Qualitative Survey in Transportation Planning: Cognitive Mapping Approach

Hironori Kato[1], Hideaki Shiroyama[2] and Yoshinori Nakagawa[3]

[1]Department of Civil Engineering, University of Tokyo
7-3-1, Hongo, Bunkyo-ku 113-8656, Tokyo, Japan
Phone: +81-3-5841-7451; Fax: +81-3-5841-7496; E-mail: kato@civil.t.u-tokyo.ac.jp

[2]Graduate School of Law and Politics, University of Tokyo
7-3-1, Hongo, Bunkyo-ku 113-0033, Tokyo, Japan
Phone: +81-3-5841-3131; E-mail: siroyama@j.u-tokyo.ac.jp

[3]Resesarch Center for Social Management, Kochi University of Technology
Tosayamada-cho, Kochi, 782-8502, Japan
Phone: +81-887-57-2773; E-mail: nakagawa.yoshinori@kochi-tech.ac.jp

Abstract. This paper proposes a method to analyze the problem perceptions of stakeholders and structuring these problems by using their cognitive maps. First, we show the importance of problem identification in transportation planning and review the past research regarding the problem structuring. Next, we formulate the method. The proposed method considers the participant's perception of the transportation problem. The principal goal of our method is to abstract the potential policy agenda by understanding the problem perception of the stakeholders. Then, we present a case study of the strategic public transportation planning in the Tokyo Metropolitan Area. We interviewed the stakeholders with the hypothetical cognitive maps and revised them after the interviews. Then, we structure the problem by identifying the factors and drivers. The case study shows that the proposed method is fairly effective. It also shows that the successful generation of a potential agenda is possible. Further, we compare the stakeholders' recognitions by means of an analysis of the problem perceptions of the stakeholders. Additionally, we analyze the interactions among the stakeholders by using a reciprocal expectation matrix. As the method is so general that it can be used for other purposes such as urban planning, educational planning, medical and public health planning, and so on, the further application to the other planning may be expected.

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INTRODUCTION

During the past decade, the definition of transportation problems has changed as the problems associated with energy consumption, air quality, equity, safety, congestion, land-use impact, noise, and a further efficient utilization of fiscal resources in urban areas (Meyer and Miller, *1*, p.75). However, these problems may not be completely shared by the people. The problems may be recognized by various participants in a different manner. Recent studies suggest that the individuals' decision often depends on the decision-making context, which is sometimes referred to as a framing effect (*2*, *3*). The framing effect can also be observed in transportation planning, particularly in the problem identification process. In order to identify transportation problems, a transportation planner should understand the multiple participants' problem identification or perceptions with regard to the transportation system as accurately as possible. Additionally, they should analyze the problem structure from a multidisciplinary viewpoint. When more participants are involved in the transportation system, their perceptions of problem identification become more difficult to comprehend. The inaccurate speculation and misunderstanding of a participant's problem perception may lead to a deadlock in building a consensus. A well-designed and sophisticated method for understanding the participant's problem perception and its feedback to the stakeholders may strongly contribute to better planning and management of the transportation system.

Several studies have considered problem identification and problem structuring methods. They can be categorized into the following two types: soft operational researches and transdisciplinary researches. The former, which studies the problem structuring method, includes studies by Ackoff (*4*), Checkland (*5*), Eden and Ackermann (*6*), Friend (*7*), Mason and Mitroff (*8*), and Howard (*9*). The latter includes studies by Hansmann *et al.* (*10*), Loukopoupos and Scholz (*11*), and Scholz *et al.* (*12*). A series of transdisciplinary researches has been referred to as an "embedded case study" (*13*). The total framework of our case study is very similar to the embedded case study approach. The similarity can be observed in the analysis process and collaborative methods. With regard to the problem structuring method, the method proposed in this study may be the most similar to the approach of Eden and Ackermann (*6*). They propose a strategic option development analysis (SODA). Here, they interviewed stakeholders to sketch their cognitive maps. Then, they integrate the maps into a comprehensive problem map to understand the overall problem structure. Although the cognitive map approach is useful to understand the interviewee's perception, the completion of the maps generally requires a long time and incurs enormous costs. In addition, the simple integration of different maps does not reflect the interactions among the stakeholders. In this study, the proposed method improves the problem structuring method in SODA by reducing the cognitive-mapping requirements and highlighting the interactions among the stakeholders.

This study proposes a practical method of problem identification and structuring for transportation planning. Our method is applied to the strategic regional transportation planning in the Kanto region, Japan.

PROPOSED METHOD

Method description

In general, decisions are made and policies are formulated in response to the perceived differences between the desired state of affairs and the decision-maker's perception and/or interpretation of the actual situation (*1*). In this study, the proposed problem structuring method considers the participant's perception of the transportation problem. The principal goal of our method is to abstract the potential policy agenda by understanding the problem perception of the stakeholders. An overview of our method can be described in FIGURE 1.

First, we select the stakeholders in relation to the problem. A "stakeholder" is defined as a participant who can influence or be influenced by the corresponding transportation problem. The manner in which a stakeholder is selected depends on the data availability. In the first case study, we utilize problem system maps corresponding with the policy targets in order to list the stakeholder candidates. This is because we were able to derive the system maps from the potential policy targets defined by the respective authorities. Such data was not available in the second case. Therefore, the local university professors provided their recommendations for selecting the potential stakeholders.

Second, we sequentially interviewed the potential stakeholders in order to comprehend their problem perceptions. We sketch hypothetical cognitive maps by collating their profiles via literature surveys or Web searches. The map contains the following three types of items: non-highlighted items, which represent causal factors influencing other factors and/or result factors influenced by other factors; oval symbols, which denote exogenous factors or factors that the stakeholder expects the other stakeholders to perform; and square boxes, which

represent the values required by the stakeholder. The arc connecting the items denotes a causal flow, which begins from a causal factor and terminates at its result factor. We interviewed the stakeholders with their hypothetical maps. In the interviews, we requested the interviewees to reveal their behavioral targets, constraints, and expectations with the other stakeholders. On an average, each interview took around two hours; after explaining the aim of our research, the interviewers requested the interviewees to freely respond about the hypothetical maps. In most of the cases, two or three people were interviewed: most of these people were chief executives or officials responsible of managing their organizations. The interviewers consist of a study team from the University of Tokyo including us.

Third, the cognitive maps are revised on the basis of the interview results. We delete the incorrect or less important factors or actions from the hypothetical map and insert additional factors or actions, if necessary. Finally, the maps reveal the following three perceptions of the stakeholders: causal flows in relation to the problem, impact flows in relation to the stakeholder's current actions, and interactions with the other stakeholders.

Fourth, we integrate the stakeholder's cognitive maps into a unified structure of transportation problems. We collect the potential problems pointed out during the interviews with the stakeholders. In order to abstract the main factors, we discuss these problems in a meeting with the experts. The main factors are abstracted from the stakeholders' behavioral goals (square boxes) or the factors near the goals in their cognitive maps that have social values. Further, we select the exogenous factors, referred to as "drivers," which represent the background factors of the problems. The drivers are mainly selected from the oval-shaped factors in the cognitive maps of the stakeholders. Then, we abstract the potential policy agenda from a matrix consisting of the main factors and drivers.
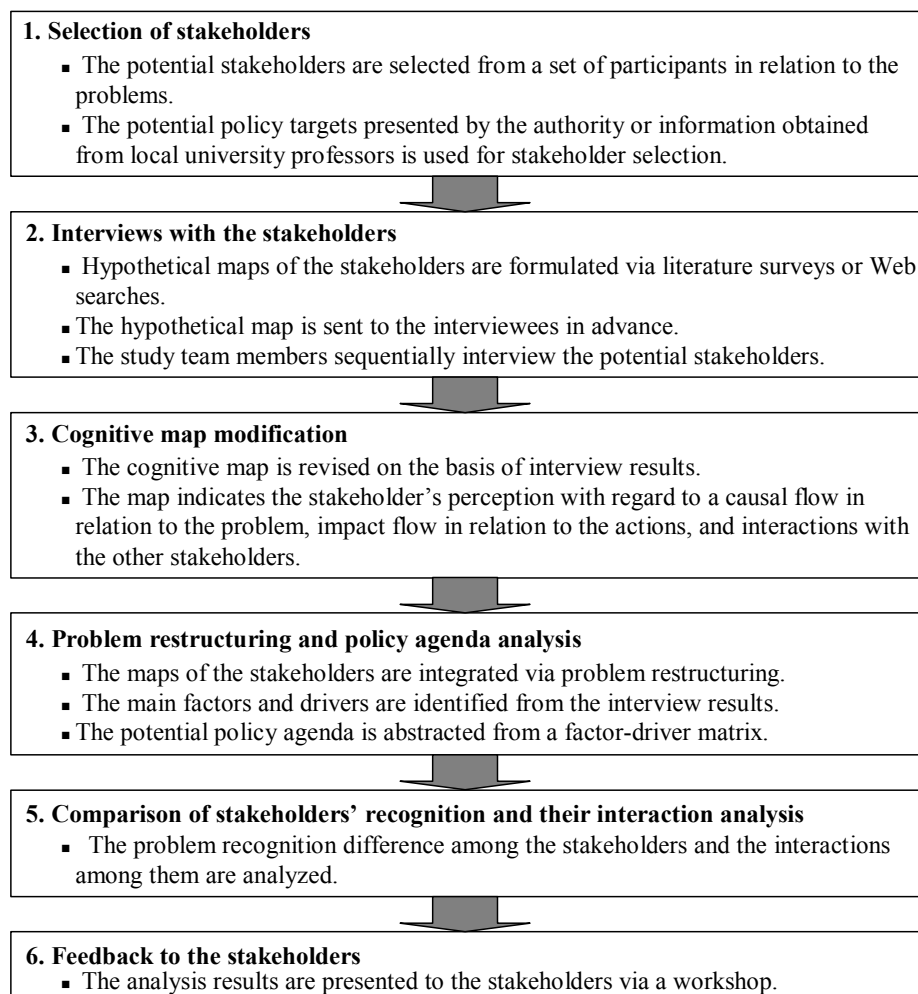
1. Selection of stakeholders
- The potential stakeholders are selected from a set of participants in relation to the problems.
- The potential policy targets presented by the authority or information obtained from local university professors is used for stakeholder selection.

2. Interviews with the stakeholders
- Hypothetical maps of the stakeholders are formulated via literature surveys or Web searches.
- The hypothetical map is sent to the interviewees in advance.
- The study team members sequentially interview the potential stakeholders.

3. Cognitive map modification
- The cognitive map is revised on the basis of interview results.
- The map indicates the stakeholder's perception with regard to a causal flow in relation to the problem, impact flow in relation to the actions, and interactions with the other stakeholders.

4. Problem restructuring and policy agenda analysis
- The maps of the stakeholders are integrated via problem restructuring.
- The main factors and drivers are identified from the interview results.
- The potential policy agenda is abstracted from a factor-driver matrix.

5. Comparison of stakeholders' recognition and their interaction analysis
- The problem recognition difference among the stakeholders and the interactions among them are analyzed.

6. Feedback to the stakeholders
- The analysis results are presented to the stakeholders via a workshop.

FIGURE 1: The proposed problem structuring method based on cognitive mapping

Fifth, we analyze the differences in problem recognition among the stakeholders. We discuss two approaches for performing the comparison. A comparison on the basis of the viewpoints of the stakeholder's mission, time, and spatial dimensions and a comparison on the basis of the viewpoints of the stakeholder's main concerns. These viewpoints are referred to as the stakeholders' "recognition." Further, we analyze the stakeholders' interactions by means of a reciprocal expectation matrix. The stakeholders' expectations of the other stakeholders are abstracted from the oval-shaped factors in the cognitive maps. We present both the analyses results in the first case study, while we present only the problem-perception-difference analysis in the second one.

Finally, the analysis results are fed back to the stakeholders and an implication of our analysis is discussed. The first case study includes a feedback workshop.

Characteristics of the proposed method

In this study, the proposed method has the following four characteristics. First, our method highlights not only the interactions among the stakeholders but also the interactions between the analysts and stakeholders in transportation planning. The latter type of interactions is referred to as the "transdisciplinary" process. The analysts may be transportation experts or local researchers. They collate information from the stakeholders and analyze them for the transportation planner. Occasionally, even the conventional transportation planning processes contain expert participation in the form of a technical committee managed by the transportation planner in which the invited experts provide comments or advice to the transportation planners. However, the role of the experts in the technical committee may be fairly passive. We expect that the experts and analysts would more proactively contribute to transportation planning in the transdisciplinary process. The active interaction between the analysts and the stakeholders may be effective in terms of not only smooth data collection but also an extensive understanding of the transportation planner by the stakeholder. This method may propose a novel role of the experts with regard to transportation planning.

Second, we employ an active interview approach for a stakeholder interview (*14*). In this approach, we interview the stakeholders with hypothetical cognitive maps, which are formulated in advance. The use of these maps may be fairly critical not only to understand the interviewee's perception but also to convey our intention to them. This means that the interview is not regarded simply as a tool for collecting the interviewee's information, but the interviewer and interviewees join the same discussion and interact with their ideas on the perception of the interviewee's problem identification. An interview of both the sides can be considered as a type of learning process. We are sure that the learning process itself has the ability to develop and establish better transportation planning.

Third, we determine the potential policy "agenda," which is discussed in the corresponding transportation problem by the factor-driver analysis. In general, each stakeholder may possess a limited perception on problem identification. If the transportation planners extract the political agenda simply from the stakeholder's idea, the extracted agenda may also be fairly limited. By analyzing the scope and range of the stakeholder's recognition, we can extend the range of the problem structure and determine a completely novel potential political agenda. This may support the transportation planners in searching the transportation planning agenda.

Finally, we discuss the potential collaboration of the stakeholders by a comparison of their problem recognition and an analysis of the reciprocal expectation among them. A new collaboration is proposed by feeding back the analysis results to the stakeholders. Our proposal may also be useful for a transportation planner to promote the new transportation policy, which requires the stakeholder's collaboration.

CASE STUDY: STRATEGIC REGIONAL TRANSPORTATION PLANNING IN KANTO REGION, JAPAN

Case overview

The Kanto region is one of the nine regions in Japan; it includes seven prefectures: Tokyo, Kanagawa, Saitama, Chiba, Tochigi, Gunma, and Ibaragi. The region covers about ten percent of the total area of Japan and comprises over thirty percent of the total population of Japan. The region includes several megacities such as Tokyo, Yokoyama, Kawasaki, Saitama, and Chiba; it also includes rural areas on its fringes. The regional population—over thirty million (in 2006)—has gradually increased as a result of immigrants. The government agency has predicted that the regional population will keep increasing, although the total population of Japan has started to decrease since 2000. When the population trend of the Tokyo Metropolitan Area is investigated in

detail, it is observed that the urban population has increased, whereas the rural population has decreased. One of the major reasons for this population decrease in the rural areas is the rapid aging of the rural societies. With regard to the transportation planning system, no statutory planning exists for the regional transportation system in Japan as of 2007. Although some informal regional transportation plans exist, such as the regional railway master plan, they have no legal background, particularly for policy implementation and budgeting, and no holistic viewpoint. The strategic regional transportation plan considered in this case study is regarded as one of the challenges to discuss the regional transportation system in the Kanto region from a holistic viewpoint. In 2003, the Kanto Region Transport Bureau under the Ministry of Land, Infrastructure and Transport (MLIT) initiated discussions on a strategic transportation plan. The planning work was commissioned to the Kanto Regional Transport Council. The Kanto Regional Transport Council consists of academic researchers and local business organizations. One of the authors is a member of a working group organized by the Council. The Council discussed the strategic regional transportation policy for two years; the policy was completed in 2005. The Council does not include the multimodal transportation policy, but only the public transportation policy. Although we utilize the information provided by the Kanto Regional Transport Council, we emphasize that the analysis in this paper is completely independent of the Council's discussion.

Selection of stakeholders

In the Council's midterm progress report, the Kanto Transport Bureau of MLIT proposed seven targets to solve the present transportation problems of the Kanto region. They are as follows: transportation policy promotion for the aged population; local and interurban transportation improvement; transportation service improvement in the rural areas; an efficient freight transportation system; environmental impact reduction; safe and secure transportation services; and tourism promotion. We use these seven tentative policy targets to set the hypothetical policy agenda, which will be used in the stakeholder interview. First, we set the hypotheses on a causal relationship between the hypothetical targets. The problem system map reveals the causal chains including the causal factors and the corresponding result factors. We sketch causal flows from a specific problem along both the upstream and downstream directions. The causal relationship is represented by using arcs and nodes in a system map. This map can reveal the stakeholders as well as their relationships with the system. The problem system map in relation to the policy target is sketched with the same concept as the stakeholder's cognitive map shown later.

After the system maps have been formulated, we list the stakeholder candidates by using these maps; several potential stakeholders are revealed in the Kanto regional transportation system. This may indicate that the transportation problem in the Kanto region is very complex. We select the interviewees including the following twelve stakeholders: three private rail operators including one urban subway operator, a public highway corporation, three prefectural transportation authorities, a local bus operator, an automobile producer, a highway authority, a local tourism policy authority, and a local police agency.

Hypothetical cognitive mapping and its modification on the basis of the interview results

We formulate the hypothetical cognitive maps of the stakeholders with regard to the regional transportation problem in the Kanto region. We browse the stakeholders' Web pages for the mapping process. The hypothetical maps are sent to interviewees before the interviews are conducted. We sequentially meet with and interview the representatives of the stakeholders. The interviews were started in April 2004, and they were completed in March 2005. Then, we revised the stakeholders' activity targets on the basis of the interview results. Further, we eliminated the less important items from the original maps after we determined that the stakeholder does not regard these items as important factors. Additionally, we included the factors that the stakeholders consider as barriers for achieving their targets. We also included the factors that they expect the other stakeholders to perform. The revised cognitive maps are shown in FIGURE 2 and 3.

Problem restructuring and policy-agenda analysis

The potential policy agenda will be abstracted by using problem restructuring. The participation of the experts and multidisciplinary discussions are critical for these analyses. The authors, including a transportation planner and public-policy analyst, are involved in the analysis. Further, we utilize the comments of other experts—mainly transportation-policy researchers.

Selection of main factors

We abstract the following five main factors of problem restructuring on the basis of the interview results:
- Transportation quantities: a lack of transportation supplies, including poor transportation facilities in the rural areas and an insufficient investment in the ring-road network.
- Transportation quality: a low level of transportation service and infrastructure quality, including traffic congestion and low traffic speed.
- Transportation marketing: insufficient efforts to generate new transportation demand or promote the demand for a less-demanded service, including the promotion of foreign tourism and marketing for weekend transportation services.
- Environment: serious environmental impacts, including the lack of environmental technology/regulations and insufficient transportation demand management.
- Safety and security: dangers of traffic safety and security, including antiterrorism and disaster prevention.

Selection of drivers

The following five potential drivers have been abstracted on the basis of the interview results: less young generation and more elderly generation; the financial deterioration of the central and local governments; global competition along with globalization; land-use changes (e.g., recent movements of additional population into central business districts); and higher social concerns with regard to the environment. Most of these potential drivers are considered with short-term viewpoints. This is partly because the time scale of the stakeholders' problem perception is fairly small. Further, it should be noted that many of the potential drivers exhibit low risks or occur with a low probability. This is probably because they find it difficult to reach a consensus for taking actions toward low-probability high-risk issues in their organization. These characteristics may bias the selection of the drivers. Thus, by means of the discussions with the experts, we consider the following additional drivers in order to avoid bias in the stakeholders' perceptions:
- Extensive changes in industrial structures: a change in the industrial structure from conventional heavy industries to knowledge-based industries can probably influence the freight transportation patterns. On the other hand, the low-income population has a lesser opportunity to be employed in a knowledge-intensive
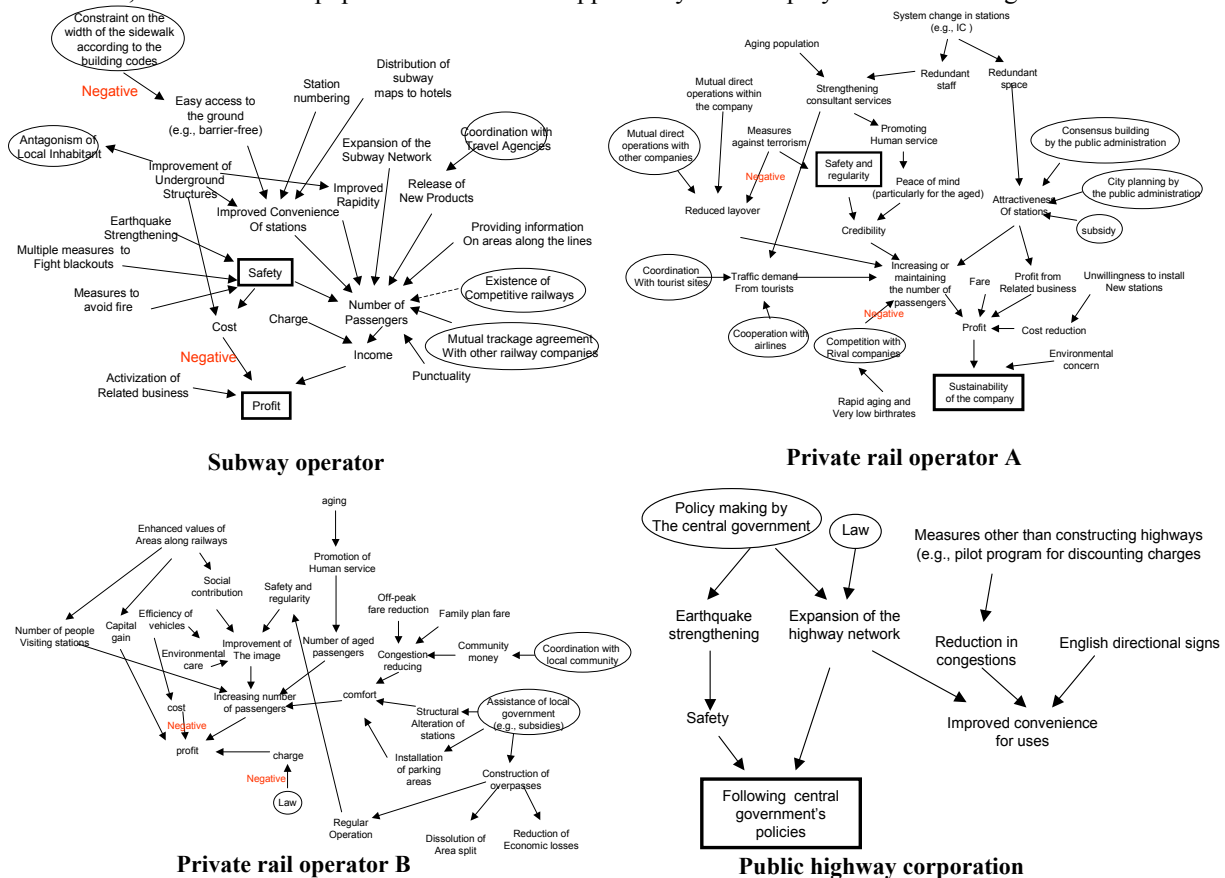
Subway operator

Private rail operator A

Private rail operator B

Public highway corporation

FIGURE2 Cognitive maps of the stakeholders concerned with transportation in Kanto Region, Japan
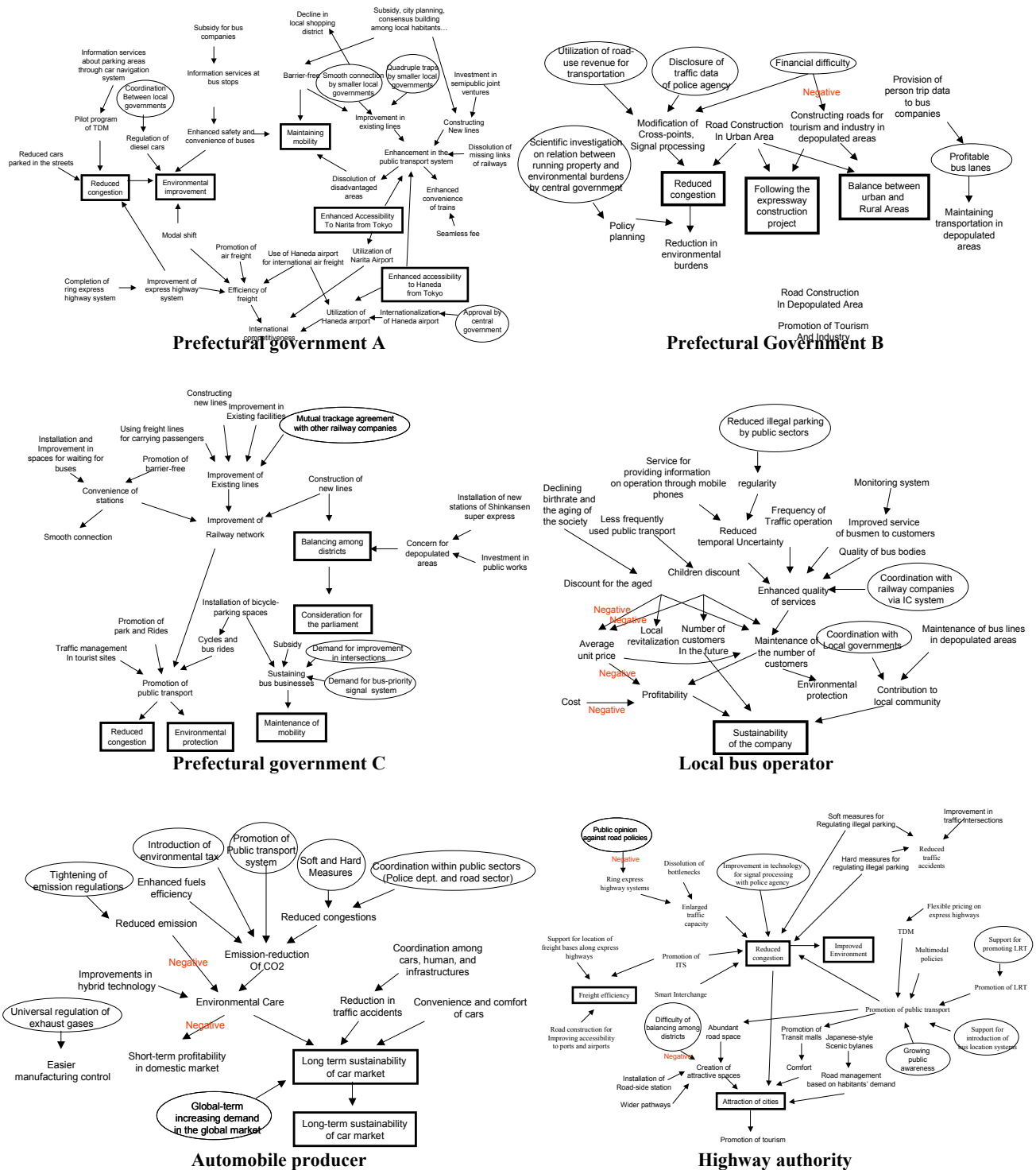
FIGURE 3 Cognitive maps of the stakeholders concerned with transportation in Kanto Region, Japan (Continued)

industry, while the high-income population may have greater opportunities. This may increase the inequality in the level of incomes among the population. As a result, the social inclusion of the low-income population and accessibility improvement in public services may be included in the more important policy agendas.

- Increase in the number of women workers: a new working style or nonconventional workers can emerge with the lack of labor force due to rapid aging of the working population. The penetration of work sharing employment system and part-time employment increase the irregular commuters.
- Greater number of foreign workers: the globalization of the labor force changes the conventional work system into flexible work and English-language-based works. An increase in the number of foreign workers results in

further investment toward internationalizing urban facilities, while urban security is included into the more important agenda.
- Larger contribution to the international society: A larger number of international viewpoints from the international society are required. For example, since the Kanto region is one of the most successful public-transportation-oriented megacities, many developing countries request Japan to share the knowledge about this system.
- Catastrophic natural disasters: Japan encounters several natural disasters, which include earthquakes, typhoons, and floods. Since the Kanto region includes the national capital (Tokyo), robustness with regard to natural disasters is extremely critical.

Policy-agenda abstraction

The abstracted potential policy agenda is listed in TABLE 1. For this abstraction, the experts in our study team, including the transportation planners and the public-policy researcher, extensively discuss the potential policy agenda. On the basis of these intensive discussions and analysis, we find out certain new agendas that have not been pointed out in the stakeholder interviews. For example, the combination of "a greater number of women workers" and "transportation quality" generates the agenda in relation to "irregular transportation." The pair of "larger contribution to the international society" and "environment" generates an international contribution as the "model city with a sustainable transportation policy." The pair of "less young generation and more elderly generation" and "transportation marketing" generates an agenda associated with "transportation for long-stay tourism" and "in-house medical-care transportation." It might prove worthwhile to discuss these issues furthermore with regard to transportation planning, although they have not been discussed in detail.

TABLE 1 Potential policy agenda in relation to the regional transportation in the Kanto region

	Quantity of transport	Quality of transport	Transport marketing	Environment	Safety and security
Less young generation and more elderly generation	Barrier-free in transport network, mobility in rural areas	Public transport service improvement, *irregular traffic*	*Long-term tourism, in-home medical care transport*		Traffic safety for elderly people
Considerable changes in industrial structure	*Social inclusion in rural areas*	ICT-aided transport service	ICT-based transport marketing		
Globalization		Efficient freight transport and accessibility to airports	International tourism promotion		Transport security and disaster prevention
Changes in land use	Transport suitable for compact cities	Reducing traffic congestions		Urban environmental probems	Security measures for traffic services
Greater number of women workers		Meeting the needs of irregular traffic			Transport security
Higher social concerns with environmental issues		Public transport promotion and efficient freight transport	*Off-peak time transport marketing*	Global and urban environmental problems	
Financial deterioration in governments	Infrastructure management in rural areas	Utilization of existing facilities			
Greater number of foreign workers	Traffic service for foreign people	Traffic service for foreign people			Security measures for traffic service
Larger contribution to international society		Model of transit-oriented cities		*Model of transit-oriented cities*	*Terrorism prevention*

Comparison of stakeholders' recognition and their interaction analysis

Comparison of the stakeholders' recognition

We analyze the stakeholders' perceptions according to the following five viewpoints: the mission: "what the stakeholder pursues?"; the networking range with the other stakeholders: "who are the major stakeholders that a stakeholder pays attention to?"; the spatial-dimension range: "what is the spatial framework under which each stakeholder acts?"; the environmental conditions: "what environmental conditions, including technical, social, and institutional conditions, are important for each stakeholder?"; and the time-dimension range: "what is the time framework under which each stakeholder acts?".

TABLE 2 summarizes the comparisons of the problem recognition of the stakeholders. First, stakeholders, even in the same category, have different recognitions. For example, although all the railway operators recognize the importance of networking with other railway operators, their attitudes toward railway networking varies along with their missions. Railway operator A shows a passive attitude toward collaborations with local governments and local communities in terms of station-space use and tourism promotion. On the other hand, railway operator B recognizes the importance of increasing the value of the railway neighborhood area and shows a proactive attitude toward collaborations with the local government and local communities in terms of local development. The subway operator's concern regarding the local community is very limited; it is concerning the issue of connecting the underground regions to the surface. The prefectural governments recognize their lack of capacity in relation to the transportation policy. One of the reasons is because they do not have their own regulatory authority in the local transportation market. The other reason is because they have weak cooperation with the prefectural governments. Further, we find variations in the recognition of stakeholders, even those belonging to the same category. Prefectural government A directly provides the transportation service to their area because it possesses municipal government functions. On the other hand, prefectural governments B and C do not provide a direct service because they include powerful municipal governments that are responsible of direct service provision. Prefectural government A shows a strong concern about the local transportation service in their area, whereas prefectural governments B and C have other concerns, mainly in relation with the balance among the subregions in their area.

Second, different stakeholders have different recognitions. With regard to the spatial dimension, the automobile producer pursues a leadership role at a global level. On the other hand, the concerns of railway operator A, railway operator B, and the bus operator are limited to their operating areas. With regard to the time dimension, private companies tend to have greater time recognitions, whereas governmental units tend to have smaller time recognitions. For example, the automobile producer has set the target year as 2050. One of the major concerns of the local bus operator is a sustainable bus market for the next generation. On the other hand, the governments whose officers usually move their positions every two to three years and with an annually fixed budget cannot have long-term viewpoints.

Interactions among stakeholders: reciprocal expectation analysis

Now, we identify the stakeholders' networking range and their expectations toward the other stakeholders. The relationship among the stakeholders is listed in TABLE 3. The table includes airline companies and citizens who have not been interviewed thus far. Their expectations are hypothetically described on the basis of the results from the interviews with the experts. Each cell in TABLE 3 lists what the stakeholder in the vertical line expects from the stakeholder in the horizontal column to perform.

A potential collaboration among the stakeholders is listed in TABLE 3. First, we identify the potential collaborations that are partly realized in practice. For example, there is a potential collaboration between the railway operators and airline companies with regard to the use of a common credit card system, tourism promotion, and airport access. A potential collaboration also exists among governmental units. The highway authority can collaborate with the public transportation authority with regard to the use of gas tax revenues. The reallocation of the tax revenues to the public transportation system can be a potential compromise, at least among these two stakeholders[1]. There is another potential collaboration between the local transportation authority and the police agency with regard to transportation demand management (TDM), the strict enforcement

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[1] The current tax system does not allow gas tax to be allocated to the public transportation system in principle. However, the tax revenue system is currently facing strong social pressure for relaxing this allocation rule. A recent example is that the gas tax revenue is used in the subway investment in Tokyo.

of illegal parking regulations, and the sharing of traffic data; however, their relationship is asymmetrical, that is, the police agency is strongly expected by the other stakeholders to perform something, although the agency does not expect a considerable amount from the other stakeholders.

Second, we also identify the potential collaborations among the stakeholders that have still not been realized in practice. For example, first, there may be a potential collaboration among the automobile producer, highway authority, and police agency with regard to implementing countermeasures against global warming. The automobile producer owns the production technology, whereas the highway authority is responsible for infrastructure development and the police agency possesses the power to control the traffic flow. The highway authority will benefit if the illegal parking regulations are tightened by the police agency and automobile technologies are improved by the automobile producers. This is because they can improve the traffic capacity without any additional investment of their own. The police agency can also benefit by tightening the traffic regulations, while it expects the highway authority to invest further in highway development. This is because the police agency has lesser resources than the highway authority. The automobile producer has the incentives to support the highway authority as well as the police agency because they cannot earn profits from the automobile users unless the road and traffic services are well managed. Second, the automobile producer can collaborate even with the public transportation operators. This is because they consider that they cannot achieve social support for a sustainable and global automobile society unless the automobile industry and public transportation system effectively coexist. Further, they can collaborate with the public transportation operators with regard to implementing countermeasures to deal with irregular transportation demands. The local bus operators and railway operators may find a new business as a means of utilizing their capacity by providing special services to young people who are not regularly employed, elderly people, and part-time-working women. The automobile producer may find comparative advantages in an irregular transportation market because such demand requires greater flexibility.

Furthermore, a potential collaboration can exist among the many stakeholders in the long-stay tourism business. The public transportation operators can collaborate with the automobile service providers (e.g., rental car companies dealing mainly with tourists). There is also room for innovation by introducing a common seasonal ticket or card system for long-stay tourists that can be shared among various transportation operators[2]. The local governments can provide sufficient incentives to promote tourism because they can obtain taxes from tourist activities. The participation of local farmers and hotels can prove to be important for ecotourism and participatory tourism.

Feedback to stakeholders via workshops

After completing the analysis, we held a workshop with the stakeholders at the end of March 2005. Not only the interviewees but also other stakeholders were invited to the workshop; here, the analysis results were discussed. The total number of participants in the workshop was ten; it took around two hours. The participants pointed out the mistakes or misunderstandings in the revised cognitive maps shown by us. All the participants showed a greater concern, particularly with the cognitive maps of the other stakeholders. Further, they commented that a reciprocal expectation matrix seemed to be very useful in their decision making.

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[2] Long-stay vacations are not so popular in Japan during the summer season. Recently, the central government has proposed long-stay tourism.

TABLE 2 Comparison of the problem recognitions among stakeholders

	Missions	Interaction with other stakeholders	Spatial domain of interest	Change of environmental conditions			Critical factors	Time domain of interest			
				Techno-logical	Social	Institutional		One year	Several years	Middle term	Long term
Subway operator	Safe and punctual operation	Competition and coordination with other railway operators	Own network and other railway networks connecting them	Common farecard system	De-centralization	The building standard law and the road construction law	Life-cycle time of facilities and vehicles	++	++	+	0
Railway operator A	Sustainable and reliable operation, profit maximization	Competition and coordination with other railway operators and coordination with airline companies	Kanto region and neighborhood regions	Smart card technology	Aging society with low birthrate	Deregulation and privatization	Life-cycle time of facilities and vehicles	++	++	+	0
Railway operator B	Profit maximization and contribution to local community	Coordination with local governmens	Local area along the railway lines	Smart card technology	Demand decrease	Fare regulation	Life-cycle time of facilities and vehicles	++	++	+	0
Local bus operator	Sustainability of the company with local economy revitalization	Coordination of time schedule with railway operators	Local area along the bus routes	Smart card technology	Aging society	Deregulation	Company's sustainability	++	++	++	++
Prefectural government A	Improvement in the local quality of life	Coordination with highway authority and transit operators	Own prefecture and airport	ITS technology	De-centralization	Decentralization	Other plans	++	++	++	0
Prefectural government B	Inter-district balance and better interaction with local council	Coordination with highway authority and transit operators	Own prefecture	ITS technology	Depopulation	Decentralization	Other plans	++	++	+	0
Prefectural government C	Inter-district balance and environmental protection	Coordination with highway authority and transit operators	Own prefecture	ITS technology	Depopulation of some districts	Lack of transport budget	Other plans	++	++	+	0
Highway authority	Traffic-congestion reduction, utilization of road spaces and local economy revitalization	Coordination with policy agency	Entire Japan	ITS technology	Public opinions against road construction	Privatization	Long-term investment plan	++	++	+	0
Highway public corporation	Follow the highway authority control and local-user communication	Coordination with police agency and truck association	Own highway network	Anti-disaster technology	Public opinions against road construction	Laws on decision-making process of road construction and privatization	Highway authority's investment plan	++	++	0	0
Automobile producer	Sustainable car-oriented society and profit maxmization	Coordination with vehicle regulator	All over the world	New fuel technology	Kyoto Protocol	Vehicle regulation	Sustainability of car-oriented society	++	++	++	++

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TABLE 3: Interactions among the stakeholders: What the stakeholders expect the others to perform

	Public transport authority	Highway authority	Police agency	Local governments	Railway operators	Local bus operators	Airline companies	Automobile producer	Citizens
Public transport authority		Reallocation of gas tax revenue to public transport investment	Coordination for TDM	Joint subsidy to public transport	Service-level control	Service-level control		Compliance with gas emission regulations	Support to transit-oriented policy
Highway authority	Corporation for intermodal policies	Coordination among regional bureaus	Data sharing, coordination for traffic congestions and traffic accidents reduction	Execution of highway investment plan	Station area development and rail crossing improvement			Improvement in vehicle safety	Support to highway investment
Police agency	Control of bus and truck operators	Highway investment							
Local governments	Joint subsidy to public transport	Coordination in highway construction	Coordination for TDM	Coordination for transprefectural transport policies	Station area development, tourism promotion and parking facilities investment	Coordination for bus-stop installation			Support to transit-oriented policy
Railway operators	Subsidy to railway investment	Subsidy to railway investment		Subsidy to railway investment	Coordination for smooth connections and common fare-card introduction	Coordination for smooth connections and common fare-card introduction	Joint credit card, tourism and airport access improvement		Support to station area development
Local bus operators	Subsidy to bus operation	Highway investment	Coordination for smooth bus operation	Coordination for bus-only lane	Smooth connection at railway stations	No over-competition			Greater use of local bus services
Airline companies	Support to airport access improvement				Joint credit card and airport access improvement	Airport access improvement	No over-competition		More use of airline service
Automobile producer	Strong leadership in transit-oriented transport policy	Highway investment	Illegal-parking control and coordination with other public sectors	Coordination with other public sectors				Non over-competition	Support to sustainable car-oriented society
Citizens	Strong leadership in transit-oriented transport policy	Highway service-level improvement	Better road traffic management and road safety control	Local transport improvement	Railway service improvement	Bus service improvement	Airline service improvement	Cheaper and higher performance vehicles	

CONCLUSIONS

This paper proposes a method to analyze the problem perceptions of stakeholders and structuring these problems by using their cognitive maps. We present the case study of the strategic public transportation planning in the Tokyo Metropolitan Area. It shows that the proposed method is fairly effective. The case study shows that the successful generation of a potential agenda is possible. Further, we compare the stakeholders' recognitions by means of an analysis of the problem perceptions of the stakeholders. Additionally, we analyze the interactions among the stakeholders by using a reciprocal expectation matrix.

In this study, although the problem structuring method is mainly applied to transportation planning, the method itself may be so general that it can be used for other purposes such as urban planning, educational planning, medical and public health planning, and so on. As a matter of fact, public policy studies have emphasized the importance of agenda setting along with the policy decision-making, policy implementation, and policy evaluation stages. For example, a conventional textbook for public policy studies (15) includes an independent chapter regarding problem structuring in which various methodologies of problem structuring are discussed. However, even such textbooks do not clearly describe detailed methodologies to problem structuring according to the stakeholders' perceptions. Thus, the method proposed in this paper may be expanded and can contribute to public policy studies.

Although the proposed method overcomes some difficulties in the earlier problem structuring methods, several further research issues still remain. They can be categorized into two issues. The first one is the methodological issue. Here, we initially select the interviewees from a list of potential stakeholders, although it is ideal to interview all the potential stakeholders. This is simply because we do not have sufficient time and resources to interview all the potential stakeholders. We have to face this kind of resource limitation when we apply the methodology in practical world. However, the interviewee selection may bias the analysis results. Therefore, a method to prioritize the stakeholders should be investigated. Then, the interview results depend considerably on the interviewed individuals. Although we attempt to meet with the persons who have sufficient knowledge and experience in their own organizations, the responses may vary from one person to another, even if the other person belongs to the same organization. A method to eliminate bias in the interviewee selection should be examined. Finally, the cognitive map depends on the individual who sketches the map. The selection of such an individual may also bias the results. The variations in the maps among such individuals should be investigated under the condition that the same interview results are obtained.

The remaining research issue is about the analytical method, particularly with regard to the stakeholder's problem recognition and potential collaboration. The first case study compares the stakeholder's recognition mainly with regard to the spatial and time dimensions. Although they definitely are important items, other items may also influence the stakeholder's recognition. The second case study does not prepare such dimensions but use the stakeholder's recognition for the comparison. We should examine other viewpoints for a better recognition analysis. Further, the potential collaboration in our case studies is limited to the collaboration that entails a win-win situation for each stakeholder. Although it is undoubtedly important to identify the win-win criteria, the public policy alternatives are, of course, not limited to such criteria. In some cases, it might be more important to make decisions that result in losses to specific stakeholders when the social benefit is substantial. Thus, it is necessary to identify under what conditions it is impossible to determine the win-win options using our problem structuring method. Furthermore, there is an uncertainty in some drivers, which can influence the stakeholder's perception. Scenario planning can be useful to consider this uncertainty (16, 17, 18,). However, earlier studies considering this scenario analysis do not explicitly analyze the interactions among the stakeholders. There might be room to investigate it further.

Finally, it should be noted that the potential agenda abstracted from the problem structuring method shown in this study are the agenda candidates, which are further discussed in the decision-making process. To proceed with the planning process, we should select a specific agenda from a set of potential policy agendas with certain selection criteria. The decision makers should discuss and decide the selection criteria by selecting the values for public welfare. The values may include economic efficiency, social equity, government financial balance, and so on. This selection is one of the most important planning processes; however, the methodology for selection of the value is not well developed thus far. This forms a future research issue that should be considered.

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