

COOPERATIVE INITIATIVES TO PROTECT WINTER ROAD TRANSPORTATION IN NIIGATA CITY

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ABSTRACT

The disruption of traffic in cities where population and traffic are concentrated not only impacts people's daily lives, it has substantial effects on distribution etc. which play essential roles in their economic activities. Traffic disruption during the winter is caused by short-term concentrated snowfall (hereafter, "unusual snowfall").

This report describes initiatives taken in order to overcome the problem of traffic disruption which can occur in cities during unusual snowfall in the winter by preventing traffic disruption by heavy snow and providing useful information to all road users through the coordinated efforts of road managers and traffic managers.

KEYWORDS

Unusual snowfall / information sharing / information provision



Photo 1 - View of Traffic Congestion During Snowfall in Niigata City

1. INTRODUCTION

1.1. The initiatives

In January 2004, an unusual snowfall of 54cm/day fell on Kanazawa City which is also located in the Hokuriku Region (Figure 1, top). This snowfall seriously disrupted the functioning of road transport in Kanazawa City by forcing road closures and causing traffic accidents, triggering large-scale prolonged congestion and other obstructive phenomena, mainly on major arterial routes. Some of these disruptions forced people to remain in their cars for 8 or more hours[2]. One of the background factors causing such a situation was the failure to transmit appropriate road information to cars trapped in congestion, so the vehicles could not be dispersed to trunk roads where traffic was relatively ensured.

Even in urban Niigata, unusual snowfall of 75cm/day was recorded in 2000 (Figure 1, bottom). Therefore, it is feared that traffic in the urban regions of Niigata might be as severely disrupted as it was in Kanazawa City. So beginning in 2006, an organization was formed to coordinate concerned organizations to share information and transmit appropriate road information to users in order to ensure road transportation in the winter. One factor behind the formation of this organization was the fact that on roads in Niigata City, as stated above, major arterial roads are managed by different organizations according to the road classification as shown in the following table, and information about each road is grasped by individual road managers (Table 1).

So it is essential for every road manager to communicate information concerning roads outside its jurisdiction during emergencies such as unusual snowfall, in order to ensure safe, smooth, and highly reliable transportation during the winter, minimizing the impacts of road closures and congestion, etc.

Thus, a major part of this initiative includes abstracting problems and challenges concerning winter season road transportation and studying congestion measures, regulations and accident prevention measures, and methods of collecting and providing information.

As stated above, the aim of this initiative is to coordinate various concerned organizations to more effectively avoid or recover from traffic disruption during unusual snowfall and provide appropriate information to road users.

And the concerned organizations are the Niigata National Highway Office of the Hokuriku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism (below, "Niigata National Highway Office"), Niigata Prefecture, Niigata Prefectural Police, Niigata City, and East Nippon Expressway Co., Ltd.

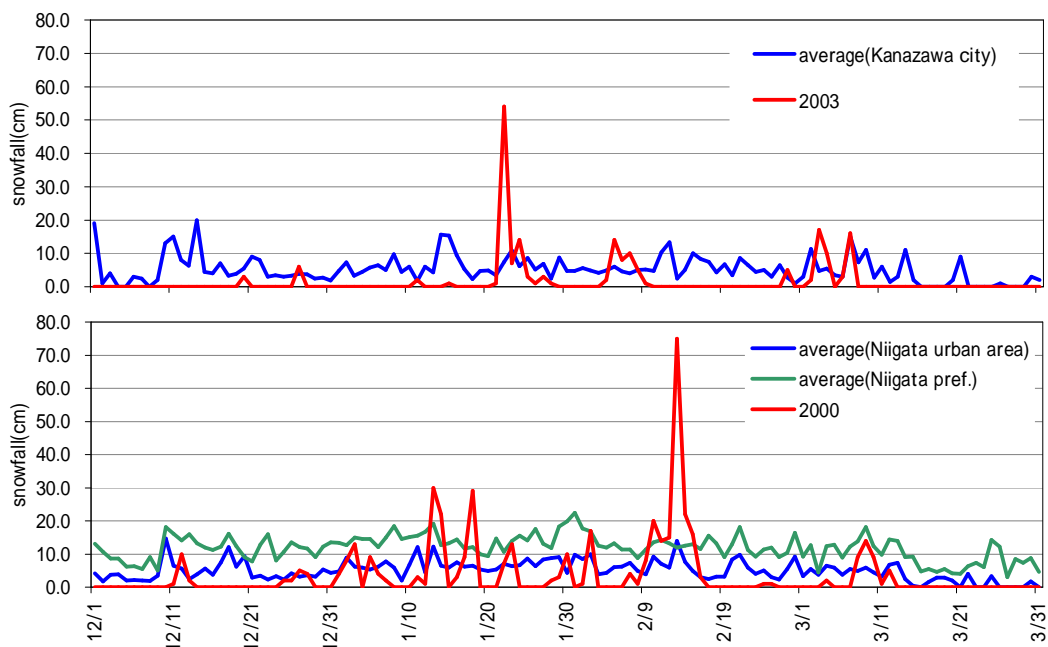


Figure 1 - Japanese Archipelago and Japan Sea Side Snowfall Mechanism [1]

Table 1 Road Categories and Managers

Road category	Road manager
National Expressway	East Nippon Expressway Co., Ltd.
National highway (managed by national government)	Niigata National Highway Office of the Hokuriku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism
National highway (managed by prefectural government)	Niigata Prefecture
Major regional roads	Niigata Prefecture, Niigata City

1.2. Regions where the initiatives are implemented (meteorological conditions)

Niigata Prefecture is located on the Japan Sea side of the main Japanese island, Honshu (Figure 2). The Hokuriku Region, which includes Niigata Prefecture, is located on the Japan Sea side, where backbone mountain ranges divide it into the Japan Sea side and Pacific Ocean side. A warm air current called the Tsushima Current flows over the Japan Sea, and during the winter, seasonal winds blowing from Siberia towards the Japanese Archipelago ceaselessly supply moist air. The seasonal winds which supply this moist air strike the backbone mountains, forming powerful cumulonimbus clouds which dump large quantities of snow on the Japan Sea side (Figure 3). As a result of such topographical conditions, this regions receives incredibly heavy snowfall, unmatched not only in Japan, but throughout the world (Figure 4).

In Figure 1 above, the top chart shows average snowfall recorded in Kanazawa City from 1989 to 2008 and snowfall from December 2003 to March 2004. The bottom half of the same figure shows the average snowfall depth recorded at 7 meteorological observation

stations in Niigata urban regions and at a total of 37 meteorological observation stations in Niigata Prefecture from 1994 to 2007, and snowfall recorded at the Toyosaka Meteorological Observation Station from December 2000 to March 2001.

In February 2001, snowfall of 75cm/day was recorded, but snowfall in Niigata City did not exceed 10cm when averaged. And if snowfall was averaged for Kanazawa City as it was for Niigata City, the result was about 10cm, but on January 23, 2003 when snowfall caused a massive disruption of traffic, unusual snowfall of 54cm/day was recorded.

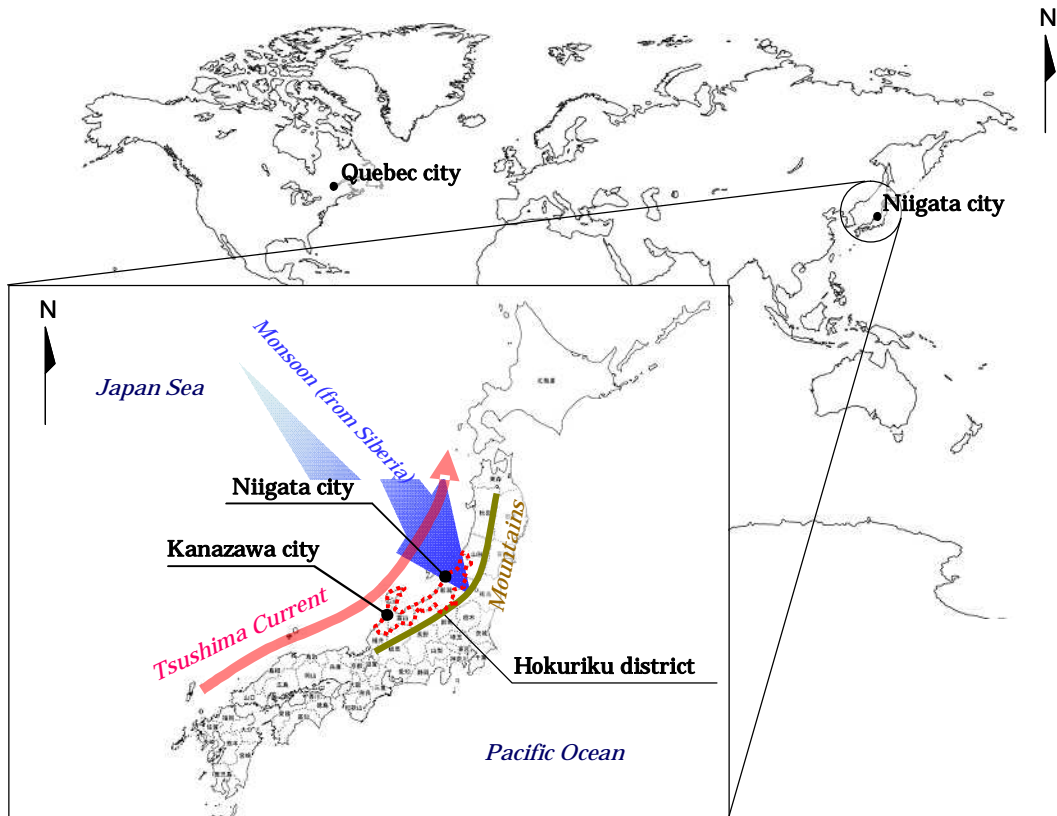


Figure 2 - Location Map

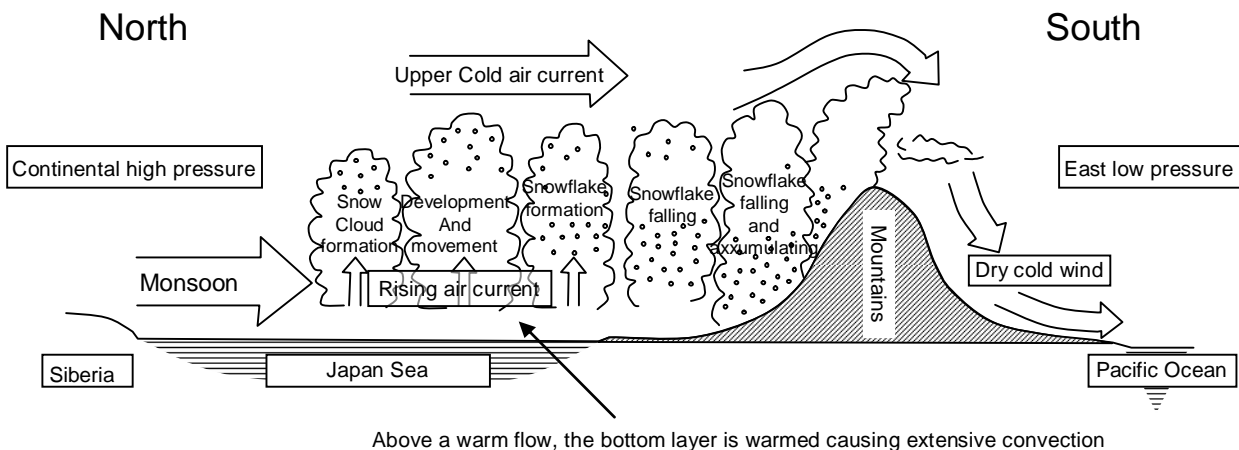


Figure 3 - Comparison of Latitudes and Average January Snowfall in Cities [1]

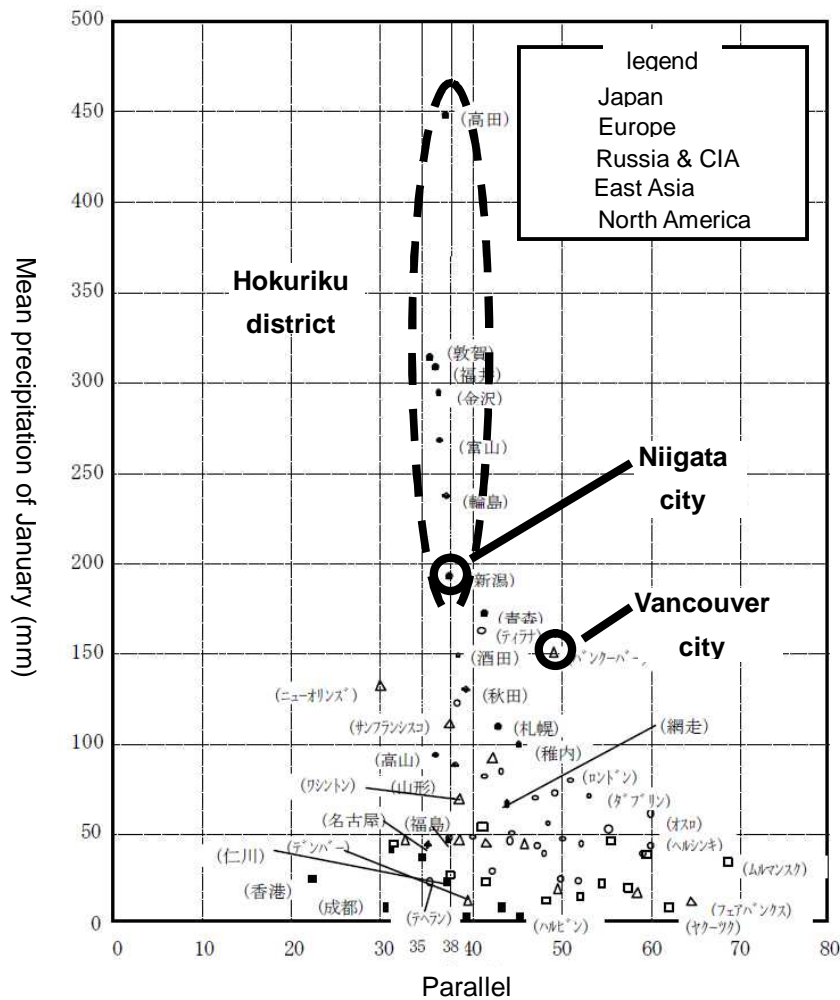


Figure 4 - Comparison of Past Average Snowfall Depth and Snowfall Depth in FY2000 in Niigata City and Kanazawa city

1.3. Region where the initiatives were introduced (traffic conditions)

Winter traffic volume in the Niigata City region was recorded at approximately 100,000 vehicles/day on National Highway No. 7 and National Highway No. 8 which are managed by the government[3]. And other government managed national highways include several heavy traveled routes with traffic exceeding 50,000 vehicles/day converging inside Niigata City (Figure 5). This is, therefore, a region where it is feared that if localized unusual snowfall such as that observed in 2000 were to occur, forcing expressways and government managed national highways to be closed, the resulting abrupt shift of traffic to other roads might cause traffic congestion as severe as that seen in Kanazawa City in the past.

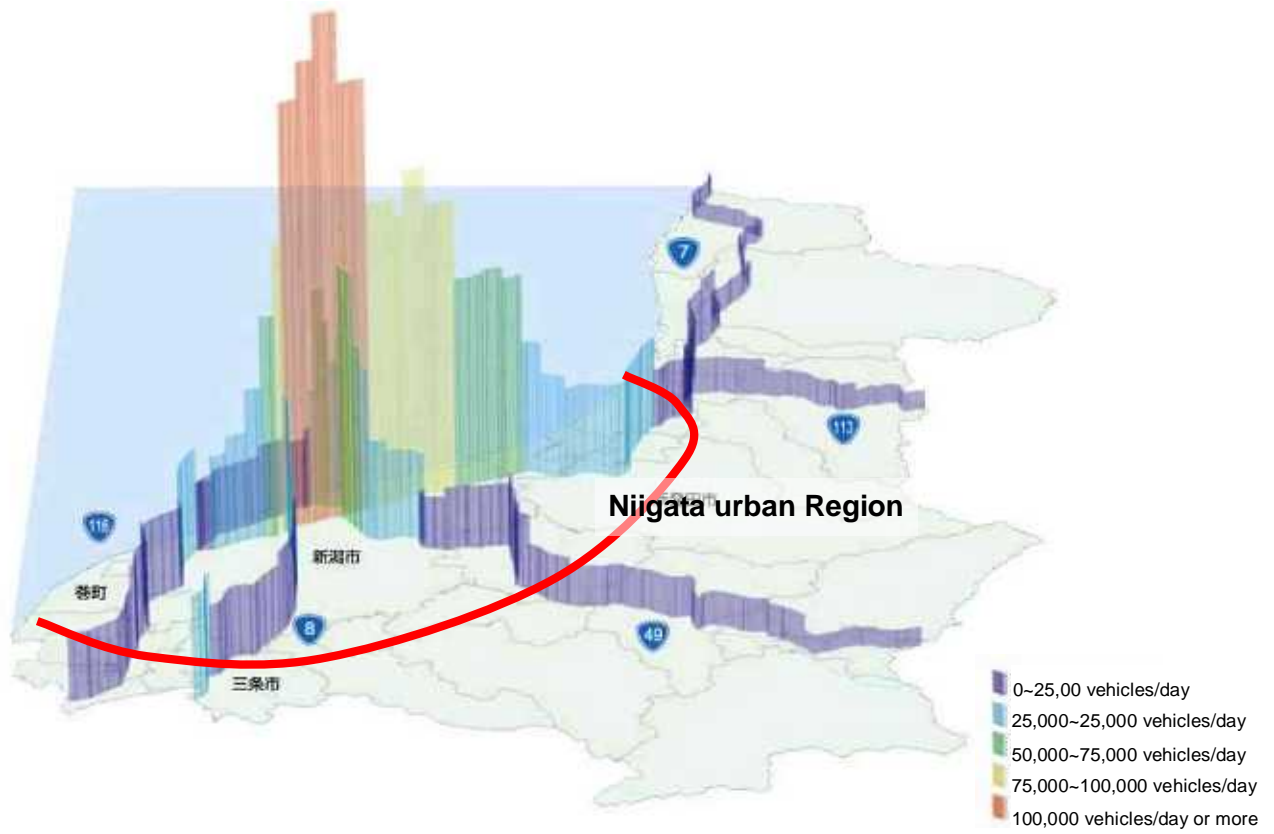


Figure 5 - State of Traffic in the Niigata City Region

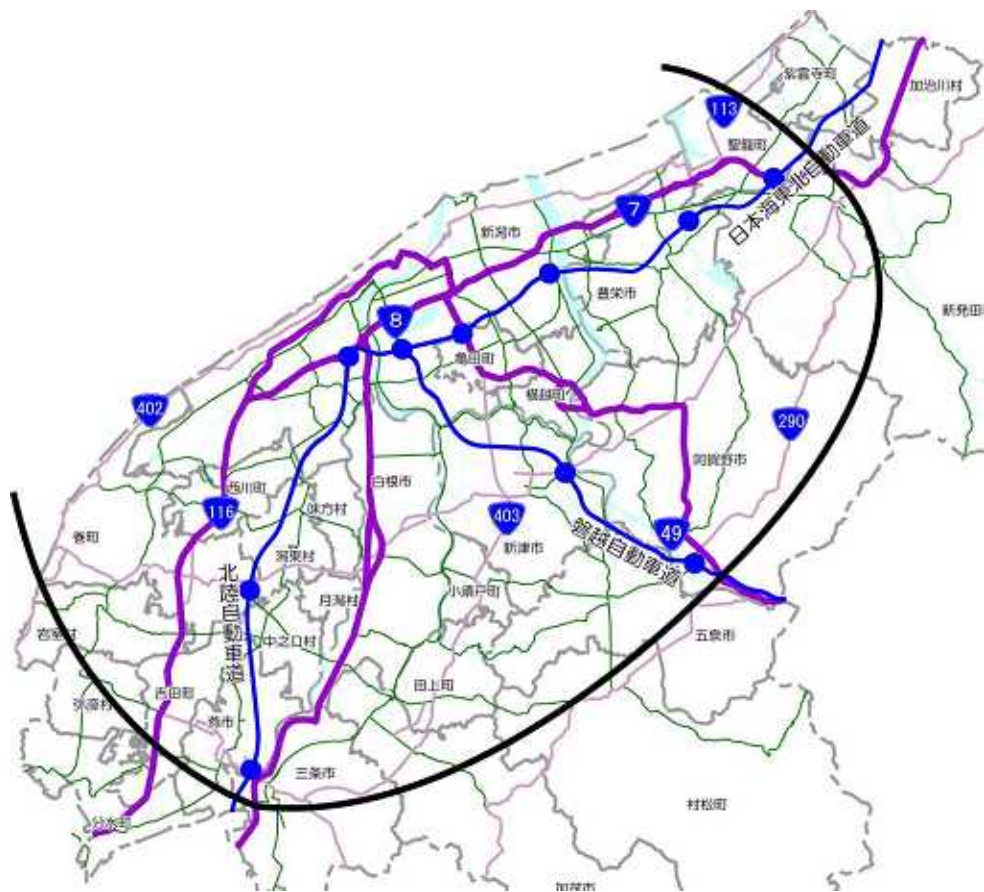


Figure 6 - Range of Introduction of the Innovations

2. STUDY OF SPECIFIC MEASURES TO STRENGTHEN COORDINATION OF CONCERNED ORGANIZATIONS

2.1. Stipulating alternate routes

As shown in the example of Kanazawa City cited above, roads to function as alternate routes were selected from among routes managed by Niigata Prefecture or Niigata City as a measure to be taken when a major road has been closed. They were selected not only with priority on their functions as simple detours, but as routes where, by coordinating concerned organizations, traffic functions can be ensured while absolutely minimizing changes to the snow removal systems managed by these organizations (normally referred to as the Yuki-michi Network (Snowy Road Network)).

2.2. Establishing an information exchange headquarters

An interview survey with members of these concerned organizations revealed that they want strengthened coordination with other organizations so they can clarify conditions at these organizations during unusual snowfall. So it was decided that staff responsible for communications from the concerned organizations must gather to share, generalize, and distribute information concerning traffic conditions, traffic restrictions, and snowfall conditions.

In light of the above situation, the information exchange headquarters was established in order to more smoothly coordinate the concerned organizations so they can share information and perform a series of other operations.

2.3. Purpose and roles of the information exchange headquarters

Looking at an example of the roles of the information exchange headquarters reveals the following flow: road managers or traffic managers gather information and provide this information uniformly to all road managers.

Step 1: Uniform collection and sharing of traffic accident, congestion, traffic restrictions, and snowfall conditions

Traffic accidents and congestion, road closures, snowfall conditions, meteorological information and other types of information are uniformly collected and shared.

Step 2: Discussing and coordinating snow removal work, the response to traffic accidents, and setting alternate routes

Based on the information which has been collected, snow removal, accident response, and setting detours are discussed and coordinated.

Step 3: Providing information to drivers and citizens

Traffic accident, congestion, road closure, and detour information which have been collected at the information exchange headquarters are provided to drivers, regional residents, etc. to avoid creating traffic disruption.

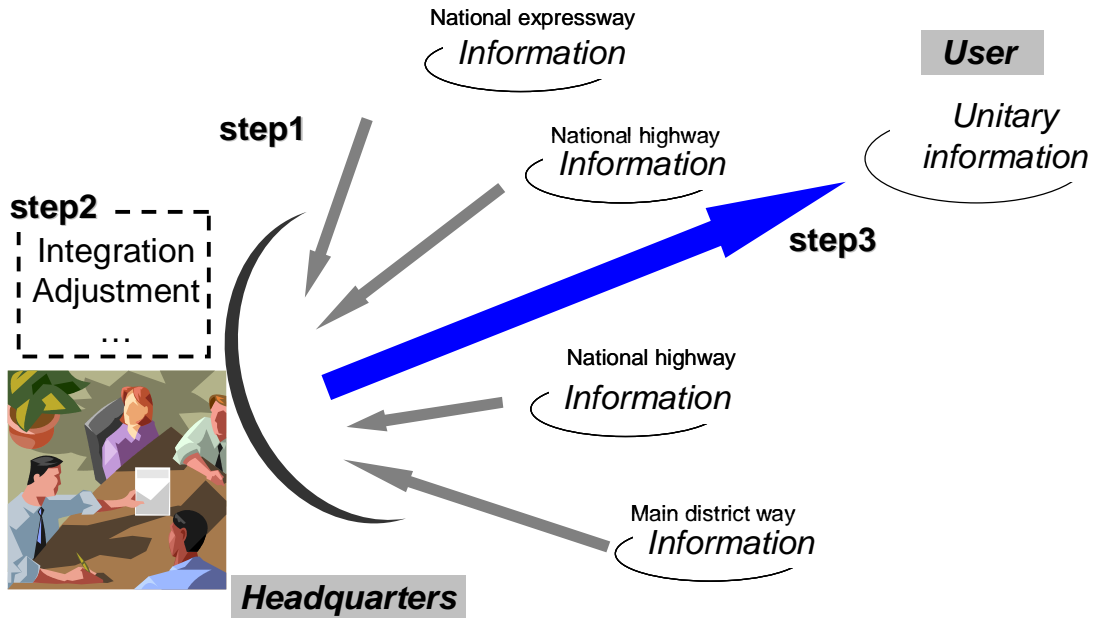


Figure 7 - Image of Information Sharing and Information Provision at the Information Exchange Headquarters

3. STUDYING SPECIFIC INFORMATION PROVISION MEASURES

3.1. Study of specific measures for road users

A questionnaire survey of road users was carried out to categorize their needs (Figure 8). Many want to be provided with information concerning all rapidly changing phenomena in real time. And many expressed a desire to be provided with information expressed in text form, as voice information, and information in the form of images obtained by live cameras, on TV, over the radio, or on web sites. In response, the most effective ways to provide information about winter road traffic were decided as shown below and the information items and contents to be provided were categorized.

1: Information about snow-covered urban roads in the Niigata Region is provided as uniform information through the internet.

2: Independent broadcasting stations are installed to provide information to radios so that road users can obtain information regardless of their location outside their homes, and whether or not their automobile is equipped with an on-board unit.

3: Information to educate people about the snowy road network is provided continuously. Within the range of the initiative, that already provided by road managers was used to provide information through the internet which could provide information.

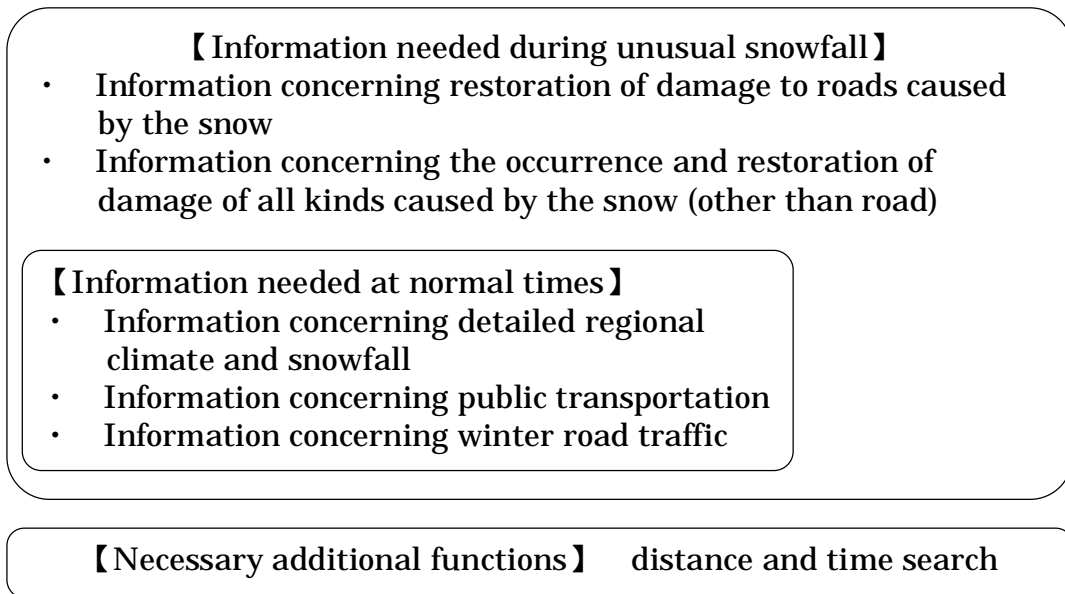


Figure 8 - Needs of Road Users

3.2. Internet web sites for road users

First in order to summarize data from web sites published by road managers and other concerned organizations, (1) a survey was conducted through the internet and (2) a questionnaire survey of managers carried out and the results were summarized. The web sites which were the targets of the document inventory work were those managed by road managers. The methods employed to manage the data published on the web sites were studied considering information collection methods.

Methods of providing information to road users through the web sites were comparatively studied, and the method adopted as a result was setting direct links to detailed pages presenting required data on existing web sites (weather, images obtained by TV cameras, etc.) (Figure 9). This approach was selected for the following three reasons. 1. It is free from security problems. 2. It does not require improvement of the other party's system. 3. Its operating load on users trying to obtain the needed information is low.

For the above reasons, it was decided to construct an internet web site as part of this initiative, considering the level of web sites of each organization, whether or not it provides data, and the data format.



Figure 9 - Web Sites for Road Users

4. SUMMARY AND FUTURE CHALLENGES

4.1. Integrated Information Provision to Road Users

A study was performed considering the needs of road users, normal information provision methods, situations where information is obtained, and existing information provision methods at each organization, to enact the provision guidelines, but the following are challenges which must be overcome in the future.

Challenge 1: To provide information by radio, conformity with the law (Radio Act), and links with existing companies are challenges, so surveys and studies of these matters will be conducted continually and the necessary facilities will be provided at the decision-making stage to begin providing information.

Challenge 2: It is necessary to inform all road users of alternate routes planned through this initiative, so brochures, pamphlets, etc. will be prepared and distributed and the information will be placed in the organizations' newsletters.

4.2. Internet web sites for road users

Because of problems with data provision problems at each organization, for the time being, information was provided by displaying weather information and photographic images by setting links to detailed pages of each organization from icons displayed on a map. But with this method, it is impossible to create supplementary information, because the display methods vary between each of the connected organizations. In the future, it will be necessary to study the construction of a system which permits data to be obtained and stored by servers independently provided as information exchange headquarters to be able to unify display methods and add supplementary information.

And because users wish to be provided with information through portable terminals (transmission of emergency mail etc.), or to receive bus and train information, studies to

realize these service will be conducted.

4.3. Providing information to road users

As a result of categorizing the information items and contents necessary based on the results of a questionnaire survey of road users, types of information that they wish added were abstracted. And based on the fact that challenges concerning the transmission of information at the information exchange headquarters have been clarified through this initiative, a study of the construction of a system intended to more efficiently share information between concerned organizations in the future will be conducted. Based on the above facts, the following two matters are considered to be challenges.

Challenge 1: To establish a method of handling emergency information and road closure information and sharing these types of information.

Challenge 2: To overcome challenges to information transmission at information exchange headquarters, an information sharing format will be prepared, input support tools constructed, and tools to display information on maps will be created.

In light of the above facts, the construction of a system which more efficiently shares information between concerned organizations by displaying information on maps or providing simple entry tools will be studied.

5. CONCLUSION

In recent winters, new records for high temperatures and low snowfall have been set, but unusual weather has occurred throughout the year, and it is now unclear when unusual snowfall will strike urban regions of Niigata Prefecture. In response to this initiative, cooperative relationships between concerned organizations will be strengthened and will be implemented in order to enhance the safety and feelings of security of road users and regional residents.

REFERENCES

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[2] Hokkoku Shimbun: Morning edition, January 23, 2004

[3] Ministry of Land, Infrastructure, Transport and Tourism, Hokuriku Regional Development Bureau (2007): 2005 Road Transport Census, Road Transport Status Table by Route and Section