An ANP Approach to Decision Support for Operation Readiness in Mega Intergrated Transportation HUB Projects

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Abstract: This paper study the main contents of operation readiness in Mega Intergrated Transportation HUB projects, and uses an Analytic Network Process (ANP) model for decision-making. As effective operation readiness is vital to successful operation in mega projects, it is a big challenge for decision makers to make accurate decisions in regard to work out a practical scheme for operation readiness. In order to improve the quality of decision-making, this paper makes use of an ANP approach. Finally, an experimental case study is used to demonstrate how to use ANP approach to solve real-world decision-making problems.

Keywords: Mega Intergrated Transportation HUB, operation readiness, ANP

I. Introduction

At present, with the rapid development of economy，the construction of mega intergrated transportation hubs entering the stage of rapid development in domestic and foreign. However, because of mega intergrated transportation hub has the following features: the facility is various and complex, huge in size, many traffic modes to assemble together highly, with many kinds of the operation management and so on. The operation management will face a huge difficulty once the construction of the project is completed. To set up a rational preparation for Operation Management (operation readiness) is very important for successful operation of the project.

The stage of Operation Readiness Management had been playing an increasingly important role as the stage between the construction and formal operation, especially for mega projects. Operation Readiness Management has the following characteristics: 1) more strategic problems; 2) the time is pressing; 3) lack of manpower, material resources and financial resources and so on. There is the kind of position of using limited time and resources to achieve strategic objects.

In the mega integrated transportation hub, strategic decision is generally made by the leadership subjectively. And usually it is by the form of meeting discussion, which can be a time-consuming, expended effort, wasting resources, and so on. In addition, the vital thing is that they don't make a best decision even invest the massive time, manpower and resources. In this case, operation readiness management of mega Intergrated Transportation HUB should be studied. Then in the paper 10 focal points of the work was summarized. An ANP Approach was used to assess operation readiness work. The aim was to make decision for three operation goals by ANP approach, so that improve the quality of decision-making in using limited time and resources for key steps.

II. The Key Indicator of Operation Readiness

According to a number of the interviews, surveys and literature reviews focusing on the operation readiness in Mega Intergrated Transportation HUB projects, there has a relatively comprehensive category of the key performance indicator for operation readiness. There are mostly 10 modules, as follow (see Fig. 1):

To determine the scope and surface of operation management

The primary task is to determine the scope and the surface in the operation readiness. In order to determine the scope and the surface, we need to understand design details and to communicate with designer. Meanwhile we should keep step with the plans of electric equipment. Moreover, we must make clear of boundary of investment, particularly for the public area.

Organizational framework and distribution of staff in operation management

After determining the scope, the surface and working content, we set up Organizational structure. We will finish rational deployment of staff based on the management surface. Meanwhile keeping communicate with each department actively to ensure that operation management goes well.

To determine operation mode

Operation Mode is a guide for Operation, we must pay more attention to Operation Mode in the stage of operation readiness. It is one of works in determining Operation Mode is to decide self-management work and outsourcing work.

Cost estimation of operation and Maintenance

Operation costs must be considered, especially for the Large and complex projects. Cost estimation of operation and maintenance is not only a necessary task, but also a big one which through the beginning and ending of operation readiness.

Tender preparation for facilities management

Make tender preparation for the outsourcing facility, particularly collect and sort out project-related material (for example: various design drawings, descriptions) complete.

Service Level Agreement（SLA）and Key Performance Indicators（KPI）

In order to satisfy customers' specific needs of service, agreements for service should be introduced. It's fundamental and important work to make an agreement before Formal Operation. Meanwhile we should establish a mechanism to avoid bad behavior and need to determine the service key performance indicators in order to achieve to quantify the service.

Procedure development for operation readiness

To develop kinds of the Management Procedure, including the sections of traffic management, comprehensive management, equipment management , security management, service management, and emergency, etc. , each of which contains a number of sub-management system .

Set up a communicating mechanism for all participants

Because many participants (such as owner, construction agency, designer, constructors, suppliers, manager and so on) were involved in the project in the construction and management,Which hold large amounts of information. Therefore, it was essential to set up a effective communicating mechanism.

To build a platform for information communication

A large number of information need to be collected, processed, stored and delivered. It is necessary to build a platform for Information Communication，so as to reduce the conflict and the blind points as far as possible.

Personnel training

Personnel training is a key work in the stage of Operation Readiness, which provides basic guarantee for the success of the formal operation . Therefore we need pay more attention to it.

Among these key performance indicator, getting the best satisfaction in transportation service, passenger service and commercial development as the main objects of operation. But because of the limited time and resources, this is impossible and reasonless to fulfill all the three objects and to get best satisfaction in each section. Through evaluating the priority of the three objects using the ANP approach, the best strategy will be selected. In order to get a group of key

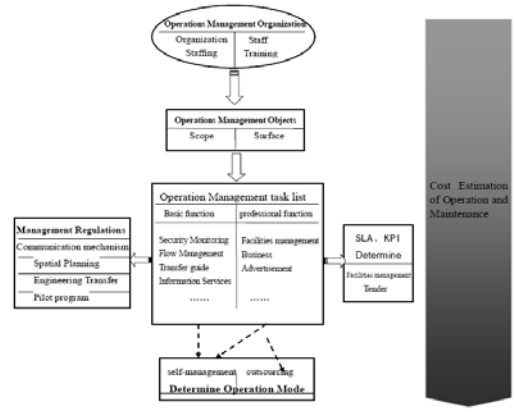

Figure 1 The contents of operation readiness

performance indicators for the proposed ANP model, the ten indicators will be divided, than the final indicators in model will be shown in the ANP model for Operation Readiness (Table 1).

Table 1 the final indicators for operation readiness

Classification	Indicators
C1 Mechanism of coordination	C11 Government
	C12Investment Entities
	C13 Society and medium
C2 Environment and safety	C21 Public security
	C22 Energy
	C23 Environment
C3operation mode	C31Operations command
	C32Emergency Rescue
	C33Accident Treatment
	C34Information release
C4 Other	C41Management tool
	C42Finance and cost management
	C43SlA and KPI
	C44Organizational framework
	C45Interface componet
	C46Management mechanism
	C47Facilities management
	C48Interior control
	C49Staff training

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Ⅲ. ANP model

ANP approach

The ANP is the first mathematical theory that makes it possible for us to deal systematically with all kinds of dependence and feedback. The Analytic Network Process (ANP) is a new theory that extends the AHP to cases of dependence and feedback and generalizes on the supermatrix approach introduced in Thomas Saaty's 1980 book on the Analytic Hierarchy Process. It can deal with the problems that allows interactions and feedback within

clusters (inner dependence) and between clusters (outer dependence).

Structure of model

There are 4 general steps in ANP model, including model construction; paired comparisons between each two clusters or nodes; supermatrix calculation based on results from paired comparisons; and result analysis (Saaty,1996/2005). In the paper, we use the SuperDecisions (SD) software to finished this four steps. It is given that the ANP model for operation readiness in SD in Figure 2. There are 5clusters in the model, including one Alternatives cluster and four Criteria clusters. The goal of the model is to gain the priority of key performance. In this model the loops indicate inner dependence among the elements in the cluster. We can see they all have inner dependence expect for the cluster2.

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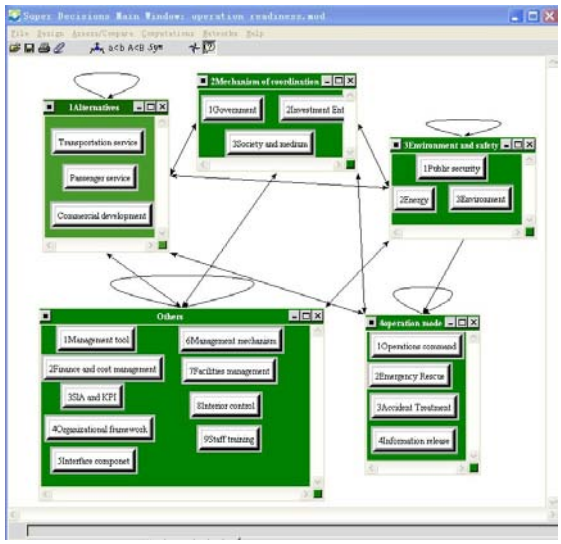

Figure 2 The ANP model for operation readiness

Comparisons and calculation

In the model, we subjectively define the fundamental scale of scores as given in Table 2. It is very important that all the comparison questions are asked from the perspective of what is more important or preferred with respect to satisfaction in the comparisons.

Table 2 Fundamental scales of the scores

Scales for scoring	
1=Extremely low	6=High
2=Very strongly low	7=Moderately high
3=strongly low	8=Strongly high
4=Moderately low	9=Very strongly high
5=Low	10=Extremely high

Decision-making problem for operation readiness in mega intergrated transportation HUB project usually is the group decision-making problem. The research literature contains many applied and theoretical papers have developed some approaches to integrate the results of individual judgments. There are four basic approaches: consensus, vote or compromise, geometric mean of the individual judgments, and weighted arithmetic mean. Among them, the research have show that the geometric mean is the most common approach used by groups to set priorities. The Equation 1 gives an expression of the approach.

$$a_{ij} = [a_{ij}^1 \times a_{ij}^2 \times \cdots \times a_{ij}^n]^{1/n} \quad (1)$$

In the equation, a_{ij}^k denote the comparison of element i to element j for decision maker $k(k = 1, 2, ..., n)$ in pairwise comparison matrix . The individual judgments of the n decision makers are combined using the geometric mean to produce the final result. The paper also uses the approach of geometric mean to process the date collected from the groups of decision makers.

The final results

According to the comparison results using SuperDecision software shown in Figure 3, it implies that: transportation service got the biggest priority, but the passenger service is 91. 86% as much as of it, so there is just relatively small difference between them. In a word, the results of priority can show that the most important section for satisfaction is transportation service, and the least one is commercial development. The result suits the basic request of operation, that is, functional object is most important. Commercial development will be more and more important role as the project is successfully operated. While we should pay more attention to transportation service and passenger service in make any plan for operation readiness.

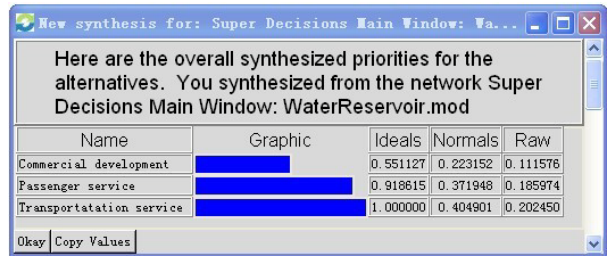

Figure 3 Overall Synthesized Priorities of the model

Ⅳ Conclusion

This paper achieved several purposes：1) Through literature reviews and practical research in mega integrated transportation hub, we summarized the key work for preparation readiness. They are necessary to finish in the

phase of operation readiness as this is directly related to the successful operation. 2) We introduce into ANP approach to provide a good support for decision-making of operation readiness. 3) We demonstrated how to successfully to use the approach in real time. Although limited data and information were collected, this paper has make a relatively success in some degree.

At the time this paper also have some shortage and the further research in some aspects, such as:1) Because the number of mega integrated transportation hub projects in the world is very small, as well as the lack of important information (many information of this kind of mega projects do not open to the public). On the conditions, it is difficult to do systematic and comprehensive research, so the result is not good enough. 2) Generally a number of decision makers with different benefits and responsibilities will be involved in the mega projects, so it is a more complicated problem of group decision-making. It is inevitable that some decision-makers could distort their views, in order to achieve a preferred outcome. In future work, better Solutions should be proposed (for example, visualize the views of each decision makers). 3) One of the difficulties in using the ANP approach in decision-making problem is how to collect the enough appropriate data, because it will effects model to obtain objective results. These indicators do not have a system of rating standard for mega integrated transportation hub project.

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