

# Policy Making for Global Transportation Planning using the Delphi-Scenario Writing Method with a New Concept of ‘Future Vision’

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**Abstract:** The present study deals with a new methodology for establishing a qualitative, long-term view of regional requirements. The purpose of this study is to create a socio-economic vision of the future for proper transportation planning for a target region. This study calls it ‘future vision,’ which consists of several future images when considering the changing characteristics of the region and its relationship with surrounding areas. These future images can cover all transportation-related topics, from global problems to local issues. Each future image is composed of scenarios that reflect the future direction and role of transportation planning, which fully describes infrastructures as well as management.

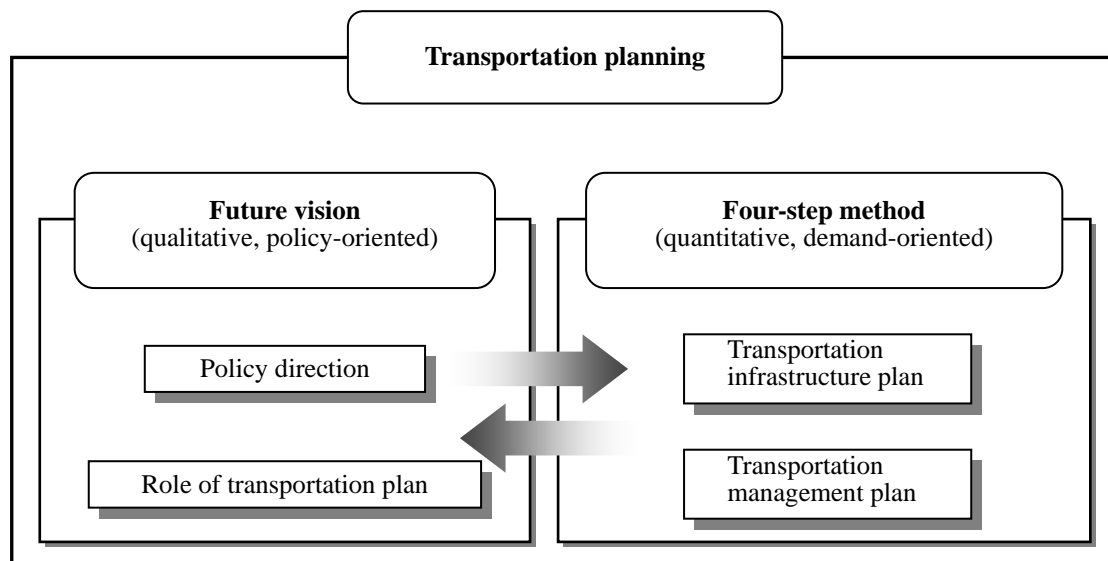
**Key words:** Policy making, global transportation planning, long-term view, future vision, scenario writing

**JEL classification:** D78, O21, R11, R49

## 1 Introduction

When planning transportation projects for a wide area, the most important factor is the number of personal trips (trips by person per day). Many methods which are used to survey personal trips and analyze the results have already been developed based on three-decade-long field studies. Conventional methods usually involve quantitative analysis based on the conventional four-step forecasting technique that ensures a reasonable level of satisfaction for practical applications. Conventional methods have been used to estimate future transportation demand using the personal trip survey data. In addition, conventional methods have been used to plan measures for counterbalancing the difference between transportation demand and existing capacity using new infrastructures (see the right box in Figure 1).

Conventional methods were very effective during periods of high economic growth because they assure an increase in transportation demand. However, due to declining economic growth, conventional planning methods are no longer useful. Moreover, in addition to quantitative analysis, qualitative analysis should be undertaken just prior to the completion of projects that have planning periods of up to 20 years, or projects that involve construction of infrastructures that are indispensable to daily life. The qualitative analysis should reflect both the national and international socioeconomic circumstances that affect transportation trends as well as changes in the way people think that will determine transportation demand in the future. As illustrated in Figure 1, the quantitative analysis and the qualitative analysis should work together by sharing and exchanging fundamental information.



**Figure 1 Concept of transportation planning in the present paper**

The present paper is aimed at describing a new long-term qualitative method to be used in transportation planning that is based on the conventional personal trip survey. In other words, the present paper proposes a new approach for determining long-term regional transportation requirements from a global planning viewpoint. The present approach is policy-oriented, and mainly discusses the policy direction, the role of planning in transportation (the role of a transportation plan), and so on (see the left box in Figure 1). Scenario writing and the Delphi method are of primary importance to the present approach. Transportation planners are asked to write scenarios of the future vision for the area to assess the role of transportation plans. Through the Delphi feedback processes, agreement among the planners can be reached concerning the future image of the area, and various problems to be discussed in the transportation planning process can be clarified. Both the quantitative method and the qualitative method contained in the future vision should complement each other to create more rational and realistic transportation plans in conjunction with the conventional four-step method.

The study area comprises the North Kyushu Metropolitan Area (Fukuoka Prefecture and a division of Saga Prefecture, Japan), where the third personal trip survey was carried out in 1993 and the long-term transportation plan which was made using the data obtained in this survey is now in re-planning stage. The estimated time frame for the completion of the plan is 2015.

## **2 Coordinating quantitative and qualitative aspects in transportation planning**

In transportation planning, the evaluation of transportation policies follows forecasting demand for travel in the future. These two important sub-processes are usually based upon a quantitative analysis and a qualitative one, respectively. In the days of economic growth, the increase of transportation demand justified policies of providing new transportation infrastructures, or the expected benefit exceeded the construction cost. Sufficient

transportation demand gave a solution but it gave no opportunity to consider the real nature of transportation planning.

Quantitative and qualitative aspects are dependent on each other. Separating them into two consecutive sub-processes might cause problems and invite errors. The authors have noticed this recently. When transportation demand does not always increase and there are new requirements such as ensuring the minimum necessary mobility to aged people in rural areas, quantitative and qualitative aspects in transportation planning should be coordinated or integrated. Consensus has to be made on transportation policies while checking both future demand and people's opinions.

In the proposing procedure, a four-step forecasting technique is employed in order to forecast transportation demand, and scenario writing and Delphi improvement are used for organising people's perception and preference into the future vision.

A four-step method is chosen in the present study, because its use is widespread in local governments in Japan, and because many newly developed methods are not satisfactory. Some efforts were devoted to solving simultaneously a combined problem of 'trip generation,' 'trip distribution,' 'mode choice' and 'route assignment.' They were successful to some extent and some of the partially combined models seem useful. Disaggregate models were also developed to bring different understandings of people's behaviour. But they hardly provide good, accurate estimates at the aggregate level, so it will be concluded that they cannot replace the existing methods.

The present study focused efforts on the qualitative aspect. In order to make a set of policies about the scope and policy alternatives in transportation planning called 'future vision,' scenario writing and Delphi method are introduced. Needless to say, scenario writing itself is not a special method. Planners often use it to describe a desirable system. Although the method does not require any particular form, it is standardised so that the difference among people's perception and preference can be recognised easily. The point is to make a collective decision by writing scenarios on the future vision.

Another tool to reduce the differences among people's perception, preference and opinion and to achieve consistency is the Delphi method (see Arai et al., 1984). Through the Delphi feedback process, people might notice the differing responses from different groups in society and the difference in their tastes. More information might change their perception. At least mutual understanding makes clear the real problems to be discussed in the transportation planning process, which is supposed to raise the probability of reaching a consensus. Moreover, the subjectivity and prejudices of the planners can be excluded from the study, and the surveys provide the planners with valuable additional information (Crookall et al., 1995, Friend et al., 1987).

Some sources in the literature point out that the Delphi method might lose important information through the feedback process. This study paid great attention to the problem and performed the feedback process with great care so as not to lose any important planning ideas by surveyors' checking at each step.

The case study, however, sets a limit on the people involved in the planning owing to practical reasons. Theoretically the proposed procedure can be applied to any citizen participation process but the initial case study dealt with a wide variety of transportation planners who have lived in the study area.

### **3 Principles for creating future vision**

This article defines the future vision as the specific characteristics of the area for the target

year including the policy direction for that area. The principles for the creation of the future vision are as follows:

- (1) The future vision will cover the North Kyushu Metropolitan Area.
- (2) Because the area for the future vision has potential as both an economic center in East Asia and a cultural community well-suited to senior citizens, the scenarios will be drawn up according to a hierarchical structure that contains four levels: future image (top level), current status (upper middle level), policy direction (lower middle level), and role of transportation plan (bottom level). The future image will be the planning strategy by which the future vision will be implemented, whereas the policy direction and the role of transportation plan will be more detailed and will contain specific objectives, plans, and proposals.
- (3) The future vision, the future image and all scenarios will be drawn up by a team of transportation planning experts (for example, see Masser et al., 1992). This team will be comprised of the authors of this paper, transportation engineers, planners, and local authorities (department of transportation) of the target area.
- (4) In order to increase the appropriateness and feasibility of the study, the future vision should take into account the opinions of various interest groups and should be adjusted accordingly where possible.

#### **4 Method for creating future vision**

The flow chart illustrating the creation of future vision is shown in Figure 2. The concept and direction of the comprehensive national development plans are summarized in the upper portion of the chart. By studying the structural changes over time in the North Kyushu Metropolitan Area and reviewing master plans of each city in the North Kyushu Metropolitan Area, the structure of the whole area can be well understood. Combining the entire area structure with the socioeconomic outlook for the target year has yielded an initial version of future vision, referred to as primary future vision.

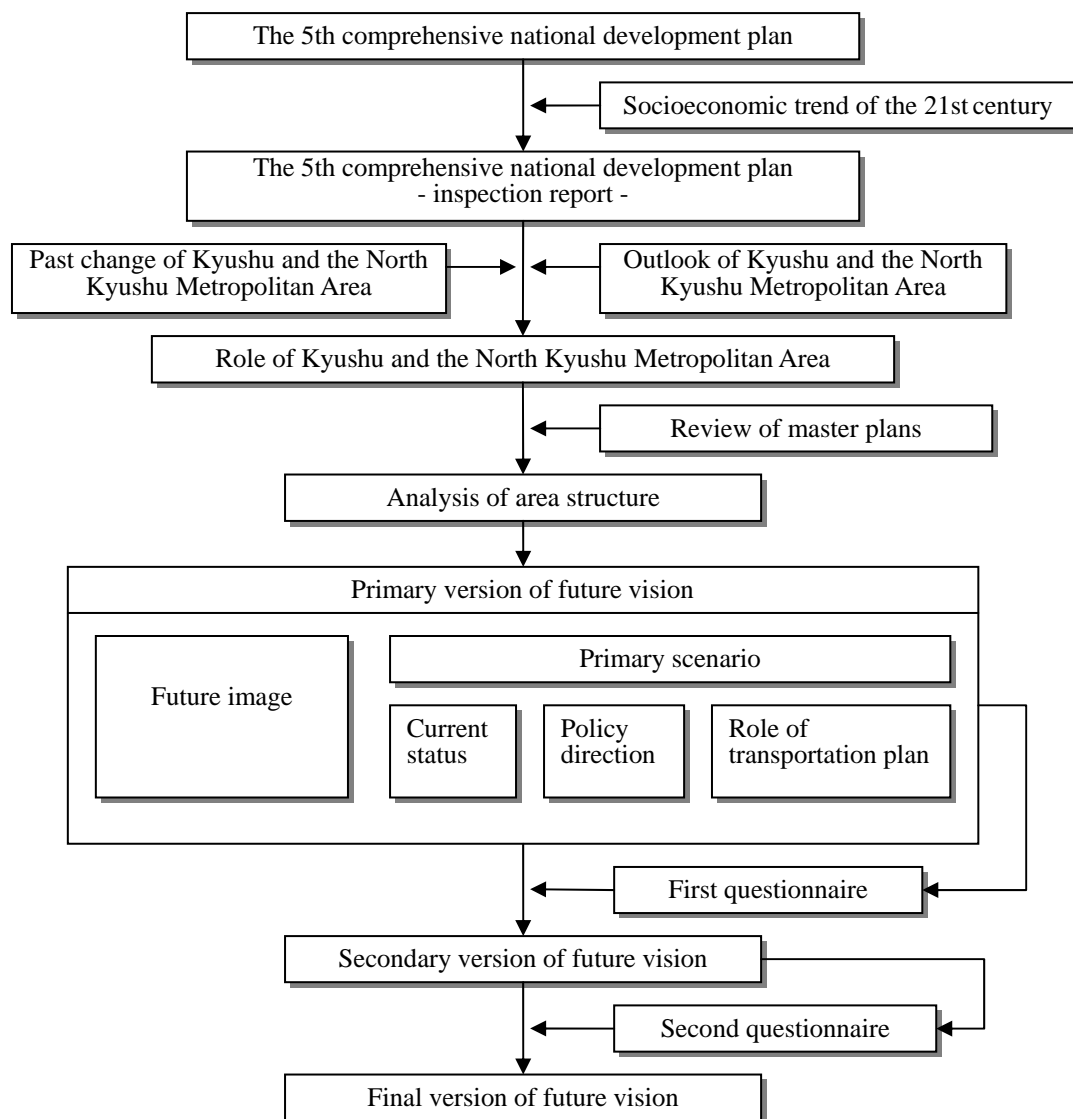
Subsequently, the questionnaire survey was carried out in order to correct errors contained in the primary future vision as well as to add any information missing from the initial survey. The information contained in the first questionnaire was used to revise the primary future vision and to create a revised plan, referred to as secondary future vision.

Finally, the second questionnaire survey was conducted in order to increase the feasibility and consistency of the scenarios. The secondary future vision revised by the second questionnaire is the final version of the future vision (referred to hereafter as future vision). The working procedures will be described below.

##### ***4.1 Setting of future image***

Based upon the fifth comprehensive national development plan (see National Land Agency, 1999, 2002) and the analysis of the roles of Kyushu and the North Kyushu Metropolitan Area, the future images of the area in the early 21st century were set as follows.

- (1) Macroscopic viewpoint: Due to the economic relationship with surrounding areas, the North Kyushu Metropolitan Area is to be “the center for vital development.”
- (2) Microscopic viewpoint: Due to increasing diversity, the area is to be “a community providing a comfortable life.”
- (3) The above two images were further broken down into seven future images, whose titles are given in Figure 3.



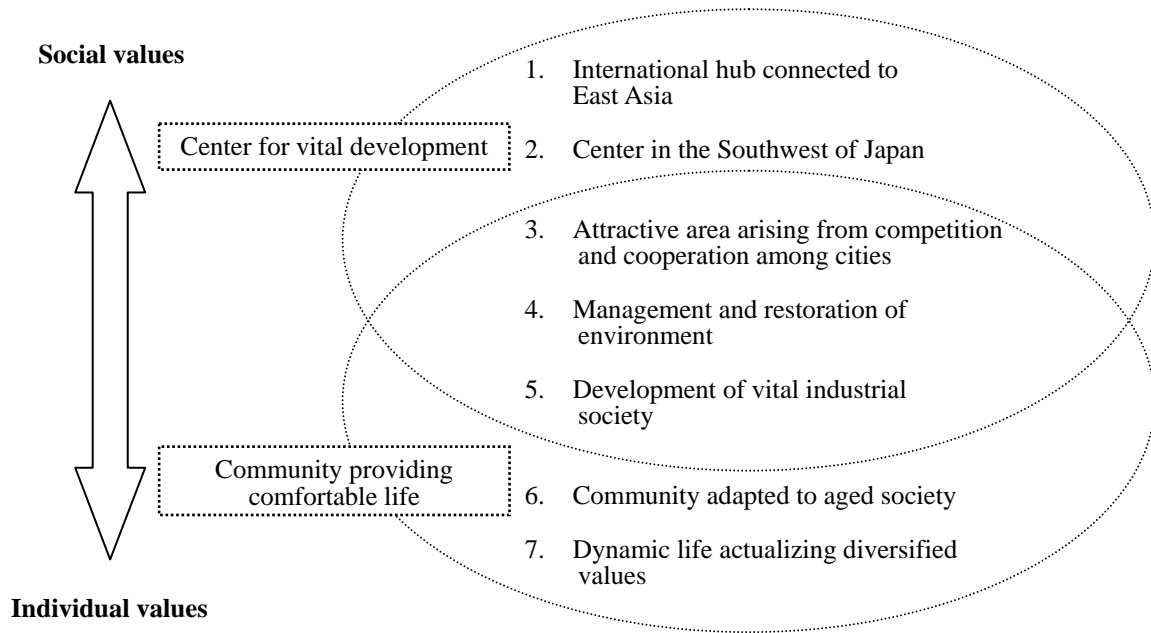
**Figure 2 Flow chart of creating the future vision**

#### **4.2 Primary version of future vision**

The detailed content of the seven future images was clarified based on the analysis of the area structure, existing plans, and projects under consideration. Next, the transportation planners drew up some scenarios to achieve each future image as follows.

- (1) Many important keywords associated with each future image were collected in the brainstorming session of the transportation planners.
- (2) The current status of each future image was accurately assessed. The keywords were classified into four groups according to the policy direction, the role of the transportation infrastructure plan, the role of the transportation management plan, and other criteria.
- (3) Based on the list of keywords, the scenarios were written according to the following viewpoints.
  - (a) Current status: The current status of the North Kyushu Metropolitan Area was described referring to the socioeconomic changes from the past.
  - (b) Policy direction: The policy direction necessary to realize each future image was described.
  - (c) Role of transportation plan: The role of the transportation plan both in terms of

infrastructure and management were assessed in order to determine the policy direction of each future image.



**Figure 3 Seven future images**

#### **4.3 First questionnaire**

The first questionnaire survey was implemented to evaluate the importance of planning items that are contained in the primary future vision in order to correct errors and to add any information missing from the primary future vision. Table 1 shows the major survey items of the first questionnaire survey. Fifty-six people in all from the field of transportation planning were chosen for surveying; specifically, university staff (17 persons), government staff (22) and think-tank staff (17).

**Table 1 First questionnaire**

Item	Content
Future image	1. Evaluation about content of future image (probable or not?) 2. Addition if missing information
Current status	1. Evaluation about current status (probable or not?) 2. Addition if missing information
Policy direction	1. Evaluation of importance and feasibility of policy direction A: important and highly feasible B: important but less feasible C: not important
Role of transportation plan	1. Evaluation of importance and feasibility of transportation plan A: important and highly feasible B: important but less feasible C: not important 2. Addition of planning elements (important and highly feasible)

#### ***4.4 Secondary version of future vision***

The team of transportation planners revised the primary future vision with the results of the first questionnaire, using the procedure shown in Figure 4. Every item of the questionnaire was categorized as ‘Adoption’ (accepted), ‘Non-adoption’ (rejected) or ‘Reexamination’ according to an overall evaluation of the importance and feasibility of each planning item. ‘Adoption’ is subdivided into three categories; ‘Adoption without amendment,’ ‘Adoption with slight amendment,’ and ‘Adoption after revision.’ For ‘Adoption with slight amendment’ category, some additions and/or refinements were made on the keywords, and for ‘Adoption after revision’ category, the content was revised reflecting the responses to the question items. Items placed in ‘Non-adoption’ category were removed from the temporary future vision. The second questionnaire survey was employed in order to assess the difficulty of implementing those items that were determined to be important but less feasible.

#### ***4.5 Second questionnaire***

The second questionnaire survey re-examined the items of transportation planning judged to be important but less feasible in the first survey, and posed a few questions about the regional axis, defined here as the degree of the socioeconomic relation between the neighboring regions. These questions were added in order to add detail to the revised scenario (see Table 2).

**Table 2 Second questionnaire**

Item	Content
Question about feasibility of transportation plan	1. Reexamination of importance and feasibility 2. Important issues to realize the plan (technological, institutional and financial)
Question about regional axis	1. Connecting axis to be strengthened

#### ***4.6 Final version of future vision - finalizing the future vision***

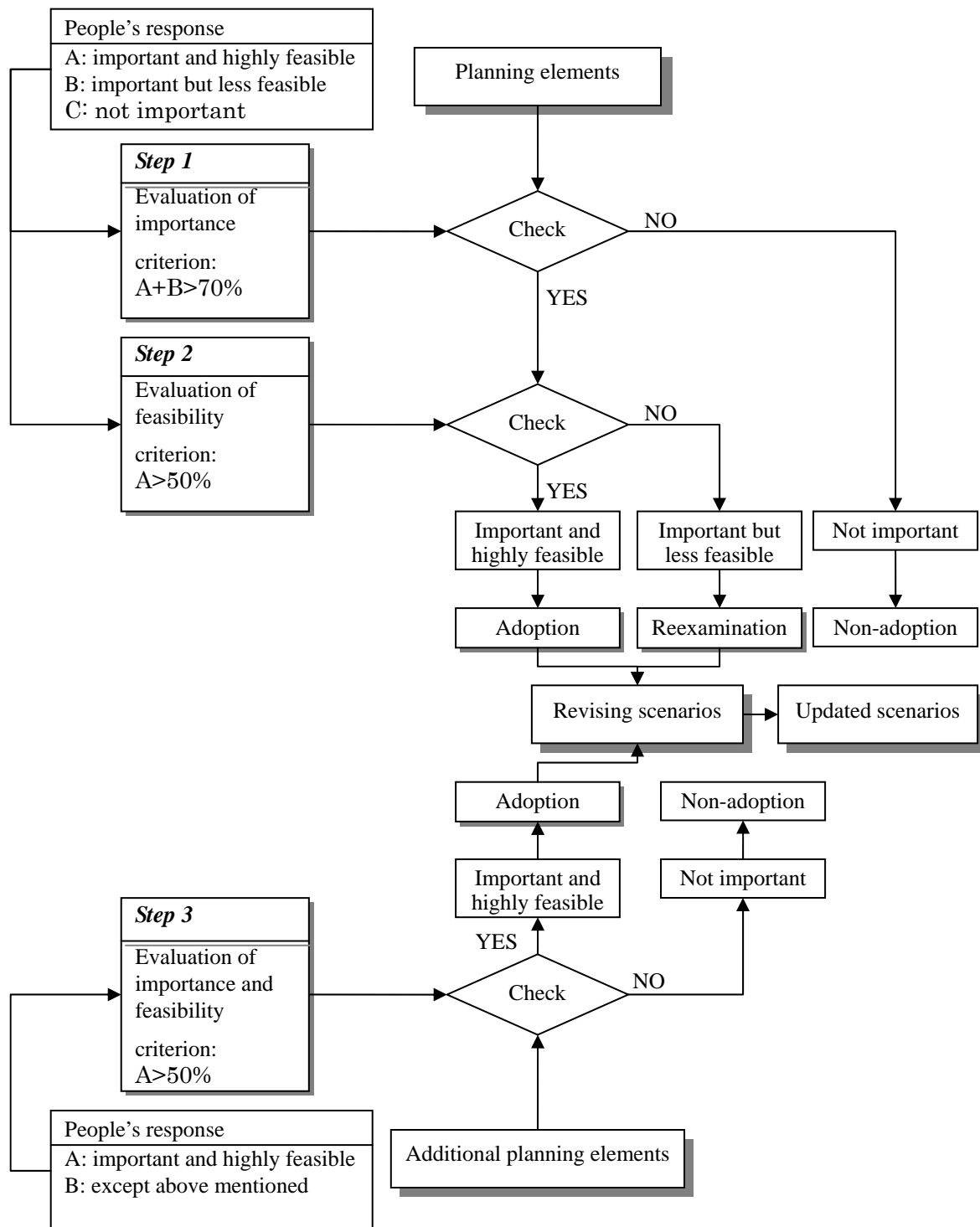
Based on the results of the second questionnaire, the secondary future vision was revised to obtain the final version of the future vision as follows.

- (1) Implementation of transportation plans: The feasibility of achieving the transportation plans was re-examined using the previously described method. If the degree of importance of an element was more than 70% and the degree of feasibility was less than 50%, amendments were implemented in order to address problems raised by these items.
- (2) Regional axis: The best method of strengthening the regional axis was arrived at after considering the results of the questionnaire, and the existing and future regional connections.
- (3) Mutual adjustment of the future image and the scenarios: Because the scenarios which were used to realize the seven future images overlapped partially and were to some extent contradictory, the contents of the future visions and the scenarios were adjusted after the secondary revision.

#### ***4.7 Feature of the future vision***

Summarizing the above discussion, the feature of the future vision is as follows:

- (1) Drawing up of the qualitative, policy-oriented scenarios by the transportation planners is unique, while the techniques employed in this study are not unique but very common.



**Figure 4 Method of revising primary future vision**

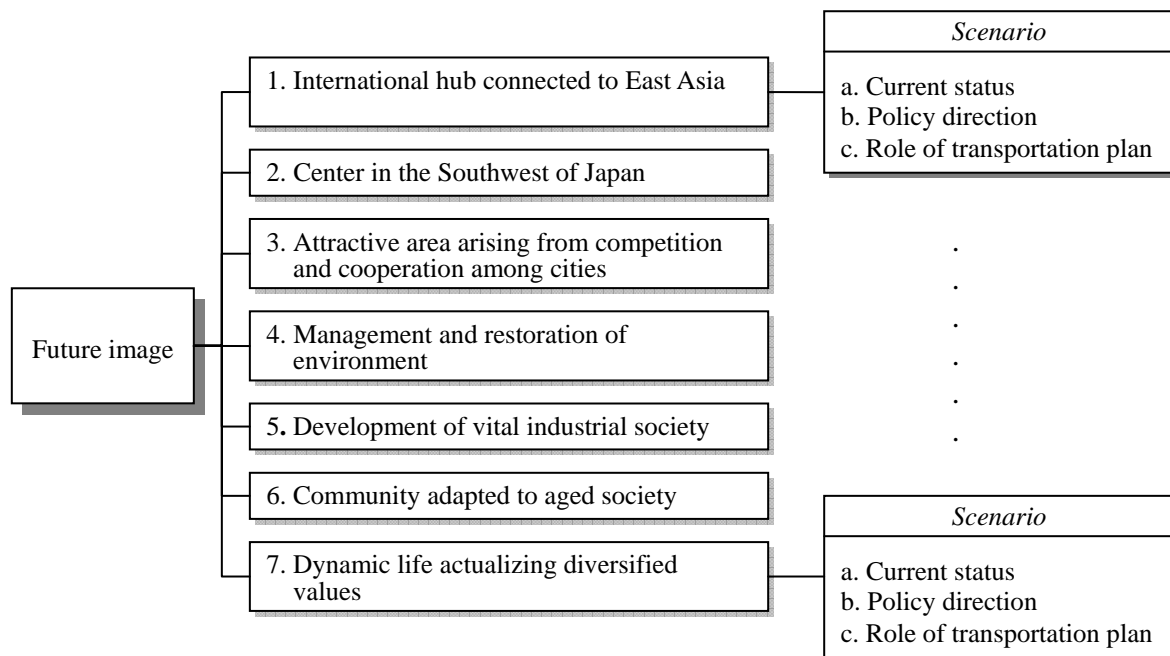
- (2) The newly-devised updating procedure of the future vision was proposed. The procedure can almost automatically revise the future vision based on the questionnaire and can be easily transferred to other applications.
- (3) The future vision is good at describing the long-term regional requirements under the stagnation of socio-economic activities, which is never covered by the conventional

methods with the demand-oriented approach.

- (4) The future vision arrived at a practical and successful phase of public involvement through repeated questionnaires, though the conventional method is weak in taking up relevant and/or independent people's opinions widely.

## 5 Future vision of the North Kyushu Metropolitan Area

As stated previously above, the future vision of the North Kyushu Metropolitan Area proposed in this study is composed of the seven future images and the corresponding scenarios necessary to realize each future image. Figure 5 illustrates the definite structure of the future vision obtained finally. This chapter describes only a scenario titled “Attractive area by competition and cooperation among cities” as an example.



**Figure 5 Structure of future vision**

### 5.1 Future image

The North Kyushu Metropolitan Area, which is the leading socioeconomic area of Kyushu, has become urbanized owing to the concentration of population, industry and economy. However, some parts of this area have been experiencing a gradual decrease in population due to industrial and economic stagnation. Using the various prediction methods, the total population of the North Kyushu Metropolitan Area, like that of Japan, is expected to peak around the beginning of the 21st century and then to decrease.

In order to construct an attractive living area again, it is necessary to motivate the residents of the area by competition and cooperation based on the individual characteristics of each city and the region. This competition and cooperation will maintain the population, stimulate the population exchange, and form an active industry/economy as well as a highly

individualized cultural society.

## **5.2 Scenario**

### **5.2.1 Current status**

Fukuoka prefecture occupies most of the North Kyushu Metropolitan Area. Fukuoka prefecture is the ninth largest prefecture in Japan and has a population of 4.83 million. The population of Fukuoka prefecture has been increasing at a similar rate to that of Kumamoto prefecture. Fukuoka prefecture's urbanization ratio, which is defined as the percentage of population in densely inhabited districts, is 66.5% and has been gradually increasing. Saga prefecture, which occupies part of the North Kyushu Metropolitan Area, has a population of approximately 880,000 and the urbanization ratio is 27.0%. Both have remained constant in recent years. The ratio of the combined population of both prefectures to that of Japan and Kyushu are 4.6% and 42.8%, respectively.

By examining the output share of the various industries in Kyushu, the area's agricultural productivity is estimated to be 3.7%, compared to 21.6% for Japan. Furthermore, Kyushu's agricultural productivity share is expected to decrease. Conversely, the manufacturing output and the commercial output have been increasing in Kyushu, and the manufacturing share is currently 3.8% compared to 50.9% for Japan. The shares of the commercial output of Kyushu and Japan are 3.7% and 55.2%, respectively.

Due to the increasing population and the various city functions such as events, construction, shopping, recreation and housing, the North Kyushu Metropolitan Area has been experiencing urbanization. This is also true for both Kyushu and Yamaguchi prefectures. Population, politics, and culture have all become increasingly concentrated in and around Fukuoka City in the Fukuoka Urban Area. Particularly because of the extreme concentration of many city functions, Fukuoka City is now converting the Fukuoka Dome into the Science Park, which is a theme park that will serve as a base for the information industry and provide academic support for Kyushu University. Kitakyushu City is planning both an international exhibition hall and a project for the western academic zone.

Conversely, some fishing and agricultural towns and villages have been experiencing a decrease in population and local socioeconomic activities because of the stagnation of the main industrial forces of the area.

### **5.2.2 Policy direction**

According to several estimates by the Research Institute for Population at the Ministry of Health and Welfare, Kyushu Economics Investigation Association, etc., the population of the North Kyushu Metropolitan Area is expected to peak in the early 21st century and then decrease. However, the population of the Fukuoka Urban Area is expected to peak slightly later than those of other cities such as Sapporo, Sendai and Hiroshima.

Therefore, in order to maintain the vitality of the entire North Kyushu Metropolitan Area and to produce one of the core cities of Japan, a commercial development comparable to that of areas such as Tokyo, Keihanshin, and Chukyo, would be required. The North Kyushu Metropolitan Area has a latent growth potential, but a high population concentration in Fukuoka City, the largest city in the area, is not necessarily desirable. For example, Fukuoka City already has problems such as inadequate water supply, waste disposal, etc. Therefore, development in conjunction with the Kitakyushu Urban Area should be considered. By strengthening links between large cities and small and mid-sized cities, local industries, advanced industries (e.g., information industry), and welfare infrastructures are encouraged, generating a comfortable city and region.

Fukuoka City plans to use nature, history, and tradition to become an international

exchange base by increasing its concentration of city functions such as information, communication, academic research and international facilities. Kitakyushu City plans to become an international, technologically advanced city that has a high quality environment, a strong industrial base, and an advanced research center and that will contribute to the international community. These cities might eventually form one large metropolitan area by competing and cooperating with each other.

The following are the promotion plans for mid-sized cities in this area. Kurume City will be a technological center and will focus on research and development. Tosu City will be a center for trade due to its ideal geographical location. Oomuta City will be a technologically industrialized city based on its existing industries and will attract new industries. Iizuka City and Munakata City will be promoted as academic research cities in cooperation with nearby universities.

Strong links such as the cooperation between Fukuoka City and Kitakyushu City are required in order for core and mid-sized cities to grow and develop. The city and industrial functions of the other towns such as Yukuhashi City and Buzen City on the East Kyushu Axis, and Tosu City and Oomuta City on an extension of the Primary National Axis will be strengthened. Links between the Chikuho Area, Fukuoka City and Kitakyushu City will be strengthened. Information exchange, communication, academic research, and city connections should be initiated between the Chikuho Area and Fukuoka City. In addition, industrial, information, and communication links between the Chikuho area and Kitakyushu City must be strengthened. Furthermore, the city and industrial functions of the towns that lie between those areas must be enlarged.

Because agricultural and fishing towns and villages offer better living conditions and scenery, such features will be combined with the conveniences of large, mid-sized and small cities to form an attractive area.

As previously mentioned, competition and cooperation among cities and regions is expected to create an active area by enhancing population mobility and increasing both inter- and intra-regional exchanges.

Clearly, the understanding and cooperation of the local inhabitants is indispensable to implementing these projects. Therefore, these projects should reflect the opinions of local inhabitants to the greatest extent possible.

### ***5.2.3 Role of transportation infrastructure plan***

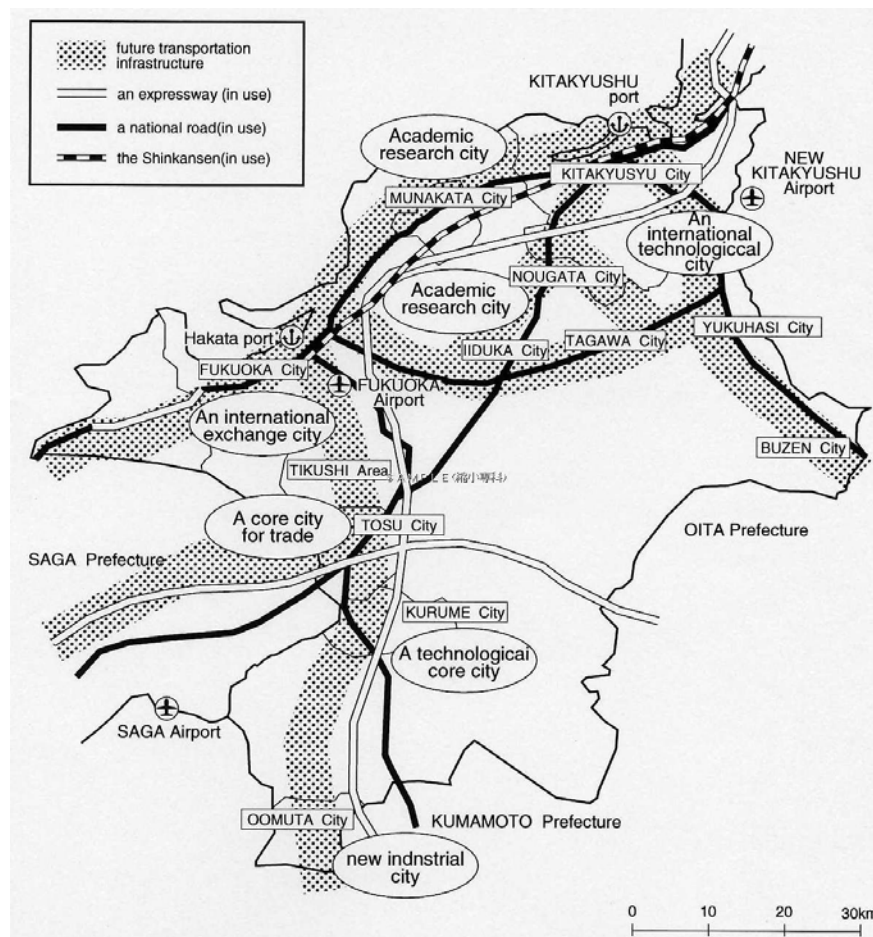
In order for the North Kyushu Metropolitan Area to become one of the leading socioeconomic areas in Japan the transportation infrastructures and services must be upgraded to allow access to the residential districts within the area and to provide for increased interchange of the population. High-level trunk roads and high-speed public transportation networks should eventually be constructed between Fukuoka City and Kitakyushu City. Both cities will require additional circular roads and high-speed inter-city roads to allow for increased mobility. Better public transportation such as a subway network, including the extension of existing subways and a new public traffic system will also become essential issues. Other cities should improve their accessibility to the two core cities; therefore, upgrading the transportation infrastructures within the regional axis is necessary.

As trade increases, a new logistics system should be constructed to promote exchange. The system will automatically run in tunnels under the roads. However, because the cost of construction may be excessive, the profitability of the system must be determined. In implementing and/or improving any transportation network, maximizing the terminal area usage (such as the vicinity of railway stations) will be also vital.

#### 5.2.4 Role of transportation management plan

In order to promote the population exchange, it is important to provide convenient and comfortable public transportation. For example, an integrated transportation fare system between different modes of public transportation, which is partly in effect (between buses and railways of different companies), an integrated ticket system, and an integrated prepaid card system will reduce the complexity and hassle of changing between modes of public transportation. Such systems also increase the efficiency of public transportation networks. However, the planners must reduce the traffic congestion in the cities by creating systems that limit automobile usage in the city through staggering commuting times, flex time systems, policies for managing transportation demand, and technical developments of such systems.

In order for the North Kyushu Metropolitan Area to play an important role internationally and domestically, the area's information and communication infrastructures must be enhanced. A broad information network will be constructed along the national expressways, and the local information networks will be built alongside the existing road networks.

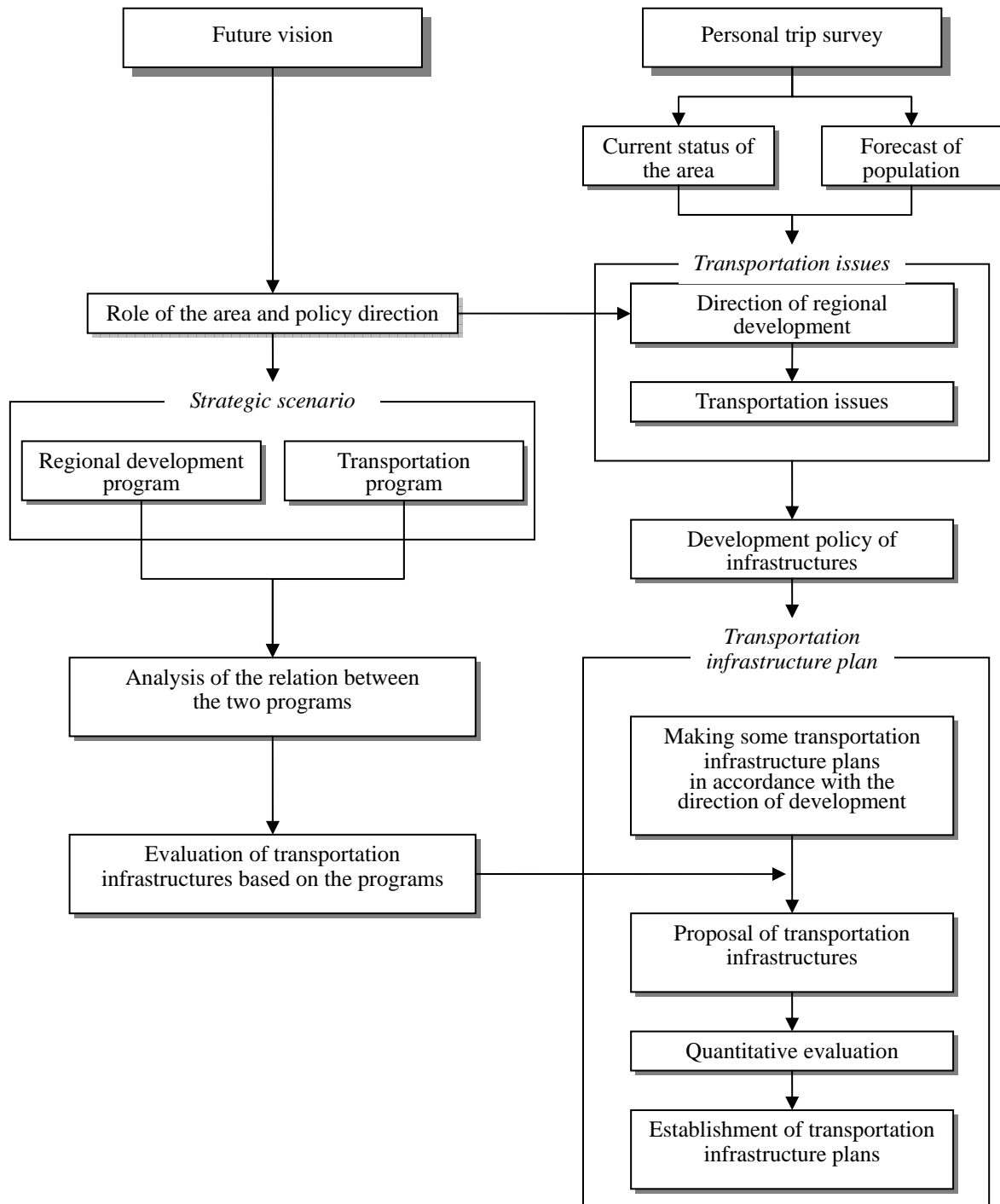


**Figure 6 Future transportation infrastructures in the study area**

#### 5.3 Direction of comprehensive transportation plan

The direction of the comprehensive transportation plan was assessed based on the regional axis determined in the second questionnaire and the seven future images. This study focused

on which axis should be strengthened in order to realize the future image. The results were finally summarized and arranged on the map shown in Figure 6. This map shows the direction for implementation and improvement of the future transportation infrastructures in the North Kyushu Metropolitan Area.



**Figure 7 Hybrid forecasting system for transportation planning**

## **6. Hybrid system for transportation planning - linking of the future vision and the personal trip survey**

The new planning system that implements the future vision is policy-oriented and qualitative, whereas the conventional transportation planning technique based on the personal trip survey is demand-oriented and quantitative. Because both methods have some advantages and disadvantages, combining the two methods will surely increase the effectiveness of planning transportation projects. This study proposes a hybrid forecasting system for transportation planning as shown in Figure 7. The right-hand side of the figure shows the conventional transportation planning procedure using the data taken by the personal trip survey. The future vision proposed in this paper supplements the conventional procedure at two stages. First, the future vision provides for discussion of the direction of the area's development. Although the direction of the area was set subjectively in the conventional planning process, the future vision provides clearer direction that is more consistent with the regional policies. Secondly, the future vision delivers well-grounded ideas for the transportation infrastructures and management principles that are not available using the demand-oriented approach. In other words, this proposal suggests that the transportation infrastructures should be based on social and/or political considerations. In order to achieve this goal, the future vision is divided into two, more detailed programs; the regional program and the transportation program, both of which involve numerous planners. The regional program specifies the strategy and direction for regional development, while the transportation program describes the transportation infrastructures and management plans necessary to implement the regional program. Based on the analysis of the relationship between the existing transportation infrastructures and the regional program, an evaluation can be done to determine which new infrastructures are required in order to fully implement the proposed transportation system.

Using the future vision in these two ways can make transportation planning more understandable and can better reflect policy-oriented factors in the planning process.

## **7 Concluding remarks**

The following are the conclusions duly arrived at through the present study.

- (1) A new method is proposed by which the future area structure is determined qualitatively, and the hierarchical structure of the future vision; future vision, future image, and scenario was successfully obtained. The scenario is composed of three elements; current status, policy direction, and role of transportation plan.
- (2) The future vision is obtained through a revision process consisting of two questionnaire surveys. The transportation planners prepared the first version of the future vision through brainstorming. The Delphi method was employed during the questionnaire survey. This approach successfully provided the scenarios with important and feasible elements.
- (3) The proposed method was applied to the North Kyushu Metropolitan Area to form the future vision of the area for 2015. This future vision gives the direction for comprehensive improvement and planning of transportation infrastructures.
- (4) The method of linking the future vision and the personal trip survey was discussed. The combined use of those two methods enabled the authors to collect the recommendations of people in various positions, enhance the transportation planning by sharing and solving the anticipated problems, and incorporate more policy-oriented planning elements into the final plans.

Future issues include the following:

- (1) The future vision proposed in this paper remains at the conceptual level and integration with the personal trip survey remains incomplete. Therefore, a method should be established that allows the future vision and the transportation planning to produce concrete results.
- (2) Implementing the future vision has become rather complicated because of the number of questions necessary to cover the broad range of the transportation policy. In order to increase the feasibility of the proposed method, the method itself should perhaps be simplified. The effective field has to be clarified for the items and subjects questioned by the Delphi method, and the problems that include technical matters may need to be addressed using the workshop-style technique or other methods.

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