Prioritization, Inventory Planning and Budgeting for Road Management Resources: A Case Study of South Korea

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Road Management Resources

- Over the past three years we have extended our earlier research applying AHP methods to transportation systems management to several related case studies in South Korea.

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- With access to key historical data and the cooperation of important government agencies,
  - we have developed new methodologies for determining how equipment should be shared among neighboring agencies;
  - how equipment inventories and purchase costs should be determined on a year to year basis,
  - how resource allocation decisions related to road based weather stations should be addressed; and,
  - how resources should be allocated to bicycle route improvement projects.

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- The development of these tools has been documented in several recent published papers.
  - Yang, C-H. and A.C. Regan (2013), Methodology for Determining the Best Use of Road Management Equipment, Transport Policy, 30, 199-206.
  - Yang, C-H., and A.C. Regan (2014), Methodology for the Prioritization of Environmental Sensor Station Installation: (Case Study: South Korea), Transport Policy, 32, 53-59.
  - Yang, C-H., and A.C. Regan (2014), Estimating road management equipment inventory needs and associated purchase costs, Transport Policy, 36, 242-247

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- In this paper we discuss how the proposed tools have been used and how these related projects fit together into an overall road management framework.
- While Yang and Kim are researchers with the Highway Division, Korea Institute of Construction Technology, they've been working closely with the Korean Ministry of Land, Infrastructure and Transportation.

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- Each of these efforts, the aim has been to produce immediately useful models which the ministry can employ to make resource allocation decisions.
  - In each case an Analytic Hierarchy Process based model was developed.
  - A reasonable question is why use the AHP?
  - The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing complex decisions. It has been in use since the 1970's.

WHY AHP?

- Of course it is a well known and well tested multi-criteria decision method and has often been used to make many transportation resource allocation decisions.

WHY AHP?

- But what about Multi-attribute global inference of quality (MAGIO), Goal programming, Data envelopment analysis (DEA) Surrogate worth tradeoffs? Multi-attribute utility method, PROMETHEE, ELECTRE?

WHY AHP?

- Two primary reasons – it allows for the prioritization of criteria using survey data, and
- ***Perhaps most importantly***, it is well accepted among the South Korean governmental agencies. It was essential that Yang and his group produce tools that would be immediately useful.

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- Road management equipment management
  - The first model examined historical records related to the use of road management equipment in 18 regional offices in South Korea
  - After carefully examining the historical records, managers in each of the offices were interviewed to obtain rankings of the importance of various kinds of equipment.
  - A model combining historical records about frequency of equipment use and managers' subjective rankings of the importance of various kinds of equipment was developed.
  - This allows managers to identify equipment which might be lent out to nearby offices without significant negative consequences.

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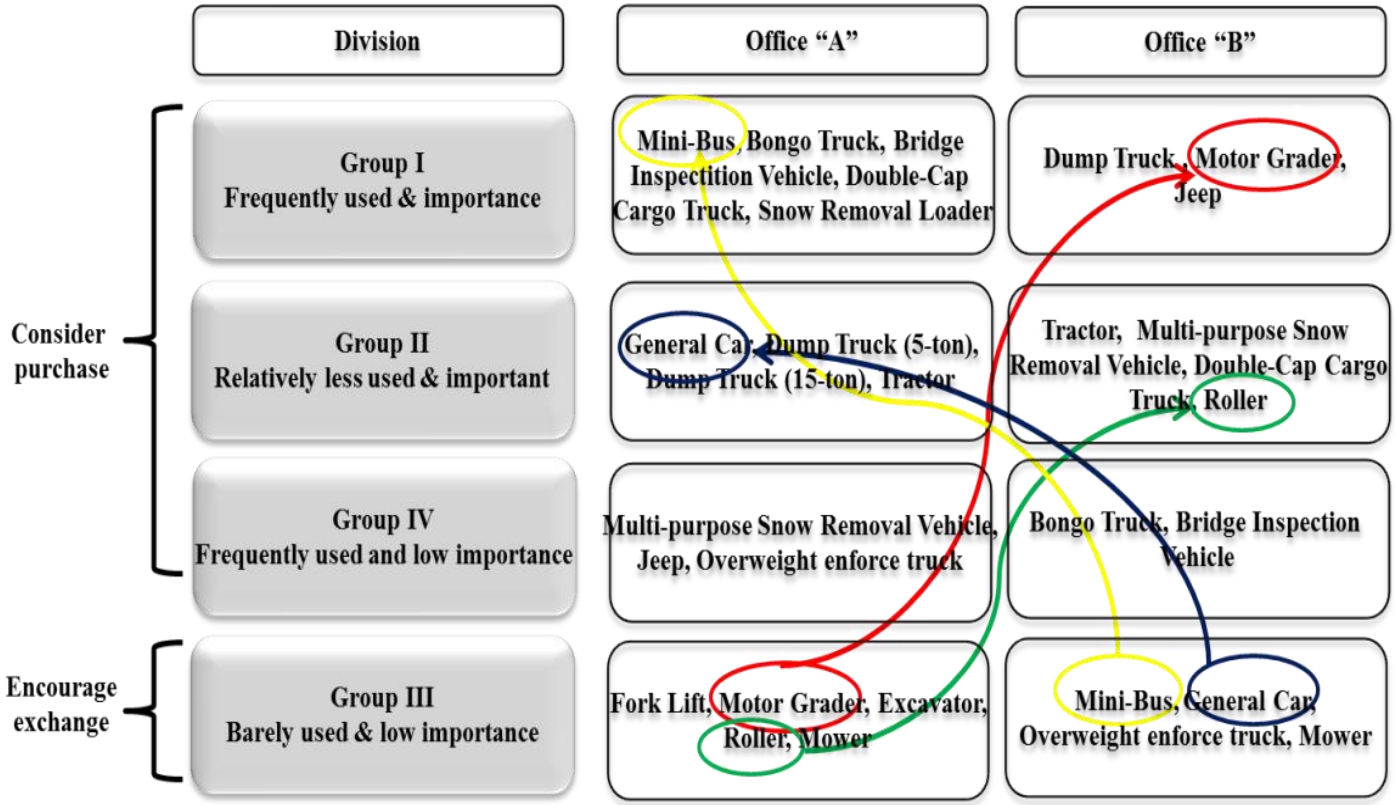

A simple example applying the first model

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- Equipment inventory needs and associated purchase costs
  - The second model is related to the first but focuses mainly on budgets for new road management equipment and priorities for the future.
  - It too combines historical data on use and costs of purchasing new equipment with subjective information provides by interviews with regional managers.

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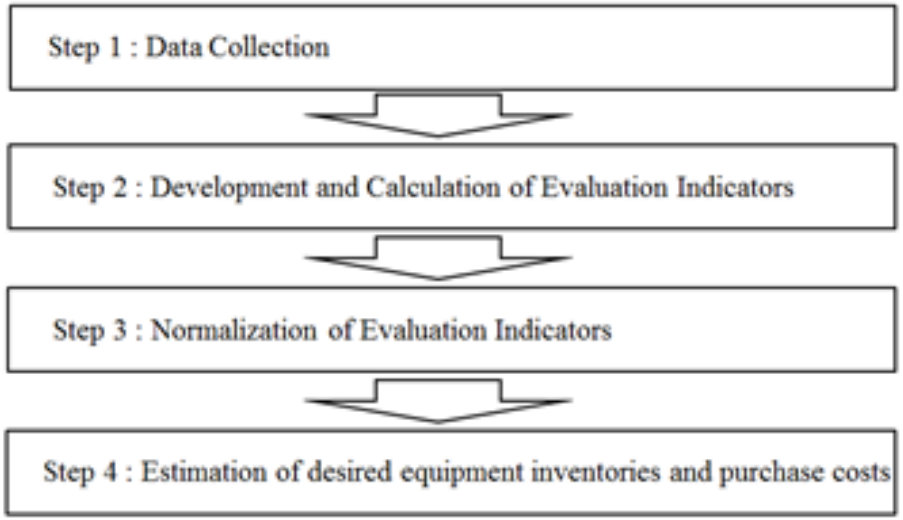

The structure of the model allows us to combine evaluation indicators which vary in units and magnitude. We chose indicators reflecting time or distance used and days used

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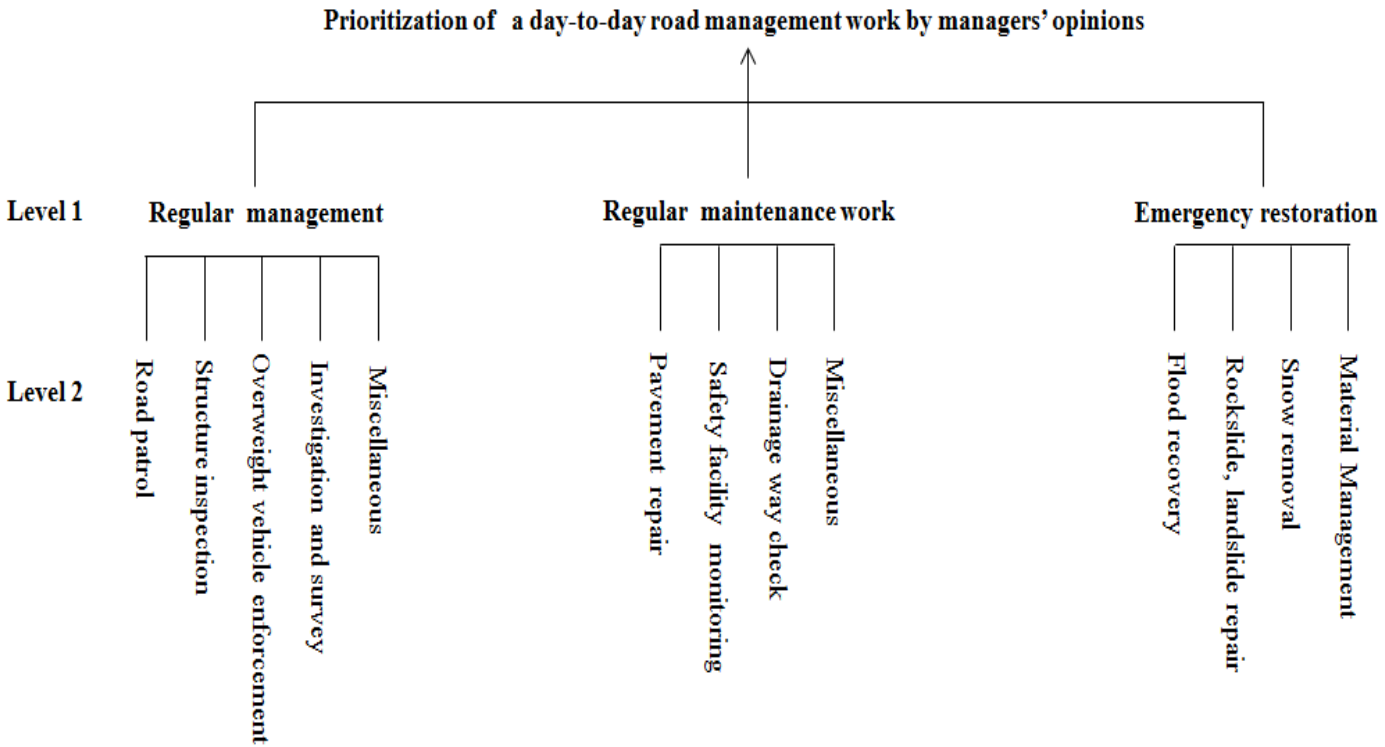

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- Environmental sensor stations (for snow removal primarily)
  - The third model examines historical records on snow conditions, traffic accidents and use of older technologies to monitor road conditions (CCTV cameras for instance), as well as information on existing environmental sensor stations (ESSs) to decide where to install new ESSs within a limited budget.
  - This model also combines historical data and rankings of importance of various criteria based on interviews with road managers.

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Four steps of the prioritization methodology

Step 1	· **Collection of available data via each regional office** · **Collection of weather information from automated weather stations**
Step 2	· Data collected are display using ArcGIS software · Establish candidate set of locations for ESS installation
Step 3	· Find locations where ESS are already installed in sections vulnerable to snow and eliminate these from candidate set · Apply snow vulnerability analysis results to candidate set
Step 4	· Survey professionals to identify criteria relevant to decision-making · Apply analytical hierarchy process to estimate relative weights for the criteria
Conclusion	· Prioritize ESS installation on national highways in South Korea

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- Bicycle Route Construction and Improvement
  - The fourth model identifies bicycle route improvement projects with the most “bang for the buck” by combining quantitative (economic feasibility) and qualitative (stakeholder preferences, attitudes) aspects of each project.

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Constructing Bicycle Route Priorities

Step 1	· **Selection of economic criteria**
Step 2	· **Determine sub-criteria for each policy criteria**
Step 3	· Apply Analytical Hierarchy Process Model
Step 4	· Produce an overall ranking
Conclusion	· Quadrant analysis

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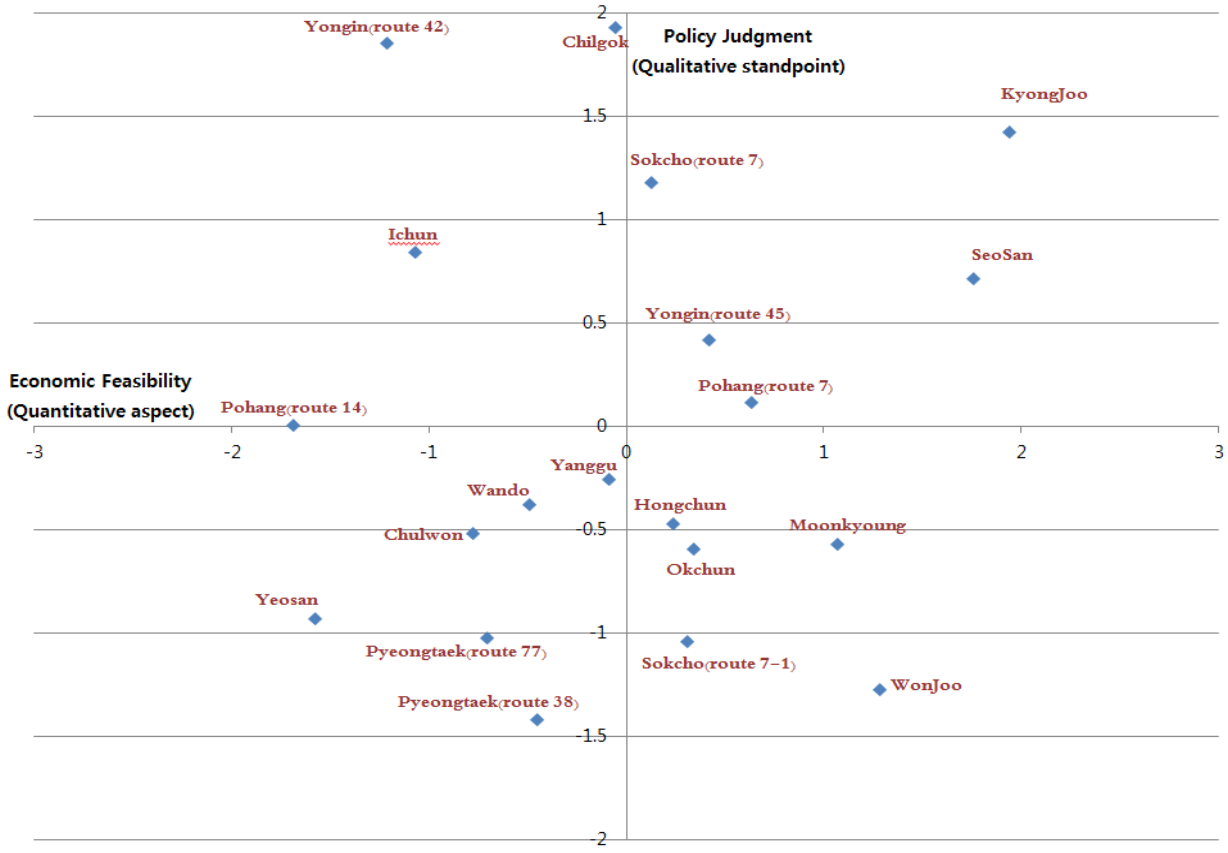
Quadrant Analysis



Common Themes/Challenges

- All of these models require access to significant amounts of data from public agencies
- Successful models require close cooperation with those agencies and individuals because of the need to combine interviews with quantitative measures.
- Sometimes even different offices of the same agencies might have slightly different historical records related to the same information.

Conclusion

- In South Korea, like much of the developed world, the emphasis in surface transportation management has shift ed from construction to maintenance and improvement.
- Budgets are limited and transportation agencies need to plan ways to both use their resources carefully, and to argue for additional resources.
- All of the tools we developed have been successfully deployed in South Korean Agencies.