the node shows the management process of PMBOK, and the link shows the relationship between management processes. Adjacency matrix describes the relationship among the nodes which forms network. The component will be ‘1’ when there is relationship between two nodes, or ‘0’ when there is no relationship. An undirected graph is a graph describing the network in which the nodes are connected by undirected arcs.

Management process of the PMBOK 4th edition

From the data flowchart of 42 processes, it is able to get the adjacent line corresponding to the mutual relations between management processes described in PMBOK. It could be visualized the concept structure of the management process of PMBOK by analyzing this adjacent matrix.

In the data flowchart in the PMBOK 4th edition, “a project document”, “the environmental factor of the body”, “the process assets of the organization”, and “the process assets of the organization” are treated in almost all processes. For the network analysis, a number and the mutual relations of the node to describe structure become important. Therefore I compare the concept structure when the above-mentioned external elements are considered as a node of the networks with the concept structure based on only 42 processes.

The adjacent matrix demanded from 42 data charts is shown in Figure 1. And a viewgraph

of network obtained from the adjacent matrix is shown in figure 2. The viewgraph of network is displayed in the circle mode which placed a node on the circumference. The link between nodes corresponds to the element “1” of the adjacent matrix.

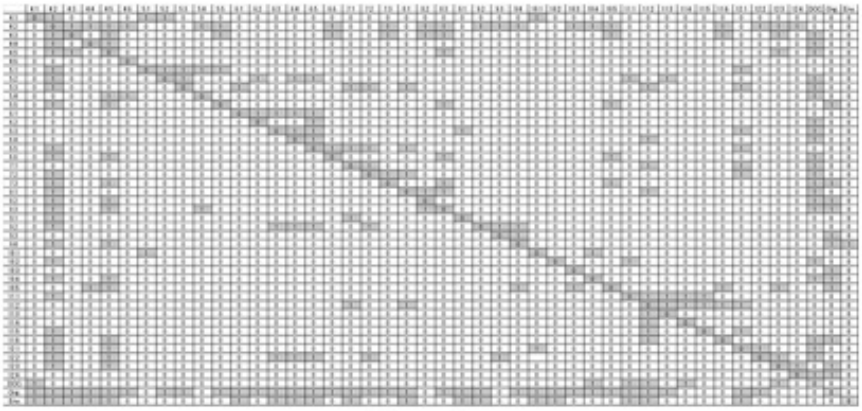
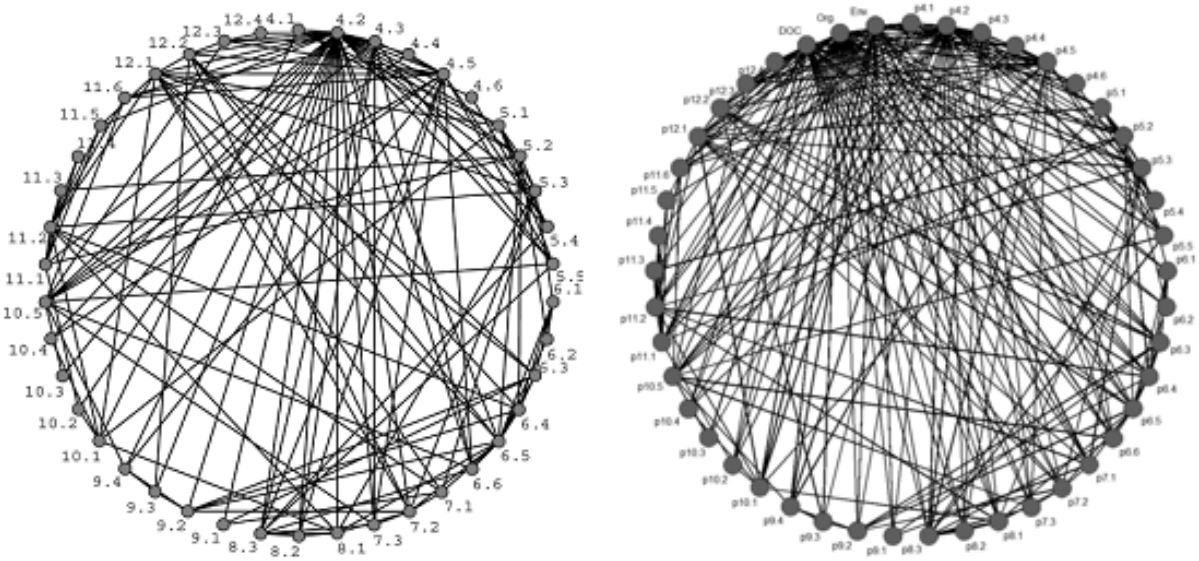


Figure 1

(a) Adjacency matrix for mutual relations among 42 processes of PMBOK4th edition
(b) Adjacency matrix for 42 processes and "***Project documents***", "***Enterprise environmental factors***", and "***Organizational process assets***"



(a) (b)

Figure 2

(a) Network graph provided from the adjacent matrix shown in figure 1(a)
(b) Network graph provided from the adjacent matrix shown in figure 1(b)

Figure 2(a) is network graph which described from the adjacent matrix by the 42 process without external elements. This network graph is corresponding to the data flow only for the knowledge area. Figure 2(b) is a network graph when I considered “a project document”, “the environmental factor of the body” and “the process assets of the organization” as a node.

Management process of the PMBOK fifth edition

Figure 3 is the adjacent matrix based on the data flowchart of the PMBOK 5th edition. In the data flowchart of the PMBOK fifth edition, “Sponsor”, a “Customer”, and “Sellers” were added as new elements of external to processes.

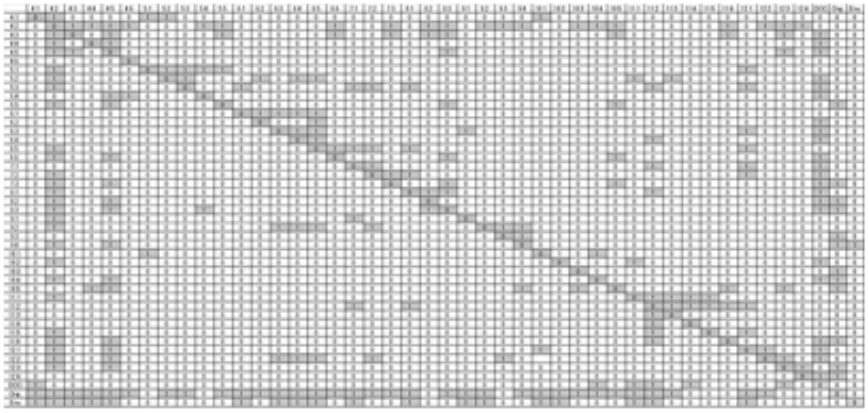
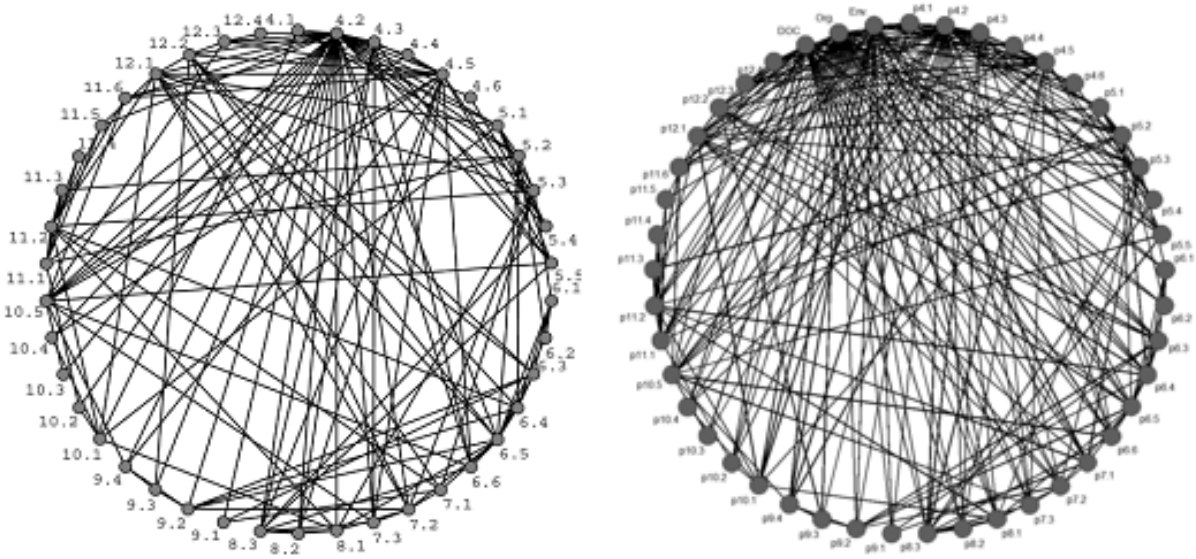


Figure 3

(a) Adjacency matrix for mutual relations among 47 processes of PMBOK 5th edition

(b) Adjacency matrix for 47 processes and "***Project documents***", "***Enterprise environmental factors***", "***Organizational process assets***", " ***Sponsor*** ", and " ***Customer*** ", " ***Sellers*** "



(a) (b)

Figure 4

(a) Network graph provided from the adjacent matrix shown in figure 3(a)

(b) Network graph provided from the adjacent matrix shown in figure 3(b)

Figure 4(a) is network graph of 47 processes without external elements. Figure 4(b) is the network graph (expanded network) corresponding to the matrix including “a project document”, “the environmental factor”, “the process assets of the organization”, “a sponsor”, “a customer” and “a seller” in addition to 47 processes.

DATA FLOW DIAGRAM FOR STAKEHOLDER MANAGEMENT

The most important characteristic feature of the PMBOK 5th edition is that a stakeholder management knowledge area was added. The management processes for stakeholders were incorporated in the communication management knowledge area in the PMBOK 4th edition. The PMBOK 5th edition isolated these and described those as independent chapters.

The above-mentioned Small world network indication is insufficient while it is able to realize visualization of the concept structure of PMBOK to describe the management flow in the individual knowledge area. Therefore, the data flow diagram of the stakeholder management knowledge area is described in order to estimate the range where the stakeholder management had an influence on the management process. The data flow diagram for communication management knowledge area of PMBOK 4th edition is shown in figure 5. The data flow diagrams of the communication and stakeholders management knowledge areas of the PMBOK 5th edition are shown in figure 6 and 7.

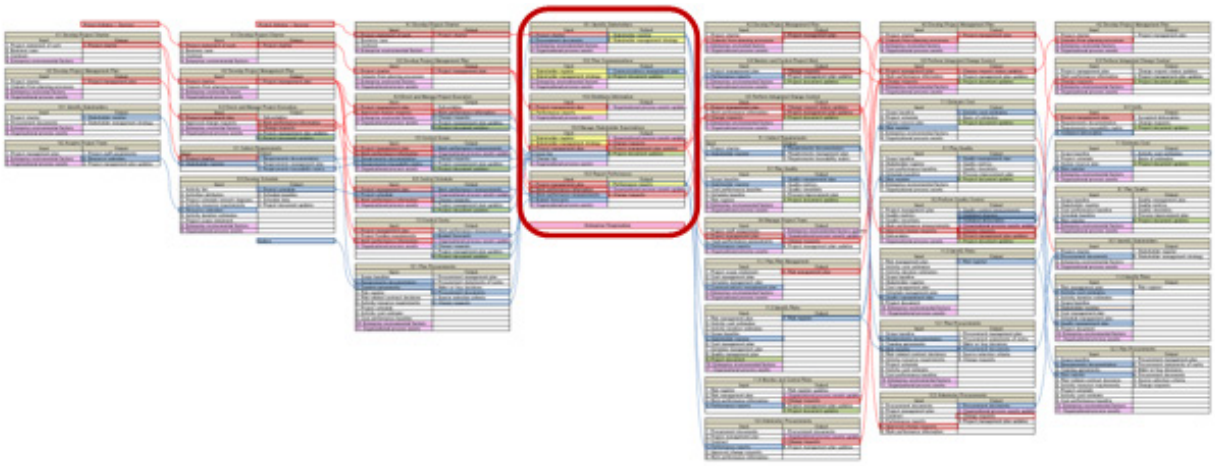


Figure 5 Detail data flow diagram of Communication Management Area of PMBOK 4th considered until the third proximity. Square is indicating the set of inputs & outputs of Communication Management processes in PMBOK 4th.

Figure 6 Detail data flow diagram of Communication Management Area of PMBOK 5th considered until the third proximity. Square is indicating the set of inputs & outputs of Communication Management processes in PMBOK 5th.

Figure 7 Detail data flow diagram of Stakeholder Management Area of PMBOK 5th considered until the third proximity. Square is indicating the set of inputs & outputs of Stakeholder Management processes in PMBOK 5th.

DISCUSSION

It is observed that network density of the expanded network graph which is including “a project document”, “the environmental factor” and “the process assets of the organization” shown in figure 2 (b) increases in comparison with figure 2(a). This means that three elements of “a project document”, “the environmental factor” and “the process assets of the organization” make the relations of 42 management processes stronger. In the comparison between figure 4(a) and figure 4(b), it is found a similar relation. Furthermore, it is considered that the density of the network graph of PMBOK 5th becomes higher rather than the one of PMBOK 4th edition.

The above-mentioned results indicate that, the network density of the PMBOK 5th edition becomes minute according to adding “Sponsor”, “Customer” and “Sellers” as new outside factor of the process and improvement of the management network by creation of project stakeholder management knowledge area as a new chapter.

CONCLUSION

Based on flow chart of the PMBOK fourth edition and the fifth edition, I visualized the concept structural analysis of each management process. As a result, I showed that the network structure of the process became minutes by supporting external elements having increased and a stakeholder management knowledge area having been established in the PMBOK fifth edition.

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