

Dissertation summary

Exploring Multiple Stakeholders' Perspectives on Resource Sharing in New Mobility Services: Toward a System of Systems

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As new transportation services such as connected, automated, shared, and autonomous services are emerging in the transportation system, some of them have already been adopted in our society. These new services and technologies are expected to improve the comfort and efficiency of our lives and change the paradigm of sustainable transportation. Therefore, we need to discuss reframing the transportation ecosystem by using new technologies and mobility services. In particular, in regional or rural areas, the concept of *sharing* is more important than other emerging service elements. This is because resources that can be used or invested are limited, and the number of potential users is also very small in regional or rural areas. Therefore, discussions about sustainable public transport services in these regions should focus the most on "sharing" because it is difficult to make a big profit.

To enrich the discussion of sharing into a single frame, this thesis brings the concept of System-of-Systems (SoS), which is collecting independent systems – resources into one system through collaboration and making a complex, strong system. This concept also connects with local public transportation design in this thesis. Based on the aforementioned discussion, the following challenges are exposed when designing public transportation services:

- (1) How to segment the users in the operation of the public transport services;
- (2) What resources can be shared and how;
- (3) How to get the private sector to collaborate in the system and make them change;
- (4) The adjustment of the environment surrounding the new transport services.

To consider the preferences of various stakeholders, this thesis presents three approaches for the design component of new local public transportation systems. Every chapter discusses the context of sharing and regional or rural areas, giving a key message,

- (1) Sharing each stakeholder's limited resources;
- (2) Contributing to a frame of System-of-Systems of new transportation services; and
- (3) Social values the stakeholders bring by sharing resources and participating in the system.

The presentation of each concept encompasses a conceptual framework and/or a grounding of

the fundamental discussion on multiple stakeholders' preferences. The empirical application to the Japanese regional or rural areas is held based on the choice modeling approach. This work aims to make a theoretical and practical contribution, putting the discussion of a new public transportation design into a single SoS and generating the value according to the service dominant logic. To date, to the author's knowledge, previous studies have mainly discussed the sharing of services or collaboration in the transportation system, not framing the concept into the SoS.

The dissertation consists of the following chapters.

Chapter 2 designs regional and rural public transportation through the approach of the system. It considers how to incorporate individual systems that already exist, each of which is discussed in terms of users, suppliers, and general public. Each "system" featured in this thesis is discussed. The design of the system adds logical validity based on the service-dominant logic. We also look at the relationship between the subsequent chapter data and the methodologies that will support this structure.

Chapter 3 explores users' heterogeneity when sharing a vehicle's space. It is assumed that the transportation service transports passengers and freight together within a vehicle to expand the insufficient demand in rural areas, although the space of the vehicle may also be between multiple passengers. In this case, the heterogeneity of the user is further accommodated in the vehicle. A stated preference (SP) survey for conventional buses and integrated (mixed) transportation was conducted in Iwami town in Tottori prefecture, a rural area in Japan. With that survey data, this chapter explores people's preferences and their heterogeneity are classified with different Value of Time (VOT) using latent class modeling. This measures the value when the space of the vehicle is shared.

Chapter 4 discusses the optimal operating direction when users with different VOT discussed above use integrated transportation. In addition to reflecting the value of heterogeneous people in the operation of vehicles, the heterogeneity of freight is also considered in addition to considering human heterogeneity by classifying rural freight as fresh goods and general goods. In addition to the VOT obtained from the data in Chapter 3, the synthetic demand is set by considering the public transportation utilization ratio, destination, and time zone obtained from the survey, and simulated through the vehicle routing problem with time window (VRPTW). The purpose function of the operation is to increase the utility of the users while considering the heterogeneity of the users, and it is also assumed that passengers gather at the meeting point to increase the efficiency of the operation. This leads to a discussion on the social value of sharing the space of the vehicle.

Chapter 5 moves to the operator's point of view and discusses how multiple operators can transition to a new business through new technologies and services. In this case, the operator of the taxi which is providing door-to-door services was explored, and an SP survey was conducted on whether to provide the operator with a new business model combining new technologies and services and business development implementation. Through this, we looked at the barriers to the process of moving to a new business model and what can be a catalyst to transitioning to a new business model. This study was conducted in areas where demand in Japan is expected to decrease (i.e., Chugoku region). The heterogeneity of preferences was examined at the municipal level through classification based on Japan's local autonomy law and population.

Chapter 6 extends the discussion from existing "traffic services" to new transport services and their surrounding infrastructure and sets a stakeholder as a general public, not only service users but citizens. The new transportation service, especially the service where new technologies are introduced,

no longer acts as a service itself but affects several people, such as people in waiting places for public transportation and pedestrians walking around the system. When designing these services, we expand the discussion to create a transportation environment where the general public wants to live the most safely, discussing the system when transportation shares space with the general public. The study involved a survey on the people’s preferences when a new technology that connects trams and buses on public transport is introduced to the general public in Hiroshima city and discusses ways to improve the acceptability of these new technologies. By taking the preferences of the general public into account, this result will help to design a safe way to share limited spaces around public transportation.

Finally, Chapter 7 summarizes the findings of each chapter and does a cross-case analysis to propose a prototype of the System of Systems with multiple stakeholders’ roles. The limitations and the further expected research are also discussed.

GRAPHICAL SUMMARY

