Innovation and Regulatory Reform in Public Transport

Innovative Capabilities and Learning of the Public Transport Organisations

Sumet Ongkittikul

This thesis is a result from a project
funded by the co-operative research programme T3 of
the Netherlands Organisation of Applied Scientific Research TNO
and the Netherlands Research School for Transport, Infrastructure,
and Logistics TRAIL

TRAIL Thesis Series no. 2006/5, The Netherlands TRAIL Research School

TRAIL
P.O.Box 5017
2600 GA Delft
The Netherlands
Phone: +31 (0) 15 278 6046
Fax: +31 (0) 15 278 4333
E-mail: info@rsTRAIL.nl

ISBN 90-5584-079-3

Printed in The Netherlands

Cover design: WENK (J. Herstel)
Cover photography: Surachai Ongkittikul
English editing: Jessica Nattaradol

With the contribution of J.E. Jurriaanse Stichting for the editing and printing costs of this thesis.

Innovation and Regulatory Reform in Public Transport

Innovative Capabilities and Learning of the Public Transport Organisations

Innovatie en regulering in het openbaar vervoer

Innovatieve capaciteit en leerprocessen van openbaar vervoersorganisaties

Thesis

to obtain the degree of Doctor from the
Erasmus University Rotterdam
by command of the
Rector Magnificus

Prof.dr. S.W.J. Lamberts

and in accordance with the decision of the Doctorate Board

The public defence shall be held on
Thursday September 28th, 2006 at 11.00 hrs

by

Sumet Ongkittikul

born at Nakhon Nayok, Thailand

Doctoral Committee

Promotors:	Prof.dr. W.A. Hafkamp Prof.ir. L.H. Immers
Other members:	Prof.dr.drs. F.H.A. Janszen Prof.dr.ir. J.A.E.E. van Nunen Prof.dr. H.J. Meurs
Copromotor:	Dr. H. Geerlings

In remembrance of my grandparents

Preface

It was a summer in 2001 when I first met Harry Geerlings and Wim Korver. I was, at that time, finishing my study in Leeds, and Harry and Wim invited me to discuss on the PhD research in the topic of innovation in relation with deregulation and privatisation in the public transport sector. It was at the TRAIL office in Delft I recall. We had a good discussion that time, I believed, so they offered me the PhD position which I gladly accepted it. I then came to Rotterdam in March 2002 to start the project.

It was Harry and Wim who helped me from the start. Because Harry is working in Rotterdam and Wim is working in Delft (TNO), so I do have to work at both places since the beginning. It was set that Harry will take care of the theoretical aspect and Wim will look after the empirical aspect. In my opinion, this worked smoothly. Unfortunately, Wim left TNO around the beginning of the fourth year of my work. However, I was able to finalise the empirical part by the time of Wim's departure, and Harry also took over some of Wim's duties as well. I can say that this thesis could not be possible without them.

I am also very grateful to Prof. Wim Hafkamp and Prof. Ben Immers, who are my promotors. I would like to thank them for giving me their valuable time to read many drafts of this thesis. Their critical comments on the early manuscript shaped and improved the thesis greatly.

My thesis also benefited from a series of meetings and discussions. I am very grateful to Prof. Piet Bovy (then the director of TRAIL Research School) and Ben Jansen (from TNO) for their critical comments on the progress of the project. I would also like to thank a number of people who participated in the so-called 'User Group Meetings' that have brought in many ideas in both theoretical and empirical perspectives. They are: Alfons Schaafsma, Didier van de Velde, Jolle van der Harst, Peter Zwaneveld, Arjan Stoelinga, Boelie Elzen, Lars Jansen, Martin Kruis, and Martin Gerritsen. I would also like to thank people who participated in the interviews Harry and I conducted. The full list of these people is provided in Annex A. Without them, this thesis could not be finished. I would also like to thanks, in particular, Alfons Schaafsma, Wim Korver, and Lars Jansen for reading and giving me critical comments on the final draft of this thesis.

I would like to thank all the people from the Erasmus Centre for Sustainability and Management (ESM). I really enjoyed working in this friendly environment. Jacko, we had a chance to work on a small project and wrote a paper together. It was a very good experience for me. Sander and Esther, we had a good time going to music festivals, and I enjoyed it very much. And lastly, I would like to thank Trude for help

me on all the administrative work. You made my life much easier since the start of my stay in Holland.

Living in Rotterdam for more than four years allowed me to know many Thai students who are studied and (still) studying at EUR. I enjoyed meeting them, and we were getting together from time to time. This makes me to realise that the more people you have met, the longer you have stayed. I will not mention their names here, because it will be quite a long list, but they (either now in Rotterdam or in Thailand) will be well informed about my thesis for sure.

Lastly, but most importantly, I am indebted to my family for their encouragement and support.

Sumet Ongkittikul

Rotterdam, August 2006

Table of Contents

List of Tables and Figures

Chapter 1 Introduction

1.1 Background

The public transport sector is rapidly evolving. Its development includes regulatory reform, industrial restructuring, and technological innovation. A unique topic in public transport is government intervention on various levels. Changes in the level of government involvement have had a drastic impact on the public transport industry. This thesis focuses more specifically on the effects of regulatory changes in innovation in the public transport sector.

Technological innovation plays an important role in improving public transport services. Over the last few decades, many new technologies have been introduced such as low floor buses, electronic ticketing systems, and dynamic travel information. However, there is very little research that examines technological innovation in the public transport sector explicitly. Most research concentrates on the economic effects of regulatory changes, i.e. privatisation and deregulation of public transport services.

Undoubtedly, regulatory reform affects the technological development. For example, when privatisation occurs, it brings about a new institutional setting in that the public transport operator is switched from a public to a private company. The consequences of this change are massive as the overall decision toward innovation changes. A pertinent issue is how this change affects innovation. This issue is the main objective of this thesis: to examine the effects of regulatory change on technological innovation in the public transport market.

This chapter is an introduction to the thesis. The next section explains the dynamic environment of the public transport market and how it affects technological development within a sector. In this dynamic environment, the most important development is regulatory reform. Section 1.3 discusses whether regulatory reform leads to more opportunities for innovation. Additionally, it describes the development of regulatory reform and its relationship with innovation. Finally, Section 1.4 presents the main research question, methodology, and structure of this thesis.

1.2 Public transport organisation and innovation in dynamic environment

It is important to realise that a public transport organisation is somewhat unstable due to the fact that regulatory reform perpetually creates new forms of organisations with diverse objectives. In the bus industry, for example, privatisation of national bus companies brought on competition. These changes have a direct impact on the organisation of the public transport industry.

There are several terms that are used to define regulatory reform in the public transport market. Most regulatory reform plays a role in both changing the ownership structure of a public transport organisation, and introducing competition. The former is usually referred as *privatisation* which is the transfer of a public-owned company to a private one. When defining competition, one must take into account two factors. First, (economic) deregulation is the cancellation of regulation (usually involving entry and exit control, and price and quantity restriction) which leads to direct competition in the market. Second, *tendering or franchising* (usually referred to as *competition for the market*) is when operators bid for the right to a contract within an area or a system. Different public transport systems (or countries) might use different terms for the same definition. For example, tendering is commonly used within the bus sector, where in railway, franchising is used, especially in UK.

The main reason for regulatory reform is to reduce government involvement in the public transport services. Governmental response to public needs is ineffectual and counterproductive for a number of reasons (Berechman, 1993). First, government (organisation) is inefficient and costly. Second, it does not encourage the personal initiative of individuals and organisations. Third, private sector operations outperform the public sector since they are sensitive to economic incentives. Fourth, it does not follow that a service not provided by the market must be provided by public sector. If the public sector wants this service to be provided without actually producing it, it can finance its provision (through, for example, contracting out). This is the ideology which calls for reforms aiming at less government involvement and increased roles for market forces (Savas, 1987).

However, as previously mentioned, there is very little research that discusses how regulatory reform affects innovation in the public transport system. Most research examines the economic aspect of regulatory change, especially in terms of gains in efficiency due to regulatory change. The topic of innovation is scarcely analysed for two main reasons.

First, innovation typically has an ad-hoc meaning. The perception of innovation is not straightforward; innovation involves newness, but the crucial question is how this newness is observed objectively. For example, the introduction of the Automatic Vehicle Location (AVL) devise in buses may not be seen as innovation to the user as it is rarely seen by passengers. But, it helps the operator manage the fleet in the system more effectively.

Second, it is often the case that an innovative change is not financially viable at the first stage of introduction. For example, the low floor buses were not adopted speedily as the cost of the bus was higher than that of a standard bus. Later, however, some measures, such as regulation and financial incentives, were used to speed up the implementation of the low floor buses.

Usually, there are many actors involved in the introduction of innovation. Thus, this leads to complex interactions between actors in the innovation process. These actors are passengers, public transport operators, and government agencies. The success or failure of a public transport system is the result of the actions and interactions between the actors (Veeneman, 2002). Furthermore, regulatory reform further

complicates the innovative process in public transport because it affects the roles of each actor in the system.

Regulatory change introduces two important elements in innovation. First, it influences the organisational structure as well as the behaviours of the decision-makers in the system. In many cases, regulatory change is the result of a transfer from public to private operator. This formulates a new organisational setting wherein private firms provide public transport services commercially while public authority subsidises loss-making services. Thus, the incentive to introduce innovation changes as a result of this new organisational setting.

The second element is the competitive environment. Regulatory change often introduces competition through competitive tendering (with the exception of bus deregulation in the UK). In order to win the right to operate in the market, an operator may adopt an innovation that increases the chances of winning. Therefore, the winning criteria in the tender documents play a crucial role in influencing the innovation that is employed by an operator.

This leads to the question as to how regulatory reform affects innovation in the public transport sector. We discussed above the technological and organisational aspects that have an impact on innovation. In the next section, we will discuss the relationship between regulatory reform and innovation.

1.3 Regulatory reform and opportunities for innovation

1.3.1 *Relationship between technology and regulatory reform*

New transport technologies are vital for both social and economic development. New technology enhances the efficiency of the mobility of both people and goods. Some new technologies help specific groups of people for social inclusion purposes, such as disabled individuals. The use of new technology, such as Vehicle Scheduling, enhances both operating efficiency and service quality.

Innovation also plays an important role in the public transport system. In general, technological developments can be explained as processes of small incremental changes (Geerlings, 1999). Public transport benefits from the development of Information and Telecommunication Technology (ICT). ICT plays an important part in the Travel Information System in that it informs passengers of any unexpected delays, both pre-trip and during the trip. Further, ICT helps the operator in managing the fleet. Another important element that influences technological development within a sector is the regulatory factor.

When regulatory reform occurs, the most important issue is the changing role of each actor in the new setting. The duties that were once the responsibility of public companies change drastically as the result of reform; therefore, the way each actor develops and implements innovation is crucial. In general, regulatory change transpires in order to ameliorate the overall performance of the system. Thus, this new setting can be seen as a dynamic capability development.

Institutional changes are also important here. The organisations that are created by way of regulatory reform have new organisational objectives. Before reforms, most public transport agencies were public-owned companies. Their objectives were to provide public transport services as social services. Prices were often set at marginal costs to maximise social welfare. However, increases in subsidy levels created a difficult situation for the public transport sector. The government saw this as a result of the inefficiency of the public transport operation. Furthermore, publicly-owned companies do not typically introduce innovative changes into the system due to the fact that they have little incentive to innovate as they do not face any competition. Hence, competition seems to be a solution to this problem and, in order to create a competitive environment, regulatory reform must be introduced.

1.3.2 *Effects of regulatory reform on innovation*

The relationship between market mechanism and innovative activity has been a much-debated issue (Symeonidis, 2002). The overriding factor is the size of the firm. Larger firms in a concentrated market are often seen as the main pioneers of technological progress for reasons that relate to the higher scale of research and development (R&D) and innovation within the economy. However, it is often argued (Symeonidis, 2002) that the lack of competitive pressure may lead to managerial inefficiency and slack, and so to a reduced level of innovative activity.

In public transport, there is not much research on the topic of the relationship between competition and innovation. The reasons for this might be twofold. First, competition in the public transport market has only recently been introduced. Second, the issue of innovation is not well-defined in transport research. The meaning of innovation is narrowly defined, and only defined in terms of technological developments. This narrow perspective limits the way in which innovation can be studied in both theory and practice. Furthermore, innovation in the service sector[1] is even more difficult to measure.

The industry's reaction to reform is also crucial here. The organisations (i.e. both the public authority and private operator) developed as a result of regulatory reform may act differently regarding the issue of innovation because they have different goals and objectives. We need to understand how decision-makers change in and adapt to the new regulatory framework, and more importantly, how these behavioural changes affect the innovative process.

1.4 Research method and outline

This research topic covers two main disciplines: regulatory reform and technological dynamics. This thesis will bridge these two topics to analyse the effects of regulatory reforms on innovation. Both theory and practice must be taken into consideration in order to carry out this research.

The theory of regulatory reform is a well-studied issue based primarily on economic disciplines. The main rationale of privatisation and deregulation stem from the market failure argument and the Contestable Theory (Baulmal et al., 1982). However,

[1] We regard the public transport sector as service sector.

the field of technological dynamics is a relatively new subject. Thus, we need to develop a new theoretical approach that incorporates technological elements into the framework of regulatory reform. We also need empirical evidence that provides a source of proof for this thesis. Therefore, this thesis will cover both theoretical and empirical aspects of the main topic.

1.4.1 *Research questions*

This thesis focuses on the relationship between regulatory reform and technological innovation in the public transport sector. The main research question can be formulated as follows:

'What effect does regulatory reform (in the public transport market) have on innovative capability of the actor, and which routes of innovation will prevail?'

As described above, this thesis is divided into two parts: a theoretical and an empirical part. The theoretical part will be described as a concept that links regulatory issues and innovation together. The empirical component uses an already developed framework to perform a case study in the public transport sector. These two parts form four sub-questions that will be addressed in this thesis. The first two sub-questions are related to theory, and the latter two sub-questions are empirical in nature.

The term 'innovation' is ill-defined. People are usually concerned with innovation in terms of technological advancements. However, innovation can be defined in various ways; both technological and organisational elements should be taken into account. A broader definition is necessary in order to fully comprehend the mechanism of innovation as well as how it responds to regulatory change. This leads to the first sub-question:

1) *What is innovation in public transport?*

The regulatory reforms of public transport change the industry dramatically. It is our main objective to study the effects of regulatory reform on innovation in great detail. This thesis will focus primarily on both technical and organisational effects. The behavioural changes of stakeholders are also analysed because those changes determine the direction of innovation in the sector. Thus, the second question is addressed as follows:

2) *How does regulatory reform in the public transport sector affect innovation?*

Due to the fact that there is change in the organisational structure of public transport, the actors' behaviour in the sector also changes. This thesis will investigate how actors in the public transport sector change their actions and ideas about innovation as a result of regulatory reform. The third question is as follows:

3) *What are the behavioural changes (with respect to innovation) of public transport actors when influenced by regulatory reform?*

Finally, policy recommendations will be addressed. Public transport policy-makers may need advice on how to design a policy that can benefit from an existing innovation. Thus, the final question is the following:

4) *What are the policy recommendations for public transport stakeholders on innovation?*

1.4.2 *Methodologies*

The aim of this research is to provide insight on the relationship between regulatory reform and innovation in the public transport sector. In order to answer the research questions, we need both a well-defined theoretical approach and concrete empirical evidence that supports the theory. This poses two difficult issues. First, the topic of innovation in public transport is rather new. The background theory on this topic must be drawn from outside the field of transport. Second, as the theory is not well-developed, empirical evidence seems strewn. In addition, the regulatory reform that has taken place in this sector is very diverse, from country to country, even from city to city. We need to consider the research methodology comprehensively, and consequently, we need to design the research framework carefully.

This topic necessitates a multi-disciplinary perspective. The theories used in this thesis emerge from two disciplines, namely the Innovation Study and the Regulatory Study. The Regulatory Study concerns both the economic and social effects of regulatory changes in a given industry. For the public transport industry, most research on regulatory changes focuses on the economic effects. However, a broader perspective can be found in the study of regulatory changes in other industries, such as electricity, energy, and telecommunications.

The Innovation Study is composed of many different theories. The main theory that this thesis employs is the Evolutionary Theory of Technological Dynamics. An important stimulus in the development of these theories is the work of Nelson and Winter (1977) and Dosi (1982, 1988a, 1988b). The models of theories on technological change they developed are referred to as the contextual approach to technological change. Nelson and Winter (1977) see technological change as a continuous series of variation and selection processes aimed at solving technically-defined problems. These processes do not take place in a random manner, but are clearly structured. There is certain rigidity and inertia present in the extent of technological change which stops unlimited variation. And, there is certain regularity to the development of technology referred to as ‘trajectories’. A trajectory comprises the changes in technology which take place within the framework of a technological regime or paradigm, i.e. the ‘direction of progress’ within a technological regime.

The Regulatory Study and Innovation Study provide a theoretical backbone for this research. Subsequently, it is necessary to illustrate the validity of the thesis using empirical evidence. The method we choose is a qualitative analysis using the case study approach. The overall nature of innovation is that it is variable. Innovation means change, and change is very difficult to quantify. The case study approach allows us to analyse both quantitative and qualitative information. This will allow us to suggest the implications of this thesis.

1.4.3 *Structure of thesis*

Chapters 2 through 5 deal with various theories on which this thesis is based. Chapters 6 to 8 present empirical evidence in the form of case studies to support the validity of the theoretical aspect. Lastly, Chapter 9 presents the conclusions of this thesis.

The theoretical aspect begins with Chapter 2 which introduces the subjects of innovation and public transport. First, the current situation of public transport is reviewed. Then, the issue of technological developments in the transport sector is discussed. Finally, the theoretical background on institutional and organisational aspects is described.

Chapter 3 introduces the innovation theory for public transport. Based on the theory of evolutionary economics, the twin characteristics approach is used as a framework to define and analyse innovation in public transport.

Chapter 4 reviews theories related to regulatory changes. Public transport institutions and organisations are both important issues. This chapter looks at the relationship between the institution, organisation, and innovation. Furthermore, the concept of dynamic capability and learning will be introduced here.

Chapter 5 constructs an analytical framework for this thesis. First, the chapter outlines the dynamic elements of regulatory reform and innovation. It then discusses the interactive process between innovation and regulatory reform. The chapter concludes with the proposed analytical framework.

The empirical part consists of three chapters, Chapters 6 to Chapter 8. Chapter 6 describes the development of regulatory reform in European countries. The chapter concentrates on two modes namely local public transport (mainly bus) and railways. The recent trend in regulatory reform is the move towards the tendering model in both the bus and railway sectors. The detailed development of this trend is discussed in this chapter.

The next two chapters present the empirical evidence in the form of a case study. Chapter 7 presents a bus tendering case study. This chapter deals with an analysis of the tendering process in the bus sector with respect to innovation using the analytical framework developed in Chapter 5. The cases consist of detailed studies in three specific areas in the Netherlands. Then, a comparison is made with the London tendering system.

Chapter 8 presents innovation in the railway tendering process. This chapter uses the same analytical framework to analyse the effects of railway tendering on innovation. There are two cases on which we focus in this chapter: the Groningen and Merseyrail Electrics cases. The role of rolling stock developments in the railway sector is also examined.

Finally, Chapter 9 presents a summary and conclusions for the thesis. Recommendations for the future studies will be presented as well.

It should be noted that some parts of this thesis were published in journals and presented in conferences. The references to those papers will be given at the footnotes of relevant chapters.

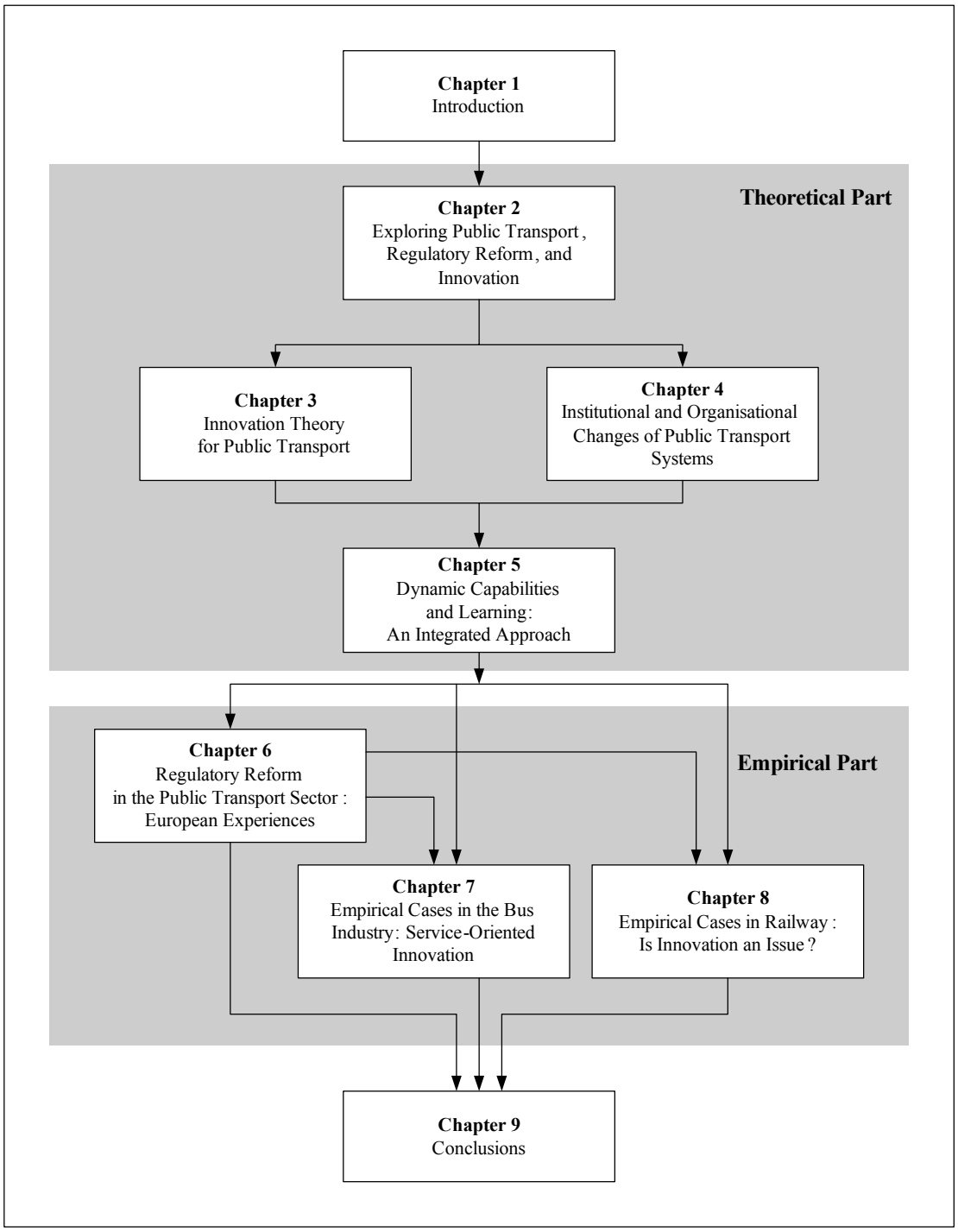


Figure 1-1 Thesis structure

Chapter 2 Exploring Public Transport, Regulatory Reform, and Innovation[1]

2.1 Introduction

Public transport plays an important role in the transport system. In urban areas, where many cities are facing a congestion problem, public transport is the key to resolving this problem. Providing transport services where people can travel together in mass quantities would result in a considerable reduction in the number of vehicles on the road. Moreover, in the lesser-congested areas, like rural districts, the issue of social inclusion arises and, again, public transport is the key. Children, elderly citizens, and disabled individuals rely on public transport services.

The public transport sector is traditionally a regulated industry. The rationale for regulation includes the following reasons: to ensure social services, to guarantee the safety standard of the services, to protect the market from monopolistic behaviour, and to prevent wasteful competition. These various bases result in differences in regulation both modally and geographically. Different public transport modes like rail, tram, or bus lines have different criteria and details of regulation. Although most modes are regulated under a monopoly, price, service quantity, and quality may be controlled differently. Furthermore, different countries or regions could also have different regulations and regulatory styles, such as regulatory practices or industry cultures.

New technologies also bring about changes in public transport services. These changes result in an overall improvement of the public transport quality, and they also shape the way public transport services are provided. In other words, these changes improve the efficiency and effectiveness of public transport systems and shape the regulation in the systems. An example of the former is that better bus engines increase both speed of the bus and fuel efficiency. An example of the latter is the invention of the catalyst converter which is now a common requirement for every bus. These are only examples of improvements in bus technology; there are many other examples that can be noted nowadays.

Besides new technologies, both institutional and organisational developments also play an important role in the public transport sector. A remarkable change in the past decade was the trend towards privatisation and deregulation of the public transport sector. In European countries, various forms of competition were introduced resulting in the reformation of both institutions and organisations in the industry. These

[1] Section 2.3 of this chapter is partly based on an article in the *Journal of The Eastern Asia Society for Transportation Studies* (Geerlings, Ast, and Ongkittikul, 2005).

changes still occur, and what is most interesting is 'how these changes affect innovation in the industry.' This theme will be addressed throughout this thesis.

This chapter aims at reviewing the topics of innovation as well as institutional and organisational changes in public transport sector. The latter topic is typically addressed in the context of the economics of regulation or regulatory reform. Unfortunately, there is not much research on innovation or the relationship between innovation and regulatory reforms.

The organisation of this chapter is as follows. Section 2.2 examines the current situation of the public transport sector in European countries focusing primarily on the regulatory changes. Section 2.3 reviews the study of technological development in transport. The relationship between innovation and regulatory reform is discussed in Section 2.4. Section 2.5 discusses characteristics of public transport services. Then, Section 2.6 provides an overview of the distinction between institution and organisation. This section also provides implications of the institutional and organisational aspects in the public transport sector. Finally, Section 2.7 summarises the chapter and places an emphasis on the importance of understanding the complexity of the relationship between innovation and regulatory reform in the public transport sector.

2.2 Public transport sector in a changing environment

2.2.1 *Current situations in public transport*

Public transport still faces fierce competition with the private car. The evidence from European countries clearly shows that the private car is a dominant mode of transport in most developed countries. The demand for car ownership and use is almost insatiable. The growing number of automobiles in most major cities indicates that people prefer to use a private car. Table 2-1 confirms this point. The modal share of passengers has increased from 75 percent in 1970 to 84 percent in 2002. This dominant position even seems to be getting stronger. In the meantime, public transport struggles to maintain its small share.

Table 2-1 Passenger-km by inland transport mode in EU-15 countries

Year	Passenger Cars '000 Million Passenger-Km	Bus & Coach '000 Million Passenger-Km	Railway '000 Million Passenger-Km	Tram & Metro '000 Million Passenger-Km	Total '000 Million Passenger-Km
1970	1562 (75%)	269 (13%)	219 (10%)	34 (2%)	2084
1980	2246 (78%)	348 (12%)	248 (9%)	35 (1%)	2877
1990	3139 (82%)	369 (10%)	268 (7%)	42 (1%)	3818
1991	3210 (82%)	374 (10%)	276 (7%)	44 (1%)	3904
1995	3463 (83%)	377 (9%)	274 (7%)	41 (1%)	4155
1997	3576 (83%)	389 (9%)	285 (7%)	43 (1%)	4293
1998	3655 (83%)	395 (9%)	287 (7%)	44 (1%)	4381
1999	3726 (83%)	398 (9%)	295 (7%)	45 (1%)	4464
2000	3780 (83%)	402 (9%)	304 (7%)	47 (1%)	4533
2001	3816 (83%)	405 (9%)	308 (7%)	48 (1%)	4577
2002	3882 (83%)	411 (9%)	307 (7%)	48 (1%)	4648

Source: Euro Stat 2003

The provision of government intervention is also a key factor in the operation of the public transport services. Generally, government contributions to public transport are significant. Figure 2-1 shows a trend of government subsidies to public transport in the Netherlands. An increase in subsidy is one reason, among others, that the governments in many countries transfer public transport services to the private sector. Formerly, public-owned companies were operating the public transport sector in a monopoly position. However, the trend towards privatisation and regulatory reforms is taking place in many countries, notably European countries.

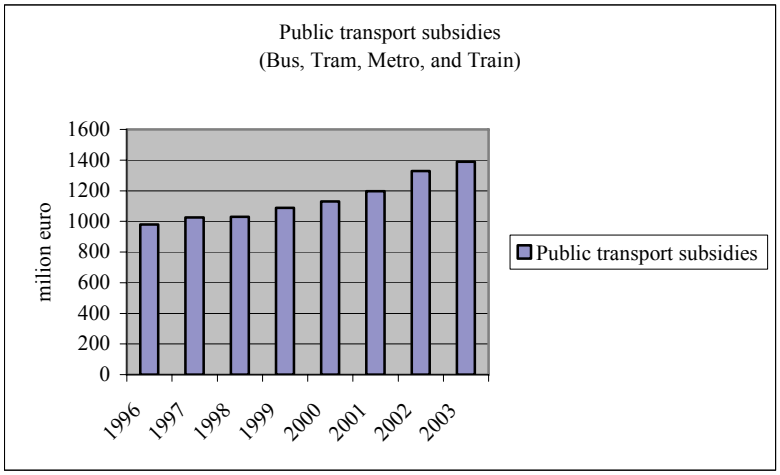


Figure 2-1 Public transport subsidies in the Netherlands
Source: CBS (2003)

The key objective of regulatory reform is to enhance the efficiency of the sector. However, it appears that the government also expects innovation from the operator as well. Clearly, the way innovation is introduced in a monopoly situation will be different when operating under a new regulatory framework.

In Europe, the European Commission realises the importance of encouraging a modal shift from the private car to more sustainable forms of transport (public transport, walking, cycling). The European Commission published its Green Paper, "The Citizens' Network – fulfilling the potential of public passenger transport," in 1995. This paper suggested various ways of making public transport more attractive and usable. Examples included improvements to vehicles and rolling stocks, system integration, information provision, quality of service, and planning priorities for public transport projects.

The European Commission began the process of improving the performance of the public transport system by identifying the best organisational structures for public transport operations in European countries. This was the ISOTOPE project which commenced in 1995 and ended in 1997. Later, the MARETOPE project, which ran from 2000 to 2004, continued the work produced by the ISOTOPE project. Both projects concern the economic efficiency of the public transport systems in different regulatory frameworks.

Not only is the efficiency aspect important to the public transport sector, but also the improvement of the quality of public transport services. The European Commission's

plan to support the relevant actors (the local authority, the operator, and manufacturer) in public transport was apparent in the funding of the QUATTRO project, which proceeded from 1996 to 1998. QUATTRO was able to make specific recommendations to enhance public transport quality, and this included the use of benchmarking.

There are several ways to improve the quality of public transport, and one of them is the benchmarking method. The European Commission funded the EQUIP project which studied the implementation of the benchmarking approach in public transport. In this project, 91 indicators are identified in order to measure the performance of the public transport system (Geerlings et al., 2006).

The above projects illustrate that the European Commission recognises the importance of the public transport sector. The problems associated with congestion have been noted for some time, and the effects of increasing emissions have led to a significant effort in trying to resolve the problem. It is obvious that the public transport has an important part to play in this respect.

Additionally, the aforementioned developments illustrate the evolution of trends in the public transport policy. We can divide the development into three separate trends. The first trend is the economic efficiency trend. This trend came with the economic reform (i.e. privatisation and deregulation) aiming to increase the efficiency of the sector and reduce the subsidy burden of the public transport services. The second trend is the quality improvement trend. This trend was realised when cities required high quality public transport services in order to attract people away from their cars. We are currently in this trend. Finally, the third trend is the environmental concern. It seems that the congestion in many urban areas is the greatest source of pollution. Not only do cars pollute, but also public transport vehicles. Thus, there are some initiatives to introduce a cleaner-engine vehicle into the public transport sector. However, this trend is still in its early phase where only a few cases have actually been implemented.

2.2.2 *Public transport policy and the regulatory reform*

The European Union (EU) realises the importance of public transport and makes it clear that the quality of public transport must improve in order to compete with the private car. Public transport needs to achieve levels of comfort, quality and speed that meet people's expectations. The European Commission proposed an approach to open up the public transport market while guaranteeing the transparency, quality and performance of public transport services by means of regulated competition (European Commission, 2001b).

Competition policy at the European level influences the direction of the public transport industry. In the near future, hundreds of cities will be forced to open their local bus, tram, and metro (underground train) systems to private competition. This brings about radical changes from both an institutional and organisational standpoint. Public authorities, especially local governments, face difficulties in that, on the one hand, they are obliged to provide affordable public transport services; while on the other hand, they have to subsidise the service effectively through open competition in the market (tendering process).

Innovation seems to be a promising option for the situations described above. In fact, the open market for the private sector gives an opportunity for an innovative idea from private operator. It is generally accepted that the private sector is more consumer-driven than the public one. However, a policy that can attract innovation is not easy to design. Innovation is a complex process. The complication occurs since the effects of innovation and regulatory change are hardly predictable.

The regulatory reform of public transport creates a wide variety of organisational forms in European public transport. One of the common features is the growing involvement of the private sector in service production through either deregulation or competitive tendering regimes. Velde (2003) observes that the growth of private involvement has led to the development of major international operators. These operators have originated almost exclusively from Britain and France in the past decade. The British deregulation of the local bus outside London led to the appearance of new private operators: Arriva, Frist Group, Go-Ahead and Stagecoach. In France, the new European trend of public transport tendering led to the expansion of French operators: Connex, Keolis and Transdev.

If we look back to the history of the regulatory reforms in Europe, the greatest breakthrough of the public transport regulatory reform occurred during the British deregulation case in 1985. It came from the Transport Act of 1985 which set the new rules for the local bus service in Great Britain. The new rules included the following requirements: to abolish quantity controls (road service licensing) on local bus services outside London; to restrict subsidy payments in support of public transport for local services to unprofitable routes required to meet social need; and to make fundamental structural changes to public sector bus ownership (McGuinness et al., 1994). The essential element of this regime is that the operators can determine fares and services on a purely commercial basis, with the exception of those areas that are not commercially feasible, such as areas social services.

It was anticipated that deregulation would result in a number of consequences. It was contended that through the process of deregulation, new operators would be able to enter the market, and incumbent bus undertakings would be transformed into more innovative, market-oriented and commercial companies (McGuinness et al., 1994). Furthermore, one of the main aims behind the 1985 legislation was to introduce a contestable competitive operating environment (Banister, 1985). Competition, it was contended, would bring with it a combination of lower operating costs, lower fares, and improved services (McGuinness et al., 1994). This British approach allows the operator to play a major role in the operating and planning of the public transport service. It leaves little room for public authorities to participate in the design and planning of the service. Thus, the service is solely in the hands of the operators. With respect to innovation, Mackie et al. (1995) reveal that established firms have been quite willing to develop new service patterns, and to switch from big bus to mini or midibus operation. They conclude that a large, well-managed incumbent has sufficient sources of competitive advantage to deter entry successfully, or at least to restrict competition.

In the railway sector, the UK rail industry has been radically reformed since the beginning of the privatisation process in 1994. The details of this process are well documented elsewhere (see for example Kain (1998)). Briefly, the industry was

restructured into potentially profitable units that were privatised by outright sale, and non-profitable units that were privatised by franchising. The potentially profitable units are the rolling stock leasing companies (ROSCOs), NetworkRail (formerly RailTrack), the infrastructure supply companies (ISCOs) and the trainload freight companies. However, a unique aspect of British Rail's privatisation was the transfer of businesses to the private sector that had little chance of making a profit, i.e. a passenger rail industry (Preston et al., 2000). This transfer process has become known as franchising.

Scandinavian countries use a different approach to introducing competition into the public transport sector. Sweden and Denmark have employed the limited competition approach on the bus service. In Sweden, before deregulation in 1989, it was compulsory that the authorities allow the scheduled bus services to be performed by those bus companies that had exclusive licences to operate certain routes (Alexandersson et al., 1998). Bus companies faced no competition on their routes. Deregulation came into force in 1989, when all earlier road licences were abolished. This reform opened up the opportunity, but not the obligation, for each local authority to promote competition among the bus companies by purchasing public transport services through competitive tendering. It should be noted that the Swedish reform, especially when compared to the British deregulation, is less radical (Alexandersson et al., 1998). It was designed with the main purpose of making it easier for the local authorities to coordinate and restructure their bus services and to bring down their costs. Most importantly, it is still not possible for bus companies to start up their services wherever they wish – neither on new routes nor on parallel routes competing with existing ones.

In the Netherlands, prior to the year 2000, local and regional public transport was historically based upon the principle of market initiative but moved de facto gradually away from that principle, giving a great degree of stability to incumbent operators, which were mostly authority-owned (Velde and Leijenaar, 2001). Although it was legally possible for the new entry from private operators, it rarely took place in practice.

A major development in the Dutch public transport in recent years was the introduction of the new Passenger Transport Act 2000. This reform's aim was twofold: more attractive public transport services (especially in areas worst hit by congestion) and an improvement in cost recovery ratios (Velde, 2003). This act decentralised the powers to provincial and regional authorities, and gradually introduced the competitive tendering of public transport services for concessions. Additionally, the act stated that authority-owned local transport companies were to be put at arm's length or privatised. The process of reform was set to be complete by the year 2006. In an early assessment of this reform, Hermans and Stoelinga (2003) studied impacts of the reform in terms of service level, patronage, and cost efficiency. The positive results are an increase in service level and patronage, and cost efficiency while some barriers still remain. The details of the Dutch public transport development regarding the regulatory reform will be discussed in more detail in Chapter 6.

In sum, there is a great deal of variance in the way each country implements regulatory reform in public transport. Also, the implementation of a reform evolves

over time. The European experiences of regulatory reform in the public transport sector will be given in more detail in Chapter 6.

2.2.3 *Structural change of the public transport market*

Regulatory reform leads to structural changes in the public transport. Over the years, the public transport industry has been changing the administrative/company-orientated balance of powers both in the nature of the relationship and of the organisation. Focusing on these developments from a long term perspective, Vroome and Wetzels (1995) observe that there are three waves which can be interpreted as follows.

During the initial 'exploratory' phase in the first wave (1925-1935), there was a period of all-out competition on the roads. At that time, wasteful competition occurred and the government decided during the second half of 1930s to regulate the market and to exclude competition. By means of statutory regulations, authorisations, permits and other means, protected zones were assigned to different companies. Local transport was assigned to municipal companies or to private transport operators, while regional transport was given over to private operators. Direct competition had been eliminated (Vroome and Wetzels, 1995). The second wave was the period during which the model was one of statutory 'heavily subsidised and regulated public transport'. In this phase, the government planned and regulated public transport, while the transport companies carried out only what the government had developed in terms of transport planning. The statutory contributions to public transport were very substantial at the end of the 1980s. This event led away from the second wave into the third phase of 'reorganisation'. The government, during this phase, tried in various ways to control (or reduce) its financial contributions to the commercialisation of public transport. The shift from the second wave to the third wave can be observed when analysing the concept of reducing government involvement in public transport planning and control. The government withdraws from the sector and accepts a newly defined role; this marks the transition to a third wave with a fundamentally new time period and pattern. Vroome and Wetzels (1995) refer to the third wave as a period characterised by the pattern of 'conditional free enterprise'.

The observation of Vroome and Wetzels above is in line with Velde (2005). Velde (2005) observes that the bus sector was functioning on the free market until the 1930s. The operators called for regulation because they started to face problems such as fierce competition from other modes of transport. The intervention of government in the following period (after 1940) was 'the coordination' period that remained in place until the 1980s (Velde, 2005). After this coordination period, fundamental changes took place in the European public transport sector at the end of the 1980s. These fundamental changes came in the form of an ideology of deregulation, liberalisation, and privatisation. These fundamental changes are still evolving.

The structural change in the public transport industry affects not only the ownership but also the organisational structure of the operators' companies. Clearly, this change is dependent on the regulatory reform. The organisational change affects planning the responsibilities of each stakeholder. In this case, the stakeholders are the authority and operators. With respect to the level of planning and control, Velde (1999) makes a distinction between the Strategic, Tactical, and Operational functions of public

transport (STO) of the authority and operators. Strategy involves answering the question of what we want to achieve. Tactics involve determining the services that can meet the policy goals. Operations involve producing those services to meet the policy goals. Considering these three levels of planning and control, the operator would previously have responded only at an operational level. The public authority took over the task at the tactical level. However, regulatory reform has increased the opportunities for private operators to get more involved in the tactical tasks. This is a complicated matter since, as mentioned above, there are differences in the details and approaches countries utilise in managing their public transport services. In other words, there is no universal solution to organising and regulating public transport services. This is due to the differences in the cultural backgrounds in each area and the previous regulations in each country. This is a (sort of) path dependency where the current situation was the result of history. The cumulative knowledge of both authority and operator plays an important role in the evolution process. For instance, deregulation in the UK was implemented because the authority (in this case the central government) perceived the inefficiency of the existing monopoly regime. Once the deregulation was implemented, the operators modified their strategies to survive in the market and tried to achieve their business objectives. The results of the new operators' actions were cost reduction and an increase in fare level resulting in a dramatic decrease in patronage. It was then that the government realised the mistake and tried to introduce the Quality Partnership (QP) regime to boost the public transport use. What we can see from this point is that each stakeholder is learning, and the actions they take are based on the past.

Undoubtedly, we need a thorough understanding of both the process of regulatory reform and the structural change. It is also important to study the interaction between actors in the public transport sector which affects the regulatory reform and structural change. We will deal with this issue in more detail in Chapter 4.

2.3 Technological development in public transport

Technological innovation plays several important roles in the transport sector. Technology is important as a means towards a certain (technical) objective. For example, the new propulsion system aims at reducing the pollution produced by an automobile. However, it also serves as a (indirect) means to fulfil the policy objective. An example is the opportunities offered by electronic contactless payment systems. This may facilitate the implementation of efficient pricing for different transport modes (Zuylen and Weber, 2002).

Innovation in public transport is not new to us. Much research addresses significant development and innovation in the public transport sector. For instance, the use of electrification or breaking technology in railway was usually regarded as an innovation. Gallamore (1999) studies the diffusion of technology in the American railroad industry and Lancaster and Taylor (1988) study the innovations with respect to the high speed train.

The term 'transport innovation' includes both new ways to manage transport systems (mostly by use of various policy tools) and new technologies (Feitelson and Salomon, 2004). If we accept this wider definition of innovation which includes organisational

and institutional aspects, it could be revealed that the regulatory reforms could also be considered as an innovation. There are a number of studies in regulatory reforms, especially from an economic aspect. Not surprisingly, innovation is also a subject in which research on regulatory reforms is interested.

It is also clear that the growth of transport will generate sincere negative effects (such as congestion, emission, accidents). But since the transport sector can be characterised as a dynamic sector, it is expected that some of these effects can be addressed by technological innovation. However, a 'technological fix' will never be envisaged (Gwilliam and Geerlings, 1992); technology can contribute to a more dynamic economic development as well as fight the external effects. This section will present a quick scan of the technologies in the transport sector.

2.3.1 *Decomposition of technological involvement in transport*

To examine the effects of technology, it is useful to decompose the technological composition of the transport system. This decomposition is called the transport mode concept proposed by Zwaneveld et al. (1999). This concept partitions transport into three components: propulsion system (PS); vehicle concept (VC); and transport concept (TC). Then, the transport mode concept (TMC) illustrates how the three items (PS, VC and TC) are utilised in the transport system. The definitions and some of the relationships between the terms are given in Figure 2-2.

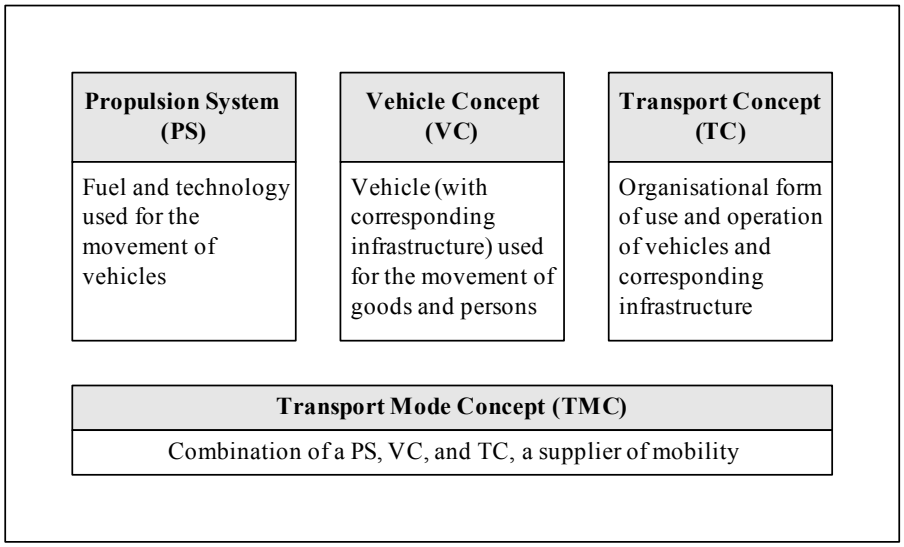


Figure 2-2 Transport mode concept
Source: Zwaneveld et al. (1999)

In each system, there are several potential technologies that could make an impact to the system. Each system has its own path of technological development. The propulsion system focuses on the fuel and technology that is used for the movement of the vehicle. As far as the vehicle concept is concerned, both the vehicle and infrastructure develop concurrently. The transport concept goes beyond the individual vehicle. This concept involves the aspects of organising and facilitating the system. Finally, the transport mode concept combines all concepts mentioned above and takes into account the individual behaviours of the system to manage and control mobility.

Fuel and propulsion technology

The development of fuel technology is an important trend in transport technology. In the past, fuel and propulsion technology have improved the performance of the transport system in terms of speed. If we look closely at the development of the transport system, in any mode, the speed has gradually increased over time. One of the key elements is the propulsion system. For example, in the railway system, the change from coal to diesel engine increased the railway speed. However, each mode has its own speed capacity. For instance, automobiles have reached their maximum practical speed (150 kmph at max) due to safety reasons. Further concerns are the environmental impacts from each propulsion system. Recently, environmental issues have become more important to the society. As transport is one of the sources of pollution, the fuel and propulsion technology have worked to improve the environmental performance of transport systems, especially in the automobile sector.

An important development in this category is the alternative fuel vehicle. There are several fuel technologies that are in the development period now, such as fuel cell (FC) technology and bio-fuel. Clearly, engine replacement is not relevant to the mobility and congestion issue, i.e. the use of alternative fuel vehicles neither reduces nor increases the level of congestion. What it does affect is the environment. Gwilliam and Geerlings (1992) observe four alternative fuels, namely hydrocarbon fuels, biofuels, hydrogen, and electric propulsion (fuel cells). These technologies are promising means of moving toward more environmentally friendly transport systems; however, the introduction of such technologies will occur in the long-term. Indeed, after more than a decade of these reports and findings, the significant implementation has not yet been realised in this field.

Helmreich and Leiss (2000) indicate two important technologies in the field of fuel and propulsion technologies that could make a major contribution in the future, namely fuel cell technology and hybrid propulsion. First, *fuel cell propulsion* may be based upon several different fuel and technology combinations depending upon the rate of technological development, fuel availability and infrastructure development. There is uncertainty over what the impacts may be from each of these combinations. Full life-cycle analysis is required to appreciate the contributions of fuel production and distribution on resource use and greenhouse gas emissions. There is little doubt that fuel cells will lead to significant improvements (>90%) in local emissions of key pollutant species. Fuel cell technologies are expected to be significant in almost all scenarios and with many different vehicle and transport technologies. They are expected to have the most positive impact on greenhouse gas emissions and air quality, and will deliver improvements to noise pollution (mainly urban traffic noise). Fuel cells are expected to show a 50% improvement in fuel efficiency in 2030 compared to conventional petrol in 1995.

Second, *hybrid propulsion* is also expected to play a significant role in the medium term, and to become an important core technology connected to fuel cell deployment (Ongkittikul and Geerlings, 2004). Whilst enabling significant reductions in resource use, and therefore greenhouse gas reductions, hybrid drive technology (for all-purpose cars, buses and possibly freight vehicles) will allow zero emission operation of these vehicles within urban areas, where air quality improvements are of the highest priority. Noise pollution will also see remarkable improvements in slow-speed urban operations.

Although propulsion technology is unlikely to contribute to mobility and congestion problems, if we consider the external effects of congestion, such as pollution and noise, this technology can be beneficial. In sum, two technological trends can be identified. The first trend is that the conventional propulsion system be adopted. This can be seen as a short-term path that would dominate the propulsion system in the next five years (or so). The second path is the new propulsion system. This is a sort of technological breakthrough in the long term (10-15 years). However, there is uncertainty in terms of which technology would dominate the market as a wide range of technologies, such as fuel cell and hydrogen technologies, will become available in the future.

Vehicle and Infrastructure Technology

Vehicle and infrastructure have a close relationship. The development of vehicle design, in some instances, is based on the infrastructure with which it is associated. It is obvious that the infrastructure is the main determinant of spatial development. Thus, the issue of technological development in the infrastructure component should also be considered in the standardisation of the system. In general, the vehicle and infrastructure technologies can be split into two modes, namely road and rail systems.

In this section we will examine several potential technologies: Automated Vehicle Guidance (AVG), the Magnetic Levitation Technology (Maglev), and the Underground Logistic System (ULG).

- AVG is a system that helps the vehicle to manoeuvre automatically on a provided path. This system has the potential of increasing the road capacity. Theoretically, it reduces the distance between vehicles and, possibly, the lane width. Hence, a direct impact of congestion reduction can be expected. Furthermore, it also increases the comfort of driving, especially in congested areas. Drivers become able to use their in-vehicle time for other activities as well. However, given the improvement in driving comfort, this system may stimulate car use which may, in turn, increase congestion. When focusing on the environmental aspects, the impacts of this system are mainly associated with the level of congestion. But, as mentioned above, this system could both reduce and increase congestion; the outcome cannot be certain. However, if we assume that this system makes traffic flow smoothly, higher energy savings are possible, which would consequently result in the reduction of pollution.
- Maglev technology is the utilisation of magnetic levitation, guidance and propulsion to greatly increase vehicle speed. It is comparable to the high-speed train. Maglev has high acceleration and deceleration, high payload, low energy consumption, low emission and noise (see Geerlings (1999) for more detail). With respect to congestion and mobility issues, Maglev may not directly affect the system since it deals with long distance travel. However, it could be used to construct regional versions of the system that correspond to the corridor area where a high capacity and efficiency link is needed.
- ULG is a new concept of transport with its own infrastructure; it offers an alternative to road and rail freight transport (Heyma et al., 2000). It potentially reduces the congestion in urban areas because it replaces short distance road transport. Furthermore, its environmental impacts seem to be minimal compared to a conventional heavy goods vehicle because it uses electric propulsion.

Helmreich and Leiss (2000) identify three promising concepts in the field of vehicle and infrastructure technologies, namely: all-purpose car, personal rapid transit, and road train.

- *All-purpose car*: The all-purpose car (APCAR) in its various forms satisfies essentially all requirements of individual mobility including urban, long-distance, business, leisure/fun, etc. applications. This includes more specialised variants such as all-terrain vehicles, sports cars, and multi-person vehicles. The all-purpose car is expected to show the most significant improvements. A reduction of the negative impacts of air quality is expected due to a slow turnover of the fleet from internal combustion engines that harm the environment to advanced diesel turbine engines as well as other more advanced engines like hybrid or fuel cell propulsion systems.
- *New systems for personal rapid transit*: This concept refers to light rail and people mover systems that are usually associated with urban transport. Research in this area has been conducted over the past few years. This concept could benefit from a better knowledge transfer, based on the assessment of pilots and demos. But the main problems for such a new system are financial barriers and potential mismatches with current dominant public transport technologies.
- *Road trains*: These are road vehicles used specifically to carry heavy goods on medium to long distances. This includes the road train vehicle (for long-distance, high capacity freight movement) as well as designs for freight intermodality. A similar concept is the Autoshuttle which is utilised for passenger transport.

Overall, the vehicle concept is a more promising means of improving mobility and congestion problems than that of the propulsion system. Furthermore, new developments appear to be more environmentally friendly due to the global trend toward a sustainable society. A major barrier in implementing the above-mentioned technologies is the issue of investment. As each technology relies heavily on the infrastructure, the costs of both infrastructure and vehicle are very high. This means that area-wide implementation necessitates a considerable diffusion period. Additionally, some regulations are needed to organise the new systems and also, in some instances, to accelerate the technology diffusion.

Transport Demand Management Trends

The demand management issue is based on both the transport concept and the transport mode concept (see Figure 2-2). Elements of this are, for example, parking facilities, supply system, and pricing concepts. In this section, two promising trends are selected, namely the demand responsive concept and road charging.

The demand responsive concept offers an individual public transport that supplies services upon request. The size of the vehicle tends to be small and it functions mostly in an urban area. This concept could increase mobility and, as it has higher occupancy than a private car, it could also reduce congestion. Technology, such as ICT and AGV, is very important to make this system successful. As the pattern of demand will rely on each individual, the ICT will help to minimise the operational route. AGV can also improve the service quality in terms of the speed and capacity of the system.

Congestion charging is a pricing measure aimed at reducing travel demands in congested timeframes and areas. In this case, the technology is not the main subject,

but it is a tool that makes this scheme possible. There is an example using ICT in the congestion-charging scheme in London, UK. According to Derek Turner, boss of the capital's street management department, the scheme reduced traffic in the area by 20% and cut delays by nearly 30% (Economist, 2003). Clearly, it reduces congestion and increases mobility. Furthermore, as the congestion decreased, the pollution level also decreased. However, in many countries, the congestion scheme was delayed or even dismissed due to public rejection.

In sum, technology takes part in the transport concepts in various levels. In some instances, technology plays a leading role in the introduction of a concept. Sometimes, technology plays an accelerated part in stimulating the scheme. One element that should be mentioned is that technological uncertainty and the public interest may influence the scheme. At the same time, individual needs and transport demand have elements of autonomous processes. As stated before, they are partly the result of the potential for new technology and, in turn, they lead to eventual innovations in transport modes.

2.3.2 *Information and Communication Technology*

Information and Communication Technology (ICT) plays a role in the transport sector in two manners. Firstly, it helps the physical transport to operate smoothly. For example, the real time information, which builds on state-of-the-art ICT, helps passengers reduce travel time. Secondly, ICT can substitute the transport demand. For example, in the past, letter writing as a means of communication was substituted by telephone calls. Recently, telecommuting has become more plausible in the information age.

In general, ICT is involved in the transport section in two ways. It helps the operation and management of transport networks (in all modes), such as railway-signalised system, area-wide traffic control, and variable message signs. It also gives information and guidance to the users such as a travel information system.

One ICT application, which has been implemented in several areas already, is a travel information and trip planning system. This technology also extends to the recent transport trend in the multi-modal issue. This multimodal travel information provides information over several modes of travel which can be beneficial to both the traveller and service provider (Helmreich and Leiss, 2000). Another ICT that will be implemented in the near future is smart card technology. A smart card is a cashless fare system that substitutes cash, ticket, and tariff information. The user has to register and to cancel. A smart card can hold information such as the current balance, transaction history and user profile. The use of smart cards is increasing. Smart cards offer the option of totally anonymous usage for applications such as Autonomous Route Guidance, driver information and congestion charging, and public transport fare collection.

Instead of transporting people, it is also possible for individuals to avoid making trips by using other means to fulfil their desired activities. In other words, by transporting information, there would be less need for travel. Such as with places of employment that allow people to work from home or at a location in closer proximity, and use the Internet as a means of communication with other colleagues. The advanced Internet technology makes this idea plausible through the telecommuting approach

(Mokhtarian and Salomon, 1997). Telecommuting reduces actual travel and, subsequently, reduces transport externalities. This measure can directly reduce the congestion problem and would therefore lead to a decrease in environmental pollution from transport. However, it should be noted that there are limitations in terms of the type of work that can apply this measure. Furthermore, although there is no scientific work supporting the argument, it is likely that the time that people can save from this telecommuting is going to be spent in travelling for other purposes. Thus, mobility could remain at the same level.

In summary, there is growing attention on the role of technology in society. We observe a certain fascination and technological optimism. Technology is seen as the key to resolving a number of different problems. This opinion is often expressed when society confronts 'new' issues, such as environmental problems or limitations in energy supply. Technological solutions can be politically preferable as they involve the least amount of government intervention and restriction.

2.4 Innovation and regulatory reform in the public transport sector

The relationship between innovation and regulatory change in public transport is not new. There are a number of examples that show the interaction between these two aspects. The importance of both regulation and innovation has been illustrated in many transport sectors. For example, Gallamore (1999) shows the relationship between innovation and regulation in the American railroad industry. He finds that the Interstate Commerce Commission (ICC) regulation could delay or thwart innovation whereas the deregulation has fostered railroad innovation and change.

To exemplify some ideas of the relationship between innovation and regulatory reforms, let us consider a simple linear relationship of this kind. Table 2-2 shows patterns of developments of innovation and regulatory change. Note that these examples are simplified linear relationships; the real-world situation may be much more complex and may have an interaction (feedback loop) between regulatory change and innovation.

Table 2-2 Patterns of the development of innovation and regulatory change

Pattern of development	Examples
Regulatory change → Innovation	Pattern · First the regulation was changed · Then the innovation occurred Examples · The use of mini-van (Technological innovation) · Multinational operator (Organisational innovation)
Innovation → Regulatory change	Pattern · Innovation is first developed · Then the change in regulation booted the diffusion of innovation Examples · Unleaded gasoline (Technological innovation) · Low-floor buses (Technological innovation) · Smart card (Technological Innovation)

Source: Ongkittikul and Geerlings (2006)

There are a number of examples that illustrate how regulatory changes lead to innovation. For instance, the bus deregulation in Great Britain affected vehicle size from larger to smaller buses (minibus effect). Deregulation also affects the

organisational reforms of the industry. After years of deregulation, there were several mergers and acquisitions which lead to the creation of multinational public transport operators.

Another pattern of development is that innovation leads to changes in regulation. In this case, the innovation is first realised to benefit the society, but there may not be any incentive to the users. Regulatory tools are seen as a means of accelerating the diffusion of the innovation which may come in forms of fiscal incentive or regulation. For example, the case of switching to unleaded gasoline in the UK shows that regulations have been an effective instrument in stimulating the desired shift from leaded to unleaded gasoline (Stoneman, 2002). Another good example is the smart card system (electronic payment). In the Netherlands, there will be an implementation of the smart card system at national level, due to the government funded project (see later in Chapter 6 and 7).

2.5 Characteristics of public transport services

Recently, there has been wide interest in the public transport service industry. The important aspects are both service performance, offered to users, and operator performance, which refer to a firm's productivity. These two aspects are closely related since the public transport is a service in which users take part in the production process. This process consists of two main functions: the production of the service and its utilisation (Costa, 1997). Those functions are performed by different agents: the producers of the service are the operators and the users are a subset of potential passengers. Figure 2-3 shows the relationship between these agents and their simple indicators showing inputs and outputs of those activities.

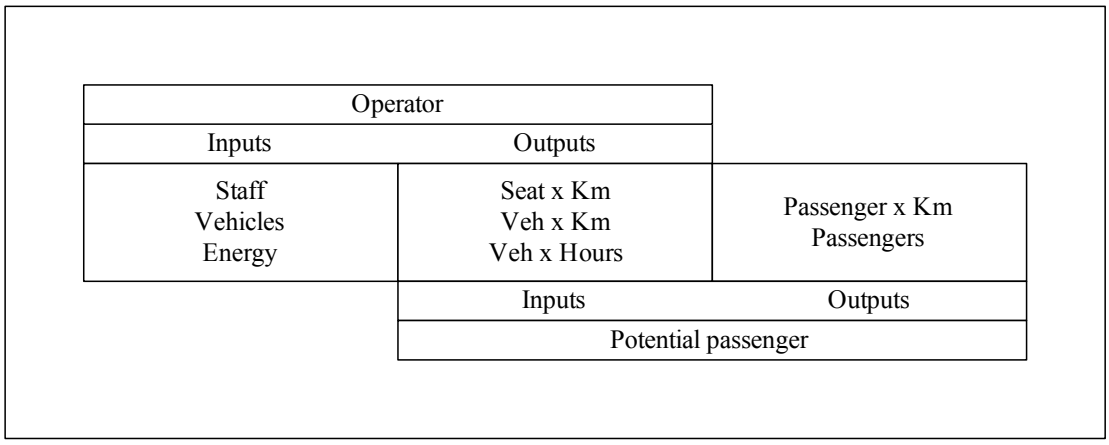


Figure 2-3 Inputs and outputs of an urban public transport system
Source: Costa (1997)

The production of the public transport service is a process of transforming inputs (such as staff, vehicle and energy) into outputs (such as distance covered by the fleet, distance covered by each seat in the fleet, or hours of vehicle operation). These outputs, which we usually call supply-related outputs, will be available to potential users. However, it should be realised that these outputs, which are services by nature, can neither be stored nor produced under client order; the service provided must match instant client needs. As a result, the potential users can become actual

passengers only if the service meets their demands. These utilised outputs are called demand-related outputs. The supply-related and demand-related outputs, which are expressed in the literature as efficiency and effectiveness respectively, have lead to different measures of productivity and, consequently, to a different conclusion as to whether a specific transit system is efficient or not (Berechman, 1993).

In general, the efficiency and effectiveness of the public transport service can be assessed in several ways. Of particular interest and complexity are cost or production frontiers. These approaches have sought to analyse the relationship between the physical outputs of a service and the amounts of inputs used. For instance, efficiency measures the extent to which a firm has managed to produce a given level of output at the least cost (Berechman, 1993).

There are two broad ways of defining the production frontier from such sets of resource inputs used to produce a level of outputs: parametric and non-parametric approaches (Button and Costa, 1999). The parametric approach is based on standard econometrics and involves selecting a functional form for the production function, making assumptions about the distribution of the inefficiency terms and fitting the function to the data. In contrast, with non-parametric, programming approaches, such as Data Envelope Analysis (DEA), the frontier envelops all the units and no functional form is assumed.

Many researchers have employed these production frontier approaches to analyse the technical efficiency of the public transport service operator. The crucial elements of using production frontier approaches are selection and specification of input and output indicators. Borger et al. (2002) state that there is a wide variability in the use of inputs and outputs in urban transit technology specifications. They observe that most studies use labour and capital as inputs, but not all include energy, while, on the output side, a similar wide variety of indicators is observed. Parametric studies mainly use supply-oriented indicators such as seat-km or vehicle-km. In non-parametric studies, there is a broader choice of outputs, although the vehicle-km or seat-km specifications are still the most common.

However, the previously mentioned methods suffer from a limitation in that these approaches ignore quality changes in both inputs and outputs. Most productivity and efficiency studies implicitly assume that the quality of input and output are constant (Oum et al., 1999). Moreover, it is pointed out by Saviotti (1996) that conventional economic treatments of technological change have two shortcomings: first, they are implicit analyses of the phenomenon, and second, they deal only with the growing output and increasing efficiency of economic development, but they neglect the growing output variety aspect.

The variety of public transport services can be found in both the input and output. Sources of variety can be identified in the areas of technology and organisation. Technological development brings about a better use of inputs and better quantity and quality of outputs. For instance, low floor bus technology has been developed over the past decade. This technology leads to a better quality of bus services in terms of improving accessibility and thus reducing boarding time. Another example of technological development in urban public transport is the guided bus technology.

This technology, combined with other traffic management technologies, leads to higher speed and better reliability of bus services.

The organisational developments also created diversity in public transport services. These developments may come either from within public transport firms or from public sectors. However, the characteristics of public transport are still influenced by public sectors. Government intervention in the sector is widespread and has traditionally been justified by reference to a series of market failures. In the past two decades, however, concerns about possible regulatory failures lead to a reassessment of the role of the state in the organisation of the sector (Borger et al., 2002).

Over the past decade, public transport has been dominated by an economic rationale of regulation. While the level of public transport subsidy is growing in many countries, many regulatory regimes have been put forward through the deregulation and privatisation processes. The hope is that private operators, disciplined by competition, can reduce the costs of providing service and thus cut subsidy requirements. Moreover, it is expected that the competition in public transport services may create opportunities for innovations. Although the effects of those regulatory regimes are still being assessed, many studies have sought to analyse some primary outcomes, especially with respect to efficiency improvements. For instance, in Great Britain, deregulation in the bus industry is associated with lower subsidies and has lead to large reductions in costs (Preston, 2001b). In sum, changes in the way public transport services are provided by a well-chosen use of a mixture of competition and regulation have shown themselves to be capable of major improvements to services at lower costs to passengers and taxpayers (Bayliss, 2002).

Recently, the quality of public transport services has been given considerable attention on the part of both researchers and practitioners. The production of transport services requires passenger participation. Passengers evaluate and perceive services in many ways. The service quality which passengers perceive may contain many attributes which also depend on modes. The important attributes of the public transport service include reliability, access to the system, and cleanliness of seats and vehicles. Hensher and Prioni (2002) have recently developed an approach for quantifying a service quality index to enable the public authorities and bus operators to benchmark service effectiveness. In practice, the aspects of improving service quality are found in many countries. For instance, there is a development of Quality Bus Partnerships (QBPs) in the UK to deliver better bus service. Also, as previously mentioned in Section 2.2.1, there is an attempt to implement a benchmarking approach in the public transport sector to improve performance in terms of both financial and quality of the public transport services (Geerlings et al., 2006).

We have seen that the characteristics of the public transport service are complex and are changing over time. Undoubtedly, the technological and organisational developments have crucially affected the development of the urban public transport industry. However, there is a lack of empirical research to gain a complete perspective of how these developments initially took place and were established in the systems.

2.6 Institutional and organisational aspects for public transport

2.6.1 *Institution and organisation of the public transport sector in Europe*

It is important to understand how institutions and organisations play a role in the public transport sector. The institutional aspects come in the form of regulatory framework. It is normal for government intervention in the public transport sector to aid and control in areas such as price, quantity, and quality. Moreover, we see the regulatory setting as an institution and the stakeholder as an organisation. Thus, it is essential to understand the mechanism of institutional and organisational changes in order to understand the innovation process in the public transport sector. Furthermore, the regulatory change ties in with the issue of the organisational change because it creates new organisations due to the privatisation process. It is necessary to understand the role of the organisational aspect in the presence of regulatory reform.

North (1994) makes a clear distinction between institution and organisation by stating that if institutions are the rule of the game, organisations and their entrepreneurs are the players. To elaborate, institutions are the rules of the game in a society or, more formally, are humanly devised constraints that shape human interaction (North, 1990b). Institutions include any form of constraint, both formal constraints – such as rules that human beings devise – and informal constraints – such as conventions and codes of behaviour. Like institutions, organisations provide a structure to human interaction. However, as we put above, a crucial distinction is that the purpose of the rules is to define the way the game is played. But the objective of the team within that set of rules is to win the game. Thus, organisations are made up of groups of individuals bound by some common purpose to achieve objectives (North, 1990b). Organisations include political bodies (e.g., political parties, regulatory bodies), economic bodies (e.g., firms, trade unions, cooperatives), social bodies (e.g. churches, athletic associations), and educational bodies (e.g., schools, universities).

In public transport, institution and organisation exist at various levels. In the European Union (EU), in terms of institutions, we have legislations and directives that member states must follow. They guide both the member state's government in organising the public transport services for citizens and the public transport company in providing and operating the services. For example, the European Directive 91/440, on the accounting separation of infrastructure and operation, brought about the industrial restructuring in the railway sector throughout member states. This directive required the separation of infrastructure and operation of the member states' railways, at least to the extent of separate accounting. We will describe this issue in more detail in Chapter 6. For the public transport services, a much-debated regulation 1191/69[2] is still in the process of revision which could have a substantial impact on the way public transport services are provided in the member states. This regulation concerns the competitive tendering for the public transport services. Again, we will explore the empirical evidence of regulatory reform in the bus and railway sectors in detail in Chapter 6.

From an organisational standpoint, the public transport industry is in a transition period. The regulatory reforms in the sector have radically changed the industry

[2] See European Commission (2000, 2002, 2005).

structure in the past decade. We have seen many new organisational forms, both public and private, that have emerged. That is partially due to the fact that the privatisation process creates many new public and private organisations. For public organisations, we see the establishment of a public transport authority that is responsible for the tendering process. For private organisations, the evolution inside the firm has been considerable, as a new type of division is initiated in the firm in order to be competitive in the market. We will see these issues again clearly in the empirical part of this thesis.

Another remarkable organisational development in public transport sector in recent years is the multinational public transport operator companies. We see Arriva (British origin company), Connex (French origin company), and Keolis (French origin company) operating throughout Europe. These companies operate not only internationally, but also multimodally (i.e. both bus and railway). For example, Arriva in the Netherlands operates both bus services and railways. This trend seems to be increasing in European countries at the moment. As new organisations have emerged, (traditional) national operators, such as Deutsche Bahn (DB), the national railway operator in Germany, and Nederlandse Spoorwegen (NS), the national railway operator in the Netherlands, compete wherever possible. Without a doubt, they have benefited from this development by intervening in the operations or by acquiring participation in new markets, either in their own countries (e.g. RATP, the urban transport operator in Paris, in Mulhouse and Clermont-Ferrand) or in other countries (such as NS, through their daughter company, NedRailway, which has won the contract for urban railway transport in Liverpool) (European Commission, 2005).

2.6.2 *Actors in the public transport sector and the effects of regulatory reform*

There are generally three major actors in the public transport sector: government agency, public transport operator, and passenger. Each actor has its goals, objectives, and expectations in terms of the way public transport services are organised. In general, government agencies want to provide adequate public transport services (e.g. reasonable price, quantity, and quality) to its citizens. The public transport operator (in the case of a private firm) aims at the profitability while the passenger prefers a reasonable public transport service. Furthermore, the complexity of the organisation is found within these three actors themselves. Next, we will discuss the role and the organisational structure of these actors.

The role of the government in public transport is substantial in that it influences both public transport operator and passenger in the public transport system. Generally, the government controls the public transport operator in various ways. The important elements are the regulatory framework and the subsidy. The regulatory framework determines the degree of freedom that the operator has in providing the public transport services. The government usually uses regulatory tools to stimulate the efficiency and enhance the quality of the public transport services. Also, the passenger interests are heard via the government.

Government agencies are typically divided into two levels: the central (or national) government and the local/regional authority. In principal, the central government aims to improve the efficiency of the public transport sector as a whole. The central government intervenes with the public transport operator when dealing with the structure of the company. For instance, the central government uses privatisation as a

tool to enhance efficiency. Another significant example of government involvement is financial support (subsidy). The subsidy level of the local public transport service in the Netherlands, for example, accounts for roughly half of the operating cost. The local/regional authority is also important in organising public transport services. In the past, the local/regional authority often owned the public transport companies. However, the current trend towards regulatory reform changes the role of the local/regional authority so that it now coordinates and monitors instead.

Furthermore, the role of the government is limited not only to the public transport sector, but also to the policies related to other transport modes. The government must improve intermodal passenger transport in a door-to-door chain. This task is difficult to achieve from both a political and an economic point of view. Developing public transport is hardly reconcilable with the overwhelming use of private cars. This brings us to another important issue revolving around the fact that the government has to take into account the environmental impact and congestion cost. The fact that public transport is still largely subsidised through taxes and that the pricing structure does not usually reflect the marginal costs of providing the public transport services (i.e. prices are uniform, independent of time and distance) complicates the situation (IDEI, 1999). Local authorities would have to face the trade-off between improving the market share of public transport while reducing pollution at the price of higher subsidies, and imposing drastic conditions on the use of private vehicles. Technological progress may help solve the problem and should be encouraged. In this respect, regulatory reform plays a significant role in enhancing technological development in the pubic transport sector.

We have seen a dramatic change in the structure of the public transport operator in the past decades (see Section 2.2.3). The transformation from public-owned companies to private companies by way of the privatisation process has affected the way the firms operate. Currently, (private) public transport operators aim to optimise their profit and to ensure continuity.

The operator is caught between government steering and passenger demand (Veeneman, 2002). The relationship between the operator and government is affected essentially by the types of regulatory framework. The operator's position relies heavily on how government intervention exists in the system. We see, for example, the deregulated system, where the operator has full responsibility for the passenger's contentment, and they can interact with the passenger through market mechanisms (price, quantity and quality of services). By taking a look at the tendering system, we can observe how the government also plays a part in the interaction with the passenger through the service specification of the tender.

The passengers can voice their need in two ways. The first, which is the direct method, is to travel via public transport. This is a market interaction where the services provided must be in conjunction with the price that passengers pay. Although there are some captive passengers who have no other choice but to utilise the public transport system, the number of passengers is a good indicator of passengers' voices. The other means is through formal organisation. Often, there is a representative for the passengers, such as a consumer organisation, that reflects the needs of passengers in a more systematic way.

2.6.3 *External factors*

There are also external actors and factors that influence the public transport sector. In this section, we will discuss briefly two external actors.

The first external actor that influences the way public transport services are provided is the infrastructure company. The infrastructure company may not be of importance for the local public transport (i.e. the bus sector), but it is very important for the railway sector. The infrastructure is a factor that determines what innovation will be implemented by the operators. For instance, when introducing a new type of train, it must function in the existing infrastructure. The crucial element is that the planning of both the infrastructure development and the service operation must be integrated. Thus, the overall performance of the services can be achieved.

The second external actor is the vehicle manufacturer. In general, the operators do not develop and manufacture vehicles. The vehicles are made by the car (or coach) or train manufacturing company. Vehicle development is closely related to innovation in the public transport sector. Cooperation between the operators and the manufacturers is needed in order to reflect the actual market needs for any innovation that could benefit the public transport system.

Both internal and external considerations are needed for analysing the actors involved in the public transport sector. Additionally, of particular importance are the behavioural changes of each actor as the result of regulatory reform through either privatisation or deregulation. The way in which actors react and adjust themselves to the new environments affects the public transport systems. Clearly, this is a point where the topics of innovation and regulatory reform have emerged.

2.7 The complexity of innovation and regulatory reform in public transport

This chapter reviews essential elements for the analysis of the technological development and regulatory reform in public transport. It is very important to realise that the public transport sector now faces a challenging task. The modal competition is fierce. And, the government expects the regulatory reform to produce a better public transport service while still reducing the overall subsidy.

We revealed in this chapter that the public transport sector is in a transition phase. The EU has placed more attention to the public transport sector as a means to decrease congestion problems. It has stressed that the public transport must improve both the efficiency, and quality of the public services. As a part of this development, we see how regulatory reform is used as a tool to enhance both efficiency of the public transport operations and quality of the public transport services. Regulatory reform creates a wide variety of organisational forms in the European public transport industry. One of the common features is the growing involvement of the private sector in the public transport industry. This can be seen as a structural change in the public transport industry. Undoubtedly, we need a thorough understanding of both the process of regulatory reform and the structural change in order to identify innovation in the public transport sector.

Technological innovation also plays an important role in the transport sector. In this chapter, we reviewed the transport mode concept (Zwaneveld et al., 1999) which partitions transport into three components: propulsion system, vehicle concept, and transport concept. Additionally, we pointed out several implications of ICT in the transport sector. Technology also seems to be closely connected with government interventions. In Section 2.4, we illustrated examples of the relationship between innovation and regulatory change in the transport sector.

Alongside technological development, both institutional and organisational developments play an important role in public transport. The institutional aspect was introduced in the form of the regulatory framework. The regulatory reform then brings in the issue of organisational change because of the creation of new organisations due to the privatisation and deregulation processes. Thus, it is crucial to understand the role of the organisational aspect in the presence of regulatory reform. In general, there are three major actors involved in the public transport sector: government agency, public transport operator, and passenger. Each actor has its goals, objectives, and expectations from the way public transport services are organised. In this regulatory changing environment, we see each actor adapt its role in order to achieve its goals, especially the government agency and public transport operator.

The relationship between innovation and regulatory reform is complex. In this chapter, we reviewed the complexity of both technological innovation and the institutional and organisational factors in the public transport sector. Here we arrived at two important issues: understanding innovation and understanding the behaviour of decision-makers in public transport. We need to understand how regulatory reform affects innovation.

The research in this field is multidisciplinary. The institutional study (regulatory reform topic) lies heavily in the economic discipline, whereas the innovation study lies in the business management and social sciences disciplines. In order to understand the relationship between these two topics (innovation and regulatory reform), we need to construct a new framework that can bridge them together. Next, we will discuss the topic of innovation in Chapter 3 and the topic of regulatory reform in Chapter 4.

Chapter 3 Innovation Theory for Public Transport[1]

3.1 Introduction

With the pressure from modal competition, public transport faces a difficult situation. The increase of car ownership implies that people prefer to be in possession of a private car over public transport. It means fewer passengers, and consequently lower revenue. Despite these facts, public transport still has to maintain its service for social reasons. Thus, the subsidy inevitably increases. In recent years, many governments in Europe have attempted to solve this problem by means of regulatory reforms. The regulatory reform of the public transport sector aims at reducing subsidy and increasing operating efficiency through competition in the sector. Moreover, it is hoped that the reforms could bring about more innovation to the sector. Yet, questions arise as to what kind of innovation we are hoping for. In fact, what does innovation mean to public transport?

Innovation is a complex subject. Its can be characterised as a change or adoption process of new technologies or techniques. Not only it is complicated to predict the consequences of such innovation, but it is even more difficult to measure its effects in a systematic way. Since the regulatory reform of public transport has taken place, the organisation of public transport has changed. The main impact of regulatory reform is the increasing role of the private sector in providing public transport services. The impression exists that most reforms involve the transfer of ownership, namely privatisation and, consequently, the introduction of competition. But there are also new organisational set-ups resulting in a more complex decision-making process in public transport services. And to make it even more complex, there are significant differences in the objectives of both the public and private sectors in providing public transport services. The public sector aims to serve the public interest whereas the private sector aims to make a profit. Innovations pursued by both organisations may differ in nature, thus complicating the (implementation of) innovation. Although innovation is not a new topic to the transport field, innovation in public transport is less studied. The meaning of innovation for public transport is unclear and subjective. This indicates the need for a more systematic study on this topic. There is a need to specify that public transport is a service sector, so innovation in this area will differ from that of manufacturing.

This chapter will analyse innovation in public transport. The central themes of this chapter are to classify innovation and identify innovative capabilities in the public transport sector. As mentioned above, the process of innovation is complex and, as a result, it is difficult to give it a certain definition. What is considered innovation in

[1] This chapter is partly based on an article in *Transport Policy* (Ongkittikul and Geerlings, 2006).

one case may not be considered innovation in another. However, in order to make the analyses in this thesis possible, a common definition is vital. This thesis constructs an innovation model to assist in measuring innovation objectively. In this chapter, the twin characteristics approach, first developed by Saviotti and Metcalfe (1984), is selected to provide a general framework for innovation classification.

The organisation of this chapter is as follows. Section 3.2 provides an overview of the theory of innovation from various disciplines. Section 3.3 reviews taxonomies and measurements of innovation in both the manufacturing and service sectors. Section 3.4 contains a critical element, the 'twin characteristics approach', for analysing public transport innovation in this study. Section 3.5 deals with the conceptual model of innovation that will be used for the rest of this thesis. Finally, Section 3.6 summarises the chapter as the basis for the analytical framework of this thesis.

3.2 Innovation theory

3.2.1 *Invention, innovation, and diffusion*

In order to introduce new technology to the market, it needs to be adopted by users in the systems. This adoption process can be described by an invention-innovation-diffusion model based on the work of Schumpeter (1939). This model divides the adoption process into three stages: invention, innovation, and diffusion. The first stage, invention, is described as the initial development of a new artefact or process. The second stage, innovation, entails economic application of an invention. The third stage, diffusion, entails the acceptance of innovation into the market of buyers and competitors.

Schumpeter also makes a distinction between stages of technological development, which are also used in the invention-innovation-diffusion model. He defines three different stages in the successful introduction of a technological change[2]:

- *The concept of innovation*. In this stage, the technology is made technically feasible. Technological factors are dominant. In a way we are dealing here with beta-oriented scientific aspects.
- *The concept of interpretation*. Technology is equipped for commercial use, but the question arises whether entrepreneurs are willing to take risks in investing in it. Economic factors (gamma-science orientation) are dominant.
- *The concept of technological dynamics*. For Schumpeter, diffusion is, in essence, a process of technical imitation (which refers to alpha-science aspects). When innovation is in the diffusion stage but, despite its economic profitability, is not adopted, the explanation is invariably related to the conservatism and irrational resistance to change of the early adopters.

However, the invention-innovation-diffusion model has been heavily criticised. The main criticism is that it is a linear process. Dosi (1991) comments that this model is a rather rough and 'heroic' conceptual distinction, which can hardly be found in practices. For instance, the invention is often introduced from the start as an

[2] This summary is taken from Geerlings (1999)

innovation by economically-minded research establishments. Diffusion entails further innovation on the part of both developers and users. All three activities are often associated with changes in the characteristics of, and incentives for, potential innovators/adopters. Although this model has drawbacks, it is still a useful theoretical concept in clarifying the process of innovation. For example, invention is suggestive of some sort of exploited potential for technological processes, while innovation and diffusion hint at the economic, social and organisational incentives and impediments to the incorporation of technological advances into economic products and processes.

This thesis focuses on two processes: innovation and diffusion. These processes are interesting here because we want to understand how (a new technology or technique) was implemented (innovation) and how quick it was diffused into the market (diffusion). We must consider innovation in a wider perspective, that is, innovation is 'any idea, practice, or material artefact perceived to be new by the relevant unit adoption' (Zaltman et al., 1973).

Not only is innovation itself important, but also the process of innovation. In fact, as innovation contains unpredictable uncertainty, the outcomes of innovation can hardly be foreseen. Thus the driving forces within innovation can be studied by looking at the innovation process ex post facto. Dosi (1988a) states that innovation concerns the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes, and new organisational set-ups. Therefore, the study of innovation emerges from various disciplines. It considers not only the economic aspect of innovation, but also how the psychology/acceptance of the users or legislation can play a role as well.

Dosi (1988a, , 1988b) characterises common features of innovation into five aspects.

- Firstly, innovation involves a fundamental element of uncertainty (Dosi, 1988a). It is not due simply to a lack of relevant information, but the underlying issue is twofold. The first is the existence of techno-economic problems whose solution procedures are unknown. The second is that an innovative solution to a particular problem involves discovery and creation since no general algorithm can be derived from the information about a problem that generates its solution 'automatically'.
- Secondly, technological innovation has been able to draw from novel opportunities stemming from scientific advances (Dosi, 1988a). The second property is the increasing reliance of new, major technological opportunities on advances in scientific knowledge.
- Thirdly, the nature of the search activities leading to new products and processes has also changed. That is, the increasing complexity of research and an innovative activity militates in favour of formal organisations (firms' research and development facilities, universities, etc.).
- Fourthly, a significant amount of innovations and improvements are originated through 'learning-by-doing' and 'learning-by-using' (Rosenberg, 1976). People and organisations can learn how to use/improve/produce things by the process of doing them, through their 'informal' activities such as solving production problems.
- Finally, it is unlikely that the patterns of technological change can be described as simple and flexible reactions to changes in market conditions. Rather technical change is a *cumulative activity* (Dosi, 1988a).

Innovation can also occur through a process of variation and selection (Nelson and Winter, 1982). This is another important aspect of innovation where the technological developments play an important part in the process. It is argued (Arthur, 1988) that past technological developments leave a permanent mark on future developments. This is where technology plays a prominent role in creating the innovation. Arthur (1994) identifies four generic sources of increasing returns: (1) large set-up or fixed costs (which give the advantage of falling unit costs to increased output); (2) learning effects (which act to improve products or lower their cost as their prevalence increases); (3) coordination effects (which confer advantages to "going along" with other economic agents taking similar action); and (4) self-reinforcing expectations (where increased prevalence on the market enhances beliefs of further prevalence).

Given the increasing returns situation above, four interesting properties arise (Arthur, 1994).

(1) *Multiple equilibria*. In this problem, two different asymptotic market-share "solutions" are possible. The outcome is indeterminate; it is not unique and predictable.

(2) *Possible inefficiency*. If one technology is inherently "better" than the other (under some measure of economic welfare), but has "bad luck" in gaining early adherents, the eventual outcome may not be of maximum possible benefit.

(3) *Lock-in*. Once a "solution" is reached, it is difficult to exit.

(4) *Path dependence*. The early history of market shares – in part the consequence of small events and chance circumstances – can determine which solution prevails.

Further implication of the innovation is that diffusion (of any technology) always takes time. Dosi (1991) suggests that rates of diffusion plausibly depend on the followings: the features of those technologies which are to be adopted; the features of those technologies which are to be substituted; the incentives that the economic environment provides for adoption on the characteristics of the potential adopters; the information available to them; and their technological competence. The topic of diffusion is discussed in turn.

3.2.2 *Empirical patterns in the diffusion of new technology*

In the field of technology studies, the diffusion of a new technology is a widely-researched subject. The diffusion process is characterised by increases over time in both the number of firms using or owning a technology (inter-firm diffusion) and more incentives to use the technology by the firm (intra-firm diffusion) (Stoneman, 2002).

There are a number of characteristics of an innovation have been found to affect diffusion (Rogers, 1995, Tidd et al., 2005).

- *Relative advantage*: Relative advantage is the degree to which an innovation is perceived as better than the product it displaces, or competing products. In theory, the greater the perceived advantage, the faster the rate of adoption.
- *Compatibility*: Compatibility is the degree to which an innovation is perceived to be consistent with the existing values, experience and needs of potential adopters.
- *Complexity*: Complexity is the degree to which an innovation is perceived as being difficult to use. Innovations which require the adopter to develop new skills and knowledge will be diffused slower than innovations which are simpler for the adopter to use.

- *Trialability*: Trialability is the degree to which an innovation can be experimented with a limited basis.
- *Observability*: Observability is the degree to which the results of an innovation are visible to others.

The diffusion of an innovation is typically described by an S-shaped (logistic) curve. In general, the S-shaped curve is plotted using historical data. This historical data often reveals a period of time that technology diffuses. In general, technological diffusion time refers to the period from the date of first use of a technology to the date of approximately 90% use or ownership of this technology. This technological diffusion time may span anywhere from five to fifty years (Mansfield, 1968).

The classic observations with respect to diffusion refer to the inter-firm diffusion of new process technology (Stoneman, 2002). Griliches' (1957) work on the diffusion of hybrid corn in different states in the U.S. is an early example. Griliches (1957) observed that if one plotted the proportion of total corn acreage in a state *I* that is planted with a hybrid seed against time, then the resulting plot is usually found to be S-shaped. This S-shape suggests that the rate of using a new technology starts at a low level and, at first, increases slowly. The rate of increase then gets larger until a point of inflection, after which the level of use still increases but at a decreasing rate. Another example is Mansfield's (1968), which is a case of intra-firm diffusion. Table 3-1 presents Mansfield's (1968) data on the intra-firm diffusion of diesel locomotives in U.S. railroads. In this case, Mansfield finds that the intra-firm diffusion of technologies also follows an S-shaped curve.

Table 3-1 Dieselisation in the US railroads: time intervals between 10 and 90 per cent usage

Time interval (years)	Number of firms
14 or more	3
11-13	7
8-10	11
5-7	3
3-4	6

Source: Mansfield (1968)

It is commonly observed that during the diffusion process technologies become cheaper and/or improve in quality (Stoneman, 2002). Although it is hard to make a comparison due to the changing environment and economic conditions, some examples can be easily found, especially in the field of computers, microprocessors, and telecommunications. Stonemand and Toivanen (1997) illustrate this point using some quality-adjusted price series for computers and microprocessors in the UK. Table 3-2 shows their results.

Table 3-2 Quality-adjusted prices for computers and microprocessors in the UK, 1960-1992

Year	Computers (1972=100)	Microprocessors (1981=100)
1960	2088.2	n/a
1965	525.0	n/a
1970	177.9	n/a
1975	79.2	1093.2
1980	29.7	228.1
1985	26.5	32.0
1990	12.8	4.1
1992	6.6	1.9

Source: Stoneman and Toivanen (1997)

Stoneman (2002) deduces a number of empirical regularities relating to the diffusion process. Firstly, the diffusion of technology takes time, and often a considerable period of time. Diffusion rates differ across industries, regions, and countries and also across technologies. Secondly, the commonly found empirical regularity curve is S-shaped, illustrating a low initial rate of growth of ownership followed by faster rates up to a point of inflection after which rates of growth decline. Finally, as new technologies mature, they tend to exhibit both improved performance and reduced prices. The nature of the product may also change.

Moreover, considering the diffusion of innovation, there was a debate among economists, sociologists, and historians about theories of "science (or technology)-push" and "demand-pull" (Freeman, 1996). The role of demand in driving innovation is undoubtedly important and there have been numerous examples of inventions and innovations that were initiated and driven largely in response to pressing social demands. However, Mowery and Rosenberg (1979) show that empirical studies of innovation that were often cited in support of "demand-pull" did not justify these conclusions. They further resolve the discrepancy in the literature between "needs" and "demand" and between "potential demand" and "effective demand". Because human "needs" are varied and often unsatisfied for long periods, they cannot alone explain the emergence of particular innovations at a particular time. Thus, innovation should not be viewed as a linear process, whether led by demand or by technology, but as a complex interaction of potential users with new developments in science and technology.

3.2.3 *Product and process innovation*

One frequently made distinction is between product innovation and process innovation. This helps to shed some light on the motives for, and results of, certain kinds of technological advancements. Product and process innovations are not separated processes. Rather, 'innovation' is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention which leads to development, production, and marketing tasks striving for the commercial success of the invention (Freeman, 1991).

Utterback and Abernathy (1975) describe the iterative process of innovation as follows: "A basic idea underlying the proposed model of product innovation is that products will be developed over time in a predictable manner with initial emphasis on

product performance, then emphasis on product variety and later emphasis on product standardisation and costs." Moreover, product innovation and process innovation are interdependent; as the rate of product innovation decreases, it is common to observe a growing rate of process innovation (Utterback, 1994). Those patterns can be illustrated in Figure 3-1.

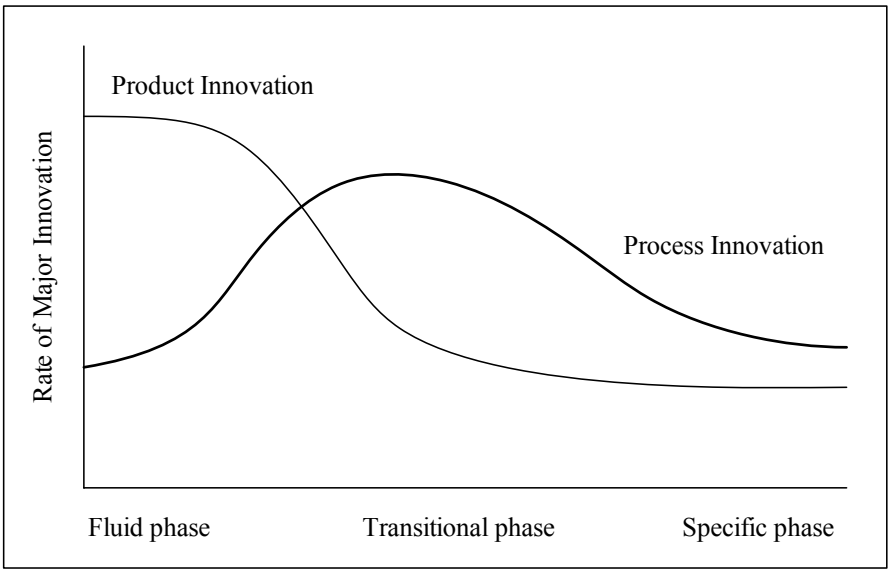


Figure 3-1 The dynamics of innovation
Source: Utterback (1994)

A product innovation is a new technology or combination of technologies introduced commercially to meet a user or a market need (Utterback and Abernathy, 1975). In this model Utterback and Abernathy (1975) describe that a firm at one time may attempt to be the first to introduce technically-advanced products (performance-maximising), or to watch others innovate but be prepared to adapt and introduce new product variations and features (sales-maximising), or to enter the market later in the product life cycle with simpler and less expensive versions (cost-minimising). In process innovation, as the production process develops over time toward levels of improved output productivity, it does so with a characteristic evolutionary pattern. For example, it becomes more capital intensive, and direct labour productivity improves through greater division of labour and specialisation. Productivity gains incrementally, some of which is stimulated by changes in the market, external to the firm (i.e. volume and product standardisation) and some of which arises from within the firm (Utterback and Abernathy, 1975).

The distinction between product and process innovation does not mean that these two are independent. Product and process innovation are interdependent. As the rate of product innovation decreases, it is common to observe a growing rate of process innovation.

In addition to the product and process innovation model, Utterback (1994) proposes the model of dynamics of innovation. His model focuses on the concept of product and process innovation, and also considers it in connection with business-oriented characteristics such as organisational change, market characteristics and competitive environments. Table 3-3 provides a summary of the model.

Table 3-3 The dynamics of innovation

Product	From high variety to dominant design, to incremental innovation on standardised products
Process	Manufacturing progresses from heavy reliance on skilled labour and general-purpose equipment to specialised equipment tended by low-skilled labour
Organisation	From entrepreneurial organic firm to hierarchical mechanistic firm with defined tasks and procedures and few rewards for radical innovation
Market	From fragmented and unstable with diverse products and rapid feedback to commodity-like with largely undifferentiated products
Competition	From many small firms with unique products to an oligopoly of firms with similar products

Source: Utterback (1994)

The table above needs more explanation. Not only do changes in products and processes occur in a systematic pattern, but organisational requirements may also be expected to vary according to a similar pattern. In the first stage, when there is a high technical uncertainty, a productive unit must be the focus in order to make successful progress. Individuals in the organisation must act together. This type of structure is called organic; it emphasises on frequent adjustment and redefinition of tasks, limited hierarchy, and high lateral communication (Utterback, 1994). This individual in the organic firm is related to their assumption of entrepreneurial roles. At later stages, a production process and a set of market relationships and expectations become highly developed with respect to a specified and standardised product. When the business environment is better known and operations become routine, it is seen as necessary to provide coordination that minimises inefficiency and costs in operations. This type of structure is known as mechanistic (Utterback, 1994).

Furthermore, the market characteristics also change during the period of innovation. When a technology is at the beginning period of its development and many producers are rushing to join the industry, the market shares of each firm are highly unstable. But when the technology is mature, products are likely to standardise and become undifferentiated in terms of function and features. Stable market shares will imply the existence of only a few significant and dominant producers. Market feedback will tend to be slow (Utterback, 1994).

As the process of decreasing product innovation and increasing process innovation moves forward, it is common to observe important changes in the competitive environment. In the early days of an industry, when products are unique in design and capabilities, competition focuses on winning over customers to the new technology embodied in an unrefined product. But when product capabilities and features are crystallised through the emergence of a dominant design, competition between rival firms stabilises. The number of competitors drops off quickly and the basis of competition shifts to refinements in product features, reliability, and cost. From this point, the competitive environment reaches a point of stability in which there are only a few firms producing standardised or slightly differentiated products. A number of small firms may remain in the industry serving specialised market segments, but compared with the small firms entering special segments early in the industry, they have little growth potential (Utterback, 1994).

The model of dynamics of innovation shows how the product innovation, process innovation, and other elements can play important roles in the way innovation succeeds in the market. Although the model is based on experiences in manufacturing

products, the idea is helpful to identify some similar characteristics of innovation in the public transport sector.

3.2.4 *Innovation in services*

Concerning the service sector, innovations have contributed to the growth in a number of service firms and to the scale of their operations, which in turn has increased their economic benefits (Aa and Elfring, 2002). Innovations provide opportunities to increase the efficiency and quality of the service delivery process.

Service sectors are of importance in a global economy. Output and employment in the service sectors have grown significantly throughout the industrial world, notably in Europe. Table 3-4 shows that as early as the 1970s, services represented more than half of the value added in European Union countries, and by the year 2001 they contributed nearly two-thirds.

Table 3-4 Share (%) of gross value added in services in total GDP in EU countries

	EC-9 (1973)	EC-10 (1981)	EC-12 (1986)	EC-15 (1995)	EC-15 (2001)
EC/EU	50.7	56.3	59.0	63.1	65.3
Ireland	44.5	49.4	50.4	48.6	49.0
Finland	n/a	49.8	53.0	56.4	57.1
Portugal	n/a	48.8	54.1	59.1	61.0
Austria	n/a	55.5	58.6	63.3	63.6
Denmark	58.8	60.9	60.3	64.0	64.0
Spain	47.8	57.3	58.0	63.7	64.2
Germany	48.1	54.2	55.9	62.5	64.9
Italy	51.1	56.4	60.6	62.8	64.9
Greece	40.3	47.7	48.9	62.6	65.4
Sweden	n/a	60.1	59.7	62.2	65.5
Netherlands	52.2	58.8	60.4	63.9	65.5
France	50.8	57.4	61.1	65.3	66.8
UK	54.7	54.5	57.1	62.1	67.2
Belgium	54.6	60.7	62.8	66.1	673.
Luxembourg	46.9	65.2	76.4	83.7	83.8

Source: Eurostat (2003)

In any economy, the service sectors are important for productivity, economic competitiveness, and quality of life (Miles, 2004). In other words, the service sectors are the great economic importance. But innovation in services is important for other reasons beyond the economy. Miles (2004) identifies two important aspects of the services innovation. First, innovation in services affects properties not only within the sector itself, but also other services activities. Second, some services play central roles in the innovation process. These roles are, among others, agents of transfer, innovation support, and sources of innovations for other sectors.

However, relatively few studies have focused on innovations in services (Aa and Elfring, 2002). Innovative developments in service industries seem to be difficult to explain in terms of traditional innovation theories and typologies (Damanpour, 1991).

The main emphasis of innovation research is on new products and production processes, especially in manufacturing. For example, the product and process innovations (Utterback, 1994) do not necessarily provide any deeper understanding of the factors responsible for the successful development of service innovations. Although it is known that service firms may innovate more or less in the same way as industrial firms, Sundbo et al. (2001) emphasise that innovations seem to be much less technologically driven and most of them are organisational or social in nature. Service firms have also been found to conduct very few research and development activities. Moreover, such innovations, if found, are usually somewhat unsystematic work of individuals in the firms. In other words, the innovation process is more informal in service than in manufacturing. Innovations in service firms also tend to be more driven, among other factors, by the market and by consumers (Sundbo et al., 2001).

3.2.5 *Innovative driving forces*

To understand an innovation process, it is also necessary to identify potential sources of innovative activities. However, we must realise that innovation involves complex interactions between a firm and its environment. Sundbo and Gallouj (1998) propose a model of the driving forces behind service innovations. In this model, there are external and internal driving forces. Table 3-5 shows the detail of each driving force.

Table 3-5 Driving forces behind service innovations

Internal	**External**	
	Actors	**Trajectories**
Management and strategy	Competitors	Technological
Innovation department and R&D	Customers	Services professional
Employees	Public sector	Managerial
	Suppliers	Institutional
		Social

Source: Sundbo & Gallouj (1998)

There are three internal forces: management and strategy; innovation department and research and development (R&D); and employees. Firstly, the management of the service firm often has a strategy or some idea of the direction the firm should take. The second driving force is formalised R&D departments or any other type of formalised department which has the responsibility for ensuring that innovations will appear. Since the innovation process in service is mostly a loosely coupled process in which the employees are involved, or they simply function as corporate entrepreneurs and start the process, they are the third internal driving force.

The external forces can be divided into external actors and trajectories. External actors can be either a person, firm or organisation whose behaviour has importance to the service firm's possibilities for selling services and therefore also their innovation activities (Sundbo and Gallouj, 1998). These external actors can be broadly categorised into four groups: customers, competitors, public sectors and suppliers. Customers are actors of major importance in service innovation since producing the service requires the customer's involvement. Competitors are also important for innovation activities since, in a competitive environment, service-providing firms have to compete with other firms who provide a similar type of service. The public sector also plays an important role, especially in a public transport sector where

government intervention is common. Suppliers are important sources of innovation since the service firm tends to be a technology adopter rather than the innovators per se.

Trajectories are ideas and logic that are diffused through the social system. There may be five types of trajectories. The first type is the service professional trajectories which are methods, general knowledge, and behaviour rules that exist within the different service professions. The second type is a managerial trajectory which is an idea for a new organisational form. The third type is technological trajectory which is a new logic for using technology that generally influences service products and production processes. The fourth type is the institutional trajectory which describes the general trend of the evolution of regulations and political institutions. The final type is the social trajectory which displays the evolutions of general social rules and conventions.

3.2.6 *The measurement of technological activity*

It is a complicated task to measure technological capability and innovation when we turn from methodological matter to the empirical world. Often we are forced to use approximate measures due to the lack of awareness to collect such data. Archibugi (1988) suggests four measurements of innovation that surface mainly at the aggregate level. The most frequently used in economic studies are: 1) statistics of research and development (R&D) in terms of personnel employed and of expenditure, 2) the technological balance of payments, 3) patent statistics, and 4) direct monitoring of innovations introduced.

Firstly, the widely used indicator in most research is the Research and Development (R&D) indicator. The data on R&D activities can be found in the official national statistic. This data enables us to identify the major, common and largely invariant features of technological activities in the industrially advanced countries. Patel and Pavitt (1995) outline that R&D is better at measuring technological activities in the science-based classes of technology (chemical and electrical-electronic) than in the production-based and information-based classes (mechanical and software).

Secondly, the Technology Balance of Payments (TBP) approach measures transactions between firms and sectors of different countries. Unlike R&D data, the TBP regards technology transfers with a commercial objective and thus excludes non-commercial inventive and innovative activities, such as the majority of those carried out by the public sector. However, the TBP, by definition, provides no indication of the amount of resources devoted to innovative activity but, at best, only of the amount of technological activity internationally transferred. In other words, all those technologies that are not the object of commercial transaction are excluded (Archibugi, 1988).

The third type of data on technological activity is a patent. Since it is a record of invention, many economists treat the patent as an intermediate output of R&D activities (Patel and Pavitt, 1995). Patent statistics are available in almost all industrialised countries and in many developing countries, broken down for very detailed technological sectors. However, Archibugi (1988) argues that unless patents are analysed individually, they provide no information about a specific sector's utilisation of an innovative activity.

Finally, it is also possible to monitor an innovation that is carried out directly. An important aspect of this data collection is the subject and method the survey adopts. There are two different ways on the basis of which innovation data can be collected (Archibugi, 1988). The first is in terms of innovations as objects. In this category, it is a matter of looking back to the sectors of production and utilisation from the available information regarding individual innovations. The second is to ask firms (and possibly other bodies involved in producing or utilising innovations), i.e. subjects, to indicate relevant innovations produced and/or used by them. The Organisation for Economic Co-operation and Development (OECD) has moved towards the standardisation of the survey methodology by proposing the Oslo manuals. The first version was issued in 1992 (OECD, 1992) and the second one in 1997 (OECD, 1997).

Due to the fact that the Oslo manual concentrates on creating an indicator for science and technology in the manufacturing industries, we still lack the measurement method for innovation in the service sector. Innovation in service sectors tends to involve both product and process innovation, which is hardly captured by this kind of data collection. The variety of the characteristics of service poses a difficult task for the measurement of innovation in this sector. Nevertheless, we will use some of the knowledge and experiences from the manufacturing sectors as a starting point.

3.2.7 *Measuring innovation activities in services*

The experience accumulated in measuring innovation in the manufacturing sector represents a good starting point for measuring innovation in services. However, it is unclear as to whether or not and to what extent the methodological and conceptual framework developed over the past decade with reference to manufacturing activities (notably the Oslo manual). Due to this ambiguity, utilising this information may or may not be constructive. Tether (2001) reveals that all of our understanding of innovation and of innovation processes at the micro level has been derived from studies of manufacturing. Services and service innovation were omitted from the Community Innovation Survey (CIS) which followed the Oslo manual in order to collect the innovation data in most countries, despite the fact that services account for roughly two-thirds of the Gross Domestic Product (GDP) and employment in Europe.

Evangelista and Sirilli (1998) have summarised a few distinctive features of services which are thought to bear important implications for innovations. Even though a general consensus on the basic features of services is lacking, some aspects are commonly recalled in the literature:

- A close interaction between production and consumption (co-terminality)
- A high information-intangible content of services products and processes
- An increasing role played by human resources as a key to competitive factors
- A critical role played by organisational factors for firms' performance

However, Tether (2001) argues that the CIS survey is based on the manufacturing discipline by expanding the Oslo manual, and the CIS embraces the service sector. As a result, survey for service is simply an adopted version of the manufacturing version, largely through the replacement of the word 'product' by the word 'service'. The revised Oslo manual (OECD, 1997) has effectively *assimilated* (Coombs and Miles, 2000) services into an approach to understanding innovation which is based on studies of manufacturers, and which centres on the product-process dichotomy.

Nevertheless, the second European Community Innovation Survey (CIS-2) reflects some new attitudes on innovation in the service industry. It provides the first internationally systematic data on services' technological innovation behaviour. Tether et al. (2002) found that services certainly do emerge as innovators – though slightly less so than manufacturing firms of comparable size. Moreover, large firms tended to report innovative activities more frequently, so that about three-quarters of firms with more than 250 employees had engaged in these activities. Within the CIS-2, Tether et al. (2001) establish that, using the data from the German case, the generally 'scale-intensive' sectors of trade, transport and communications as well as banking and insurance tend to be largely oriented towards the provision of standardised services. By contrast, in the 'specialist supplier' sectors of technical services and other financial services, university graduates constitute a much larger proportion of total employment, and firms in these sectors tend to earn a larger average proportion of their income from bespoke and partially customised services. This variation shows that even within the service sector there is the tremendous diversity that is repeatedly found. There are broad trends, which reflect the sectoral categorisations discussed earlier, but there is also immense variation in behaviour within each broad sector (Tether et al., 2001).

This reveals an attempt at measuring innovation in the service sector. It shows that the topic of innovation measurement is now attracting a lot of attention. In the sectoral comparison, it is essential that the measurement system will be generalised. The complexity of the innovation itself makes the measurement difficult.

The traditional innovation measurement seems to be ineffective as a means for measuring innovation in the public transport sector. The generalisation of the data measurement, such as R&D statistics, loses the richness of the information that is the essence to understanding innovation in a specific product. Archibugi (1988) suggests that it is also possible to assess specific products or research projects by utilising an exclusively sectoral approach. The main approaches are based on the theory of technometrics (Sahal, 1985). In contrast to the use of R&D statistics which measure at an aggregate level, this approach focuses on a measurement of technological advances from a specific set of technologies.

An important aspect for studying an innovation in a specific industry is the ability to analyse changes of components within an industry. One approach that is applicable here is the Twin Characteristics Approach (Saviotti and Metcalfe, 1984). This approach analyses innovation or changes in a specific sector in detail. It will be discussed in the next section.

3.3 A twin characteristics approach

The twin characteristics approach initiated by Saviotti and Metcalfe (1984) is a good starting point to represent the variety of technological developments of public transport services. The starting point of this approach is a characteristic description of a given technology. A product will then be defined in terms of a set of characteristics. At any point in time this set of characteristics defines the current state of technology, each characteristic having variable levels. In this approach, a product could be described as the combination of two sets of characteristics, called technical (X_i) and

service (Y_j) characteristics respectively. The two sets of characteristics are interrelated in that the purpose of technical characteristics is to provide services. This relationship is illustrated by a mapping pattern as shown in Figure 3-2. Moreover, the two sets of characteristics can be conceptualised as the inner structure (technical characteristics) and the interface (service characteristics) of the technological system and the interface or boundary of the system.

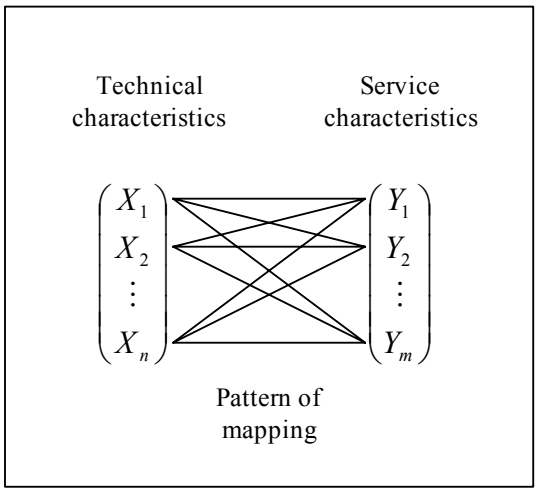


Figure 3-2 The twin characteristics
Source: Saviotti & Metcalfe (1984)

The twin characteristics approach has a number of relevant applications, since it allows us to distinguish between radical and incremental innovation, and to define elementary phenomena in technological evolution (Frenken et al., 1999). A radical innovation is one that gives rise to entirely new technical characteristics which need to be represented by different variables, whereas an incremental innovation is one which improves services without any qualitative change in internal structure or technical characteristics (Saviotti, 1996). To be more precise, the distinction between radical and incremental innovations corresponds to the relationship between qualitative and quantitative changes. A completely new technology differs from any previous one, at least in its technical characteristics, and possibly also in its service characteristics. In other words, a radical innovation leading to qualitative change needs to be represented in a new dimension of technical characteristics space. On the other hand, an incremental innovation will only lead to changes in the values of the existing characteristics (Saviotti, 2001).

This characteristics approach allows us to understand the process of innovation in any given system. The notion, developed by Saviotti and Metcalfe (1984), of the product (goods) as a combination of technical and service characteristics is now familiar in the economics of innovation and technical change (Gallouj, 2002). This approach is based on the evolutionary theory of economic change (Nelson and Winter, 1982).

In this approach, technical characteristics are components which produce the final services. In public transport services, the technical characteristics can be divided into three categories: basic inputs, technological compositions, and managerial and operational compositions. Basic inputs represent the general production requirements of the industry. For instance, to produce transport services, like any other businesses,

capital and labour are norms. Technological compositions represent the variety of transport technology used presently. This component will be useful when we explore technological innovation because it will help us to identify the differences and variety of technological development in a systematic way. Finally, managerial and operational compositions bring together the elements that are involved in the production of services in an indirect way. This may be called the competence (Gallouj and Weinstein, 1997), which represents the utilisation of basic inputs and technological compositions.

We will now augment this structure to characterise public transport services in more detail. The proposed framework is to divide the technical characteristics into two groups, namely technical and competence characteristics. This framework, which was originally proposed by Gallouj and Weinstein (1997), is more applicable within the service sector. The idea of introducing 'competence' is that the provision of a service is generally the result of a combination of the following two mechanisms: the utilisation of (tangible or intangible) technical characteristics that are themselves based on competences and the direct mobilisation of competences (Gallouj, 2002). Figure 3-3 shows the service characteristics (Y_i) as a combination of technical characteristics (T_i) and competences (C_i).

In this notion, a product (goods or service) is represented by a set of service characteristics (Y_i). These service characteristics are obtained by a certain subset of the technical characteristics (T_j), with each Y_i being obtained by a certain subset of the T_j. Similarly, each technical characteristic mobilises the competence C_k (certain competences may involve the ability to combine different technologies); in certain situations, those same competences may be mobilised directly to produce the product (Gallouj, 2002). These competences are derived from various sources: initial education, continued training, organisational learning, and experiences.

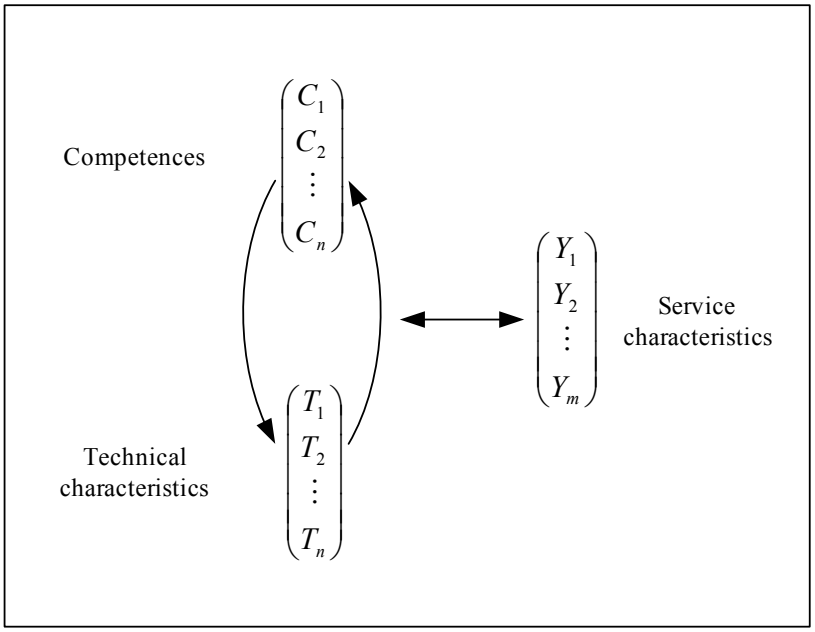


Figure 3-3 A representation of a product or service as a system of characteristics and competences
Source: Gallouj and Weinstein (1997)

For the public transport sector, Ongkittikul (2002) elaborates on the twin characteristics approach by using the simple twin characteristics framework which consists only technical and service characteristics. The modified framework reclassifies the technical characteristics (X_i) into two new groups: technical characteristic (T) and competence (C). For public transport services, the technical characteristic is a hardware component such as vehicle, infrastructure and propulsion systems. Competences refer to the managerial skills of operators running the public transport system. These skills include labour, organisational structure, and contractual arrangement. The public transport sector is a labour-intensive sector; the division of labour plays an important role. The competence for the labour component is to utilise the staff's activity to achieve high performance. Further, marketing and ticketing activities can also be considered as essential operator's competences. In recent years, it has been realised that the operation of public transport is not only a matter of transporting people, but also reaching and encouraging people to use public transport systems. To do this, many activities are required such as advertising and marketing campaigns. Finally, public transport operators normally face contractual arrangements with the public authority with the main concentration on subsidisation level. Contractual arrangements also include aspects such as subsidy, level of service requirement, and ownerships. Note that the service characteristics are similar to those described in the previous section. Figure 3-4 shows the new characteristics-based approach of public transport service.

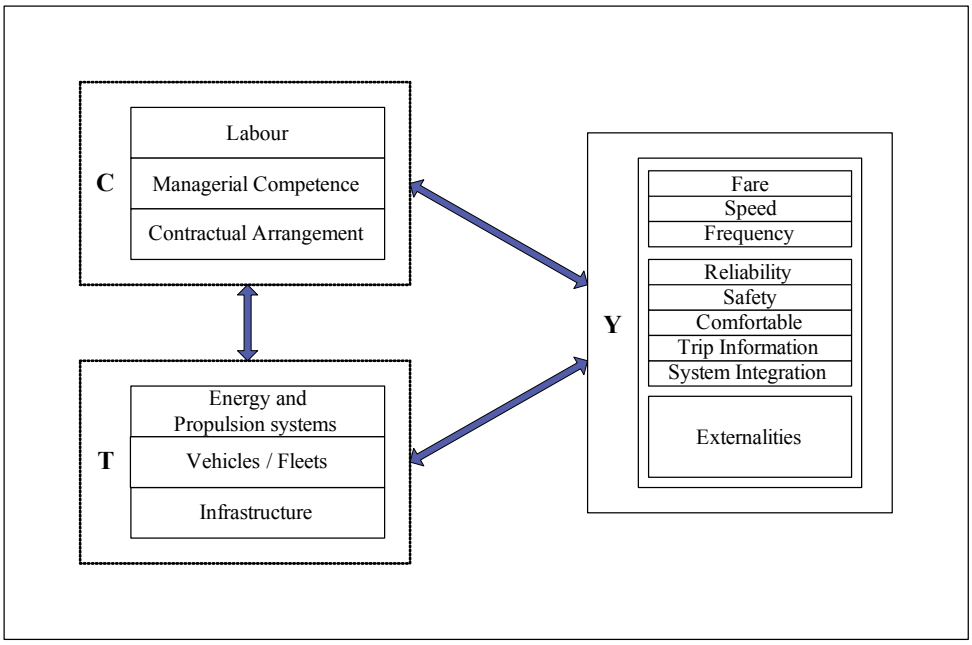


Figure 3-4 The characteristics-based approach of public transport service
Source: Developed from Gallouj and Weinstein (1997) and Ongkittikul (2002)

It is also useful to divide the production activity of public transport service into two main categories: core and supplementary activities. Core activities refer to the essential part of the service which the operator must carry out to fulfil the basic passenger needs. A core activity is the task of transporting people from an origin to a destination. This involves the operations of the coordination between vehicle, infrastructure, and driver. Supplementary activity refers to the other tasks that make

public transport more attractive to the users. This includes travel information services, marketing, and ticketing systems (see later in Figure 3-5).

3.4 Classification of innovation in public transport

Using the characteristics-based approach described above, innovation can be defined as any change affecting one or more terms of one or more vectors of characteristics (of whatever kind – service, technical or competence). However, we are concerned with not only technological changes, but also organisational innovations in all their tangible and intangible aspects. This notion can be adopted here to exploit the process of innovation in public transport service. Gallouj (2002) identifies six models of innovation, namely radical innovation, ameliorative innovation, incremental innovation, ad hoc innovation, recombination innovation, and objectifying or formulisation innovation.

- *Radical innovation*. It is the creation of a totally new product, i.e. one defined in terms of a system of characteristics and competences unconnected with those of an old product.
- *Improvement innovation*. According to the strictest definition, this type of innovation consists simply of improving certain characteristics, without any change to the structure of the system.
- *Incremental innovation (innovation by substitution or addition of characteristics)*. The general structure of the system remains the same, but the system is changed marginally through the addition of new elements to [T] and/or [Y] or through the substitution of elements.
- *Ad hoc innovation*. Ad hoc innovation can be defined, in general terms, as the interactive (social) construction of a solution to a particular problem posed by a given client.
- *Recombinative innovation*. Innovation of this kind exploits the possibilities opened up by new combinations of various final and technical characteristics, derived from an established stock of knowledge and a given technological trajectory.
- *Formalisation innovation*. This model consists of putting service characteristics 'into order', specifying them, making them less hazy, making them concrete, giving them a shape.

For innovation in public transport service, it is not necessary to employ all six models of innovation mentioned above. Rather, this study proposes the systematic classification of innovation into three categories: 1) service innovation, 2) pure technical innovation, and 3) competence development. This classification is described as follows.

3.4.1 *Service innovation*

Service characteristics play a central role in classifying innovation. Most innovations aim to improve (or, at least, not decrease) service characteristics. As a result, any change in service characteristics could be considered as innovation in this category. Thus, the two sub-categories suggested are endogenous service innovation and exogenous service innovation. The endogenous service innovation comes from any change in competences and/or technical characteristics whereas the exogenous service

innovation relates to any external force or constraint. In the endogenous category, two groups of innovation can be distinguished: (pure technical) innovation and competence development. These categories are described in more detail below. Secondly, the exogenous type includes the change caused by external factors. For instance, if the intervention of public authority forces every operator to provide standard travel information, this could also be considered a service innovation in this category. Figure 3-5 shows the classification of innovation in public transport.

3.4.2 *Pure technical innovation*

Pure technical innovation includes the changes in technical characteristics, for instance, change of propulsion, vehicle or infrastructure systems. This innovation may or may not require and/or affect any change in other characteristic groups. This could be the case for incremental or radical innovation of the systems. Thus, three sub-groups can be identified as follows:

- *Incremental innovation*: This innovation does not require any change in competence and service characteristics. For example, the use of new propulsion systems (e.g. natural gas) does not require a change of driver skill, and the services provided are nearly the same.
- *Componential innovation*: This innovation does require a development of new competence to acquire a new component. For example, a trolley bus may need a driver to develop his/her skill to operate. However, the service characteristics remain mostly unchanged.
- *System shift or radical innovation*: An introduction of a new system that requires the operator to develop new competences to handle such a new system, and it consequently brings about new service characteristics.

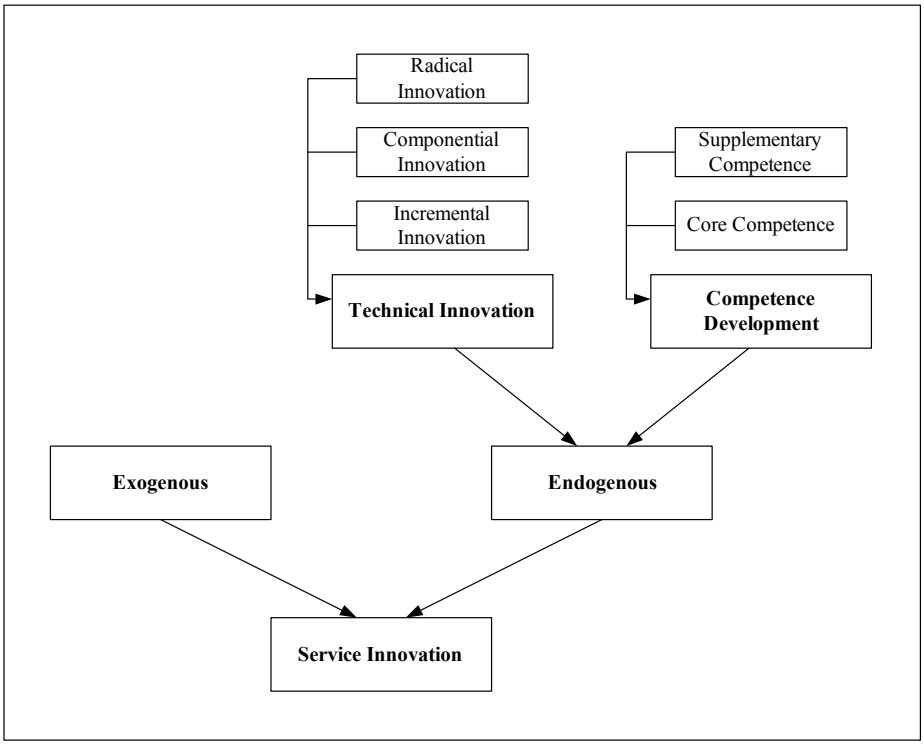


Figure 3-5 Classifying innovation in public transport

3.4.3 *Competence development*

At the firm level, there is a learning process that can be the result of competitive pressure or constraint from the industrial environment. Thus, innovation is required to maintain the position of the firm. This category entails both endogenous and exogenous forces on innovative activities. The development of competences could occur endogenously, such as managerial skills in the division of labour. A contractual arrangement is also an essential part of public transport service nowadays. The company's competence dealing with different kinds of contracts in different environments is also beneficial in this industry. The move toward regulatory reforms, such as liberalisation, deregulation or tendering makes this competence more important. Further, a firm could be forced to develop new competences due to an exogenous constraint such as a new regulatory framework or new technology. New technology in the competence development differs from the one used in pure technical innovation which focuses mainly on the improvement of main service characteristics, such as fare, speed, and frequency. New technology in competence development refers to other supplementary technology that can marginally improve the service characteristics. For instance, relaying travel information is a new technology that public transport firms have to develop. This innovation may or may not affect service characteristics.

This classification implies the aim of introducing such innovation. Technical innovation aims to improve technological elements toward better performance. In other words, given constraints in other dimensions, an improvement can be made through technical characteristics. The competences can be seen as organisational learning tasks. This mainly deals within the organisation of public transport operators. Finally, the service exogenous innovation may overlap both technical innovation and competence development. However, the overall aim of innovation is presented through service innovation which leads to the improvement of service attributes.

3.5 A concept of innovation in public transport: from theory to practice

It is always difficult when one wants to bring theory into practice. Innovation is a complex system where elements within the systems are connected and interdependent. The classification developed in the previous section aims at decomposing the elements of innovation in the public transport system. However, when we look at 'innovation', as we defined, in the real world, the variety seems more complicated than any framework could fully describe.

The classification analyses the public transport services as a system. However, when we look at the public transport sector, the organisation of the public transport plays a very important role in the innovation process. This section integrated the organisational element into the classification of innovation in public transport. Furthermore, the regulatory elements corresponding to the organisation can be integrated as well. This allows us to study the relationship between regulatory change and innovation.

The concept of innovation in public transport introduced here is divided into two parts. First, this section introduces the innovative capability of public transport

system (Ongkittikul, 2004a). Second, the subject of innovation and diffusion are discussed. These two aspects are crucial to understanding the meaning of innovation in public transport throughout this thesis.

3.5.1 *Sources and procedures of innovation in public transport*

Innovation is a knowledge cumulative process where each actor in the system assumes to be a knowledge processor. The actors process the available information and decide the course of action. This exemplifies the close relationship between source and procedures in innovation processes because the actors perceive the information (source) and then take an action (procedure). In the course of action, the outcomes are available as information, and actors would decide the course of action again, as a repetition process.

The public transport policy also follows this mechanism. Therefore, it is useful to determine the sources and procedures of innovation in public transport, namely demand, increasing returns, and regulatory reforms.

Demand is a classic source of innovation. The demand of public transport service is based on two principles: user demand and public authority demand. The user demand could be seen as passenger needs that stem from travel demand. The need for travel can be fulfilled by the service that is available at that time. The authority demand is that the service fulfils the social interest, i.e. the service to an area that does not have enough user demand but it is essential to supply the service anyway. The mechanism of these demands is complicated and can hardly be defined. However, it is helpful to realise that the demand for public transport comes not only from travel demand, but also from public interest.

Both increasing returns and path dependence were presented in a public transport context. Gifford (2003) gives an example of increasing returns in the context of urban transportation. Firstly, an example of economies of scale and scope (large set-up or fixed costs) is route redundancy in a dense network. A large provider can efficiently support multiple routes in a particular region. Secondly, learning affects urban transportation. For instance, routine operation of public transport service would provide cumulative knowledge that the operator can use to reduce costs in the long term. Thirdly, coordination effects in urban transportation are widespread, such as the use of new technologies that offer greater benefits as the number of users increase. Finally, the adaptive expectations (self-reinforcing expectations) include the irreversibility or quasi-irreversibility of particular decisions such as a road or location of infrastructure.

It is believed that competition, through regulatory reforms, would create innovation. Regulation is seen as a constraint of innovation and its reform has probably induced some changes to the system. This source of innovation relies on the two previous sources. The process of evolution occurs because there is a demand for change, either from user or government. It then searches for the possibility of facilitating the existing or available technologies. Consequently, regulatory reform is needed for adopting the new technology (or innovation).

3.5.2 *Innovative capability of the public transport system*

The classification given in Section 3.4 can be translated to more operational categories. This chapter classifies the innovative capabilities of the public transport system into three categories, namely, innovative capabilities related to 1) infrastructure, 2) vehicle, and 3) service operation. Figure 3-6 shows examples of innovations according to this classification of innovative capabilities.

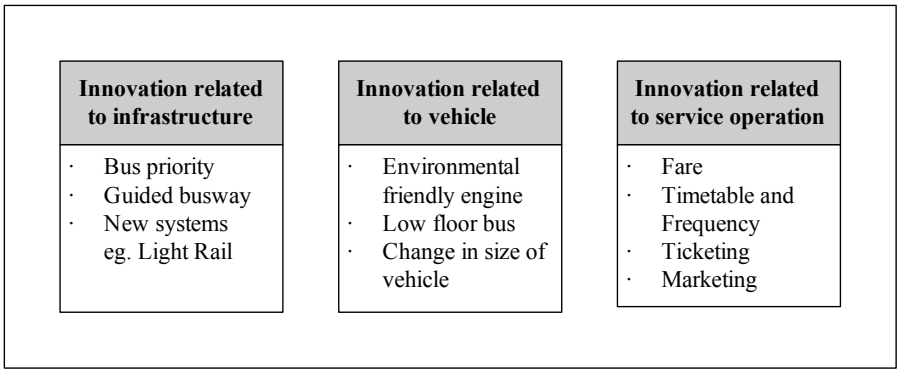


Figure 3-6 Examples of innovations with respect to innovative capabilities in the bus industry
Source: Ongkittikul (2004a)

This innovative capability is considered as a tool kit to examine innovation in the public transport industry. It is based on the classification in Section 3.4 in the sense that the innovation classification presents several overlaps in terms of the responsibility between the actors involved in public transport services. This innovative capability attempts to cluster the technological fields of each actor involved and elaborate the characteristic approach in a practical and operational manner. We can see the relevance between the classification in Section 3.4 and this innovative capability approach. Clearly, most innovation dictates that both technical capability and competence development be implemented. However, the level of capabilities can vary dependent on the type of innovation. The innovation in vehicle and infrastructure may require considerable knowledge and resources in order to implement the innovation. This clearly necessitates technical capabilities. Yet, soft innovation (such as fare, ticketing, and marketing) requires managerial skills to operate properly. This is the sort of competence development in our interest.

Regulatory reform also plays a crucial role in the innovative capability of the public transport system. The important implication here is that there are more roles for private operators in providing public transport services. Private operator participation is possible because of the introduction of competition in the sector. It is common now to observe a separate role between public authority and private operator. The former is more engaged at the policy and planning level, whereas the latter is more involved at the operation level. However, what we are interested in here is how these two actors differ in innovative capability. It is obvious that public authority has a high level of participation in infrastructure, which in turn reflects its innovative capability. For example, bus priority or guided busways are usually introduced by public authority. On the other hand, operators tend to be more active on the operation side, such as innovation in timetable or marketing ideas. Figure 3-7 shows a simple map of such a level of participation of public authority and operator.

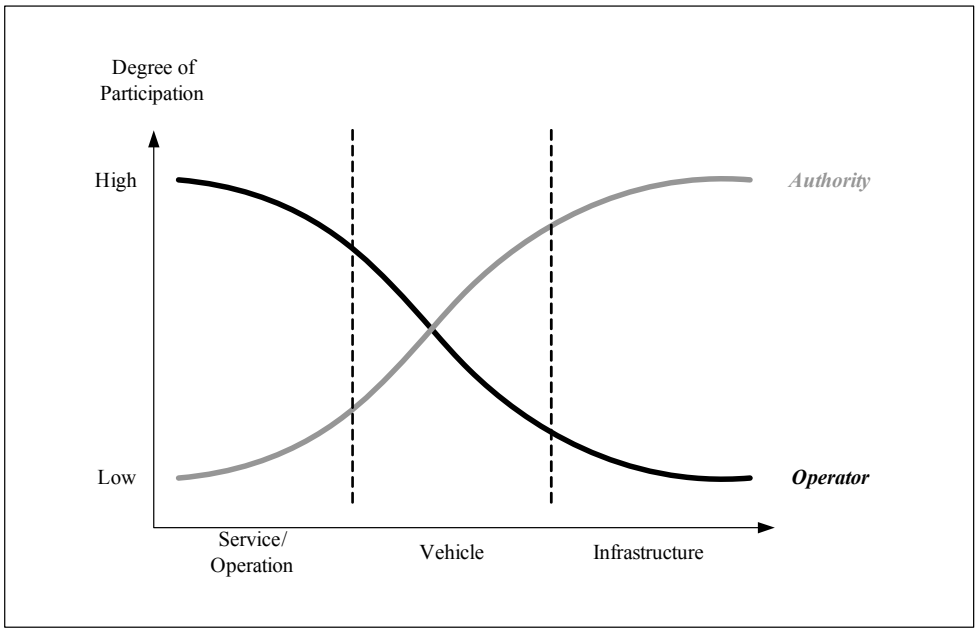


Figure 3-7 Level of participation of authority and operator

The authority and operators have different innovative capabilities in each aspect. It is remarkable to see how these responsibilities (which imply innovative capabilities of actors) change during the course of regulatory reforms. The comparison of these innovative capabilities' changes would enable us to analyse the effects of regulatory reforms with respect to innovation. The distinction between potential and practical innovative capabilities is noteworthy here. Potential innovative capabilities are the (ideal) capabilities that should happen whereas practical innovative capabilities are, generally, what actually happened. It is always the case that one regulatory regime that aims to improve the services turns out not to be successful as the result of potential innovative capabilities which are not fully materialised. This could be derived from the fact that incentives are not encouraging enough for organisations to do so.

The important aspect of innovative capabilities is not only based on the innovation per se, but also on the decision-making process in the organisation. The most pertinent factor now is the regulatory reform which results in the behavioural changes of decision-making units of public transport organisations. This aspect will be discussed in detail in Chapter 4.

It must be noted that the authority-operator relationship presented in this innovative capability model is rather abstract as the relationship within public transport industry is very complicated and often involves more than these two stakeholders. For instance, local authority is usually influenced by central government or, even within local authority the public transport section would be affected by the way of traffic management works on the normal traffic on the road. Another example is that of the railways where there is an infrastructure company responsible for infrastructure management, which is inevitably connected to the public transport operator. But the merit of understanding this innovative capability leads to the realisation of a limited scope of the regulatory reforms in public transport, especially in tendering for bus or

railway concessions. The full analysis of innovative capabilities of buses and railways will be given in the case studies demonstrated later in this thesis (Chapter 7 for bus cases and Chapter 8 for railway cases).

3.5.3 *Innovation and diffusion*

This chapter establishes a framework whereby the changes within the public transport system can be identified, thus innovation can be realised explicitly. However, two dimensions are not explicitly considered in this framework. The first one is the timing of innovation in relation to government intervention. The second is the spatial factor. The spatial factor is directly related to the element of something being 'new to the market'. The difficult question here is how to draw market boundaries as the public transport market evolves rapidly. For example, the low floor bus used in one area may be considered innovation if it is introduced in another area. However, the idea of using a low floor bus to enhance accessibility is not new anymore. The merit of innovation is lost. This would suggest that this innovation has reached to the diffusion phase.

The view of innovation and diffusion is in line with the classic linear model invention-innovation-diffusion of Schumpeter. However, the process of invention and innovation in the service industry are very closely related. Especially in public transport, the process of invention and innovation are merely the same, as most new ideas must first be examined by public authority in order to be implemented. But once it becomes commercially possible and socially acceptable, the innovation enters the diffusion phase as the risk associated with the uncertainty of the innovation is reduced. An excellent example of the distinction between innovation and diffusion is the low floor bus and the cleaner bus engine. In the Netherlands, both types of innovation were introduced. The low floor bus is now in the diffusing stage as more low floor buses are being used, thanks to the tendering process in local transport. In contrast, the cleaner-engine bus has hardly been implemented due to the high cost of the system in terms of both vehicle and supporting infrastructure. The cleaner-engine buses may perhaps reach the diffusion process one day. Here, we regularly observe government intervention in terms of regulation in the transition phase between innovation and diffusion. If the intervention is at the early stage of innovation, this may be called a technology-forcing policy. However, a problem still arises because the government may not have all the information regarding a specific innovation and the effects associated with it. So, the question is twofold: whether government should intervene at all and, if so, when the government should intervene. Although these questions are not the main topic covered in this thesis, the answers can provide some useful information about the effects of regulatory reforms on innovation. In fact, we can see this process as an interactive process.

It is useful to locate where the innovation is positioned in time and space. This refers to what stage the innovation is in and where it is heading. In practice, three levels can be identified regarding how new it is to the public transport sector. Level I contains an innovation that is new to the industry. Often the technological advances have been proven in other sectors before being introduced into a new sector. For example, the cleaner-engine is likely to be used in passenger cars before being introduced into the buses. Level II includes an innovation that is new to the country. The boundary of the country is likely to bond some common characteristics, especially the regulatory features. Finally, Level III incorporates those aspects at the micro-level, i.e. this

innovation is new to the area. This level involves a diffusion of the establishing innovation. Table 3-6 summarises the definition and characters of each level.

Table 3-6 Definition of innovation Level I, II, and III

	Characteristics	Risk and Uncertainty	Diffusion Patterns
Innovation Level I	New to the industry	Very high, both cost and demand	Diffusion is at an early stage: very low pace
Innovation Level II	New to the country	Risk about cost is reduced: demand is still uncertain	Can be diffused more rapidly when conditions are right
Innovation Level III	New to the area	Risk in cost is minimal: demand is likely to be predictable	A successful innovation diffuses at full pace

The innovation in Level I is normally a demonstration project. Some are successful whereas many have failed. Examples in this category are the hydro-fuel buses and the Maglev train. These technologies are very new. Although they have a lot of potential for the public transport market in the future, the cost and the associated knowledge in this technology seems not yet mature enough to be used at a larger scale. The innovation in Level II involves less radical elements. The technological advancement in this category is proven elsewhere but the implementation can be difficult as the conditions in each country differ. An example in this case could be the European train traffic management system. The technology is there, but the implementation can be difficult as the risk of implementation is still high. However, the technology can be diffused quickly if there is a proper incentive for the diffusion, such as a regulatory regime or a good funding mechanism. The innovation in Level III is at the diffusion stage. An example in this category is the diffusion of the low floor buses or the use of catalytic converters.

It is unlikely that regulatory reform will create the innovation demonstrated in Level I in the short term. We would expect that the regulatory reform may induce or deter the innovation in Levels II and III as it can create an incentive for authority or an operator to implement any innovation. However, if we ask whether the regulatory reform affects innovation in each level, the answer is different. The regulatory reform that changes the structure of the industry affects innovation at all levels.

3.6 The implication of innovative capabilities

This chapter explains the foundation of the concept of innovation for the public transport sector. It is clear that identifying and classifying innovation is a difficult task given the multidisciplinary characteristics and various elements involved. The essential perspective is to judge innovation in a broader view. Furthermore, we have to look at innovation as a *process*. This chapter provides an analytical framework that concentrates particularly on the innovation process.

There are many scholars who pay attention to the theory of innovation. An important contribution in studying innovation theory is the work of Schumpeter (1939). His model postulates the adoption process of new technology into three stages: invention, innovation, and diffusion. Based on the Schumpeter's idea, Nelson and Winter (1982) propose that innovation can occur through a process of variation and selection. Dosi (1988a) elaborates on this work when he suggests that the innovation should be

based on various disciplinary theories. Not only is innovation itself important, but he stresses the relevance of studying the process of innovation as well, and he identifies unique characteristics in the process, such as routines and the need for a paradigm shift. Nelson, Winter and Dosi's approach is widely known as the evolutionary theory of technology dynamics. In addition to this, Arthur (1988) argues that past technological developments leave a permanent mark on future developments. But he stresses the relevance of the diffusion process as a research subject. This phenomenon is called a path dependency. Finally, he observes a typical pattern in the diffusion of innovation, described as an S-shaped curve.

Another important concept is the product and process innovation by Utterback and Abernathy (1975). They describe the product and process innovation as an iterative process, i.e. products will be developed over time in a predictable manner with initial emphasis on product performance, followed by an emphasis on product variety and later an emphasis on product standardisation and costs. Furthermore, they identify in the innovation process many variables that are of relevance: product, process, organisation, market, and competition. So, there is no causal relationship between the process of innovation and diffusion.

We are interested in the public transport sector, which can be characterised as a service sector. The innovation in this sector is different from the manufacturing sector, traditionally studied in the discipline of technology dynamics. To understand an innovation process in the service sector, we need to identify the driving forces behind service innovation, namely the so-called internal and external forces. Internal forces are management and strategy aspects related to innovation, and research and development and employees interests. External forces are those from external actors and trajectories, such as legislation and market developments. The innovative driving forces relate to the way we measure and classify innovation. These driving forces then reflect the needs for improvement of the service that the system provided. However, we need first to find a common understanding in terms of what kind of improvements or changes could be called innovation. Therefore, the next challenging task is to classify and measure innovation in the public transport sector.

Innovation in public transport is systematically identified in this chapter. We adopt a broader perspective of innovation which covers both technological and organisational aspects of innovative activities. Innovation in the public transport services is in this study characterised as the twin characteristics approach. This approach defines the public transport services as the result of three sets of characteristics: technical characteristics, competence, and service characteristics. Using this approach, the innovation can be classified into three groups: service innovation, pure technical innovation, and competence development. Within these three groups of innovation, we classify the innovative capabilities of the public transport system into three categories, namely, innovative capabilities related to 1) infrastructure, 2) vehicle, and 3) service operation. These innovative capabilities can be utilised as a guideline for analysing the innovation process in the public transport sector.

Furthermore, we can also analyse the innovation and diffusion process in the public transport sector. We define three levels of innovation to locate where the innovation is positioned in time and space. Level I includes an innovation that is new to the industry. Often, the technological advances have been proven in other sectors before

they are introduced into a new sector. Level II includes an innovation that is new to the country. The boundary of the country is likely to bond some common characteristics. Level III incorporates those aspects at the micro-level, i.e. this innovation is new to the area. This level involves a diffusion of the establishing innovation.

However, there is still a missing link for this thesis. The question that remains is what kinds of driving forces and incentives are important for innovation in public transport. To understand this process, we need a framework to understand the learning process that develops the innovative capability of public transport organisations.

So far we have discussed little about the role of regulatory reform in the innovation process, which is a dominant development of the current public transport policies. Regulatory reform affects the innovative capabilities as it changes the institutional and organisational structure of the public transport sector. The innovative capability approach we discussed in this chapter concentrates on the internal structure of the public transport characteristics, i.e. technical characteristics, competence development, and service characteristics. Although the driving force of the change in characteristics may occur from driving forces within the system, such as the need for better quality of services, external factors can affect the change in characteristics in various ways. We can see regulatory reform as the external factor that triggers the changes of characteristics which in turn lead to innovation. Overall, it can be concluded that the process of innovation and diffusion is a complex system. Still, some major factors can be identified that help to understand the innovation process (ex-post) but, more importantly, some factors can even help contribute to make an R&D policy in the service industry possible (ex-ante).

Chapter 4 Institutional and Organisational Changes of Public Transport Systems

4.1 Introduction

The public transport industry's environment is evolving. In Europe, the public transport sector which is rapidly changing affects both the institution and organisation of public transport. The general trend of the sector is an increase in the participation of the private sector, both in operation and in infrastructure management. The increase in participation derives mainly from the regulatory reforms of public transport through liberalisation, privatisation, and deregulation. However, there is a strong link between technological and organisational developments in the public transport industry. We discussed in Chapter 3 that an innovation involves both technological and organisational developments in order to be successful; the technological element was discussed extensively in Chapter 3. In this chapter, we mainly focus on the latter, the organisational developments, which include both institutional and organisational aspects of public transport.

In public transport, regulatory reform has a profound effect on both institutional and organisational aspects. The definition of institution and organisation by North (1990b, 1994) is that institutions are the rules of the game in a society or, more formally, are humanly devised constraints that shape human interaction; organisations are groups of individuals bound by some common purpose to achieve objectives. Most public transport services are provided according to certain rules or regulations which can be regarded as an institutional setting. In this respect, the regulatory framework is an institution and any regulatory reform is an institutional change. The competition that is introduced in the sector changes the structure of the public transport firm as well. When this occurs, the objective of the organisation is changed. For instance, the social welfare maximisation in public transport that is owned by public authority will convert to profit maximisation when it is privatised.

This thesis focuses on the innovation element of public transport under this regulatory setting. The objective of this chapter is twofold. First, the theoretical background on the subject of regulatory change is provided. Second, the conceptual framework is developed to analyse the effects of regulatory reform on innovation in the public transport sector.

The organisation of this chapter is as follows. The chapter begins with an outline of regulation in the public transport sector in Section 4.2. Then, Section 4.3 explains the evolutionary economics perspective. Section 4.4 introduces a new perspective on institutional and organisational aspects for innovation and regulatory reform. Section 4.5 compares the conventional approach to the evolutionary economics approach.

Section 4.6 introduces a concept of dynamic capabilities and proposes a conceptual framework for analysing the effect of regulation on innovation. Finally, Section 4.7 summarises the theoretical issue and proposes an implication of this chapter used as the basis for the analytical framework of this thesis.

4.2 Regulation of public transport

The policy in public utility sectors is dominated by the theory of economic regulation which indicates that regulation is needed when an industry is a natural monopolist. The rationale among economists is that, in such an industry, the firm would produce consumer goods with a decreasing cost function. Without regulation, such firms would expand their production in order to get the lowest unit cost. This would lead to a situation where the firm that has the lowest unit cost would dominate the market. Having eliminated all competitors, the monopolistic firm would then enjoy supernormal profits. In this situation, consumers would suffer from the price set by this firm. Therefore, regulation is essential in preventing the market from the formation of a monopoly.

The public transport sector is one of the many types of public utilities. The public transport market is usually subject to some types of regulation, but its form, purpose, and subject of this can vary widely. In general, Nash (1982) identifies two reasons as to why regulation is necessary: ensuring safety and the prevention of 'wasteful' competition[1]. In a broader perspective, Button and Keeler (1993) define social regulation (where the safety aspect belongs) and economic regulation (where wasteful competition concerns belong). The former involves such things as passenger safety, environmental controls (i.e. safety to non-user) and operator qualifications, while the latter relates to a more economic aspect which has control over such matters as rates, fares, number of suppliers, and permissible routings.

The most important driving force of government intervention in the public transport markets is market failure. Under competitive conditions, the market may not be able to allocate its resources efficiently. This occurs for two reasons (Nash, 1982). Firstly, the market may be operating in a monopolistic competition. The theory of monopoly assumes that an industry has high sunk costs and that the existing firms would operate at minimum average costs. When this happens, a new entry is deterred and the monopolistic firm would set a price above the normal rate of profit. Secondly, it is possible that, in some circumstances, a new entry does occur; the outcome is likely to be wasteful competition. The theory assumes that the operating firms face the same technological constraints, thus a new firm could not offer a radical service improvement. This means that the new firm is likely to simply duplicate an existing service focusing on both price and quality aspects. Given the situation that an incumbent firm supplies an adequate capacity according to existing demand, the excessive service from the new entry would be considered wasteful.

[1] 'Wasteful' competition is a situation where competition may lead to the decrease of average loads (a number of passengers per vehicle) from a number of firms that operate duplicated services, hence the raising of unit costs. Even if competition is strong enough to eliminate any excess profits, the resulting equilibrium will be a monopolistic competition one of excess capacity and unnecessarily high unit costs (Nash, 1982).

A number of sources of market failure can be identified, namely externalities, public goods, natural monopoly, and imperfect information (Berechman, 1993). Firstly, externalities occur when the production or consumption of an economic agent does not reflect its true costs. Common cases of negative externalities are traffic congestion and air pollution from road traffic. Secondly, a public good is when one's consumption is not excludable and is nonrival, where one party's use of the good does not diminish another's access to it or benefit from it. Mackie (2001) argues that bus travel is clearly not a public good because non-paying customers can be excluded from the system. However, the provision of maintenance, in practice, is defined as a public good. Thirdly, a natural monopoly occurs only under certain conditions of scale economies. Under these conditions, only one monopolistic firm can dominate the market with the lowest production costs given the market demand. Finally, imperfect information occurs when information is costly which leads to high uncertainties and incorrect market decisions.

In a market failure situation, the economic theory suggests that some forms of regulation are needed to resolve the problem. Berechman (1993) reveals that the most predominant forms of public transport regulation are quantity, fare, and entry and exit. Quantity regulation, which defines the amount of services to be produced and their spatial allotment, essentially constitutes a minimum level constraint on total output and on its major attributes, such as frequency. Fare regulation is primarily manifested by a ubiquitous, highly uniform fare structure which is largely independent of the actual long-run marginal costs of service provision. While reasons for this fare structure have theoretical and practical explanations, the implications, not surprisingly, are harmful for the financial standing and efficiency of public transport firms. Finally, entry and exit regulation essentially bans new suppliers from directly competing with existing monopoly public transport firms. Thus, with respect to the organisation of public transport markets and the provision of new or innovative services, this type of regulation is most significant (Berechman, 1993).

However, there were critics who questioned the regulation theory between the 1960s and 1970s. Button and Keeler (1993) reveal that there were theoretical developments in economics, namely the Chicago models for regulation (Stigler, 1971), and the contestability theory (Baulmal et al., 1982). The Chicago models postulate that the public interest is not necessarily served by regulation. The contestability theory states that with sufficiently easy entry and exit in the market (no sunk costs and lags in matching price cuts), even a natural monopoly could have a zero-profit, competitive outcome. In sum, Button and Keeler (1993) reveal that the impetus against regulation came from two sources: an inherent scepticism of price and entry controls in industries, not natural monopolies, and evidence from various sources that a free market in transport would work more efficiently than a regulated one.

In the public transport markets, the case against regulation is also prevalent. Tight regulation prevents competition in the sector. The policy development partly follows the theoretical developments discussed above. Concurrently, the force toward a deregulation regime is partly due to the political pressure. These political drives lead to a decline in public transport use and an increase in subsidy level. The combination of the ideology of deregulation (theoretical driven) and financial difficulties (political driven) has driven the public transport systems in the past two decades.

There are differences in detail and approach in the ways countries have organised and regulated their public transport services. Velde (1999) makes a useful distinction, regarding organisation forms in public transport, between systems in which the rights of initiative are rested in the (public) authority and those in which the rights of initiative are rested in the market (see Figure 4-1).

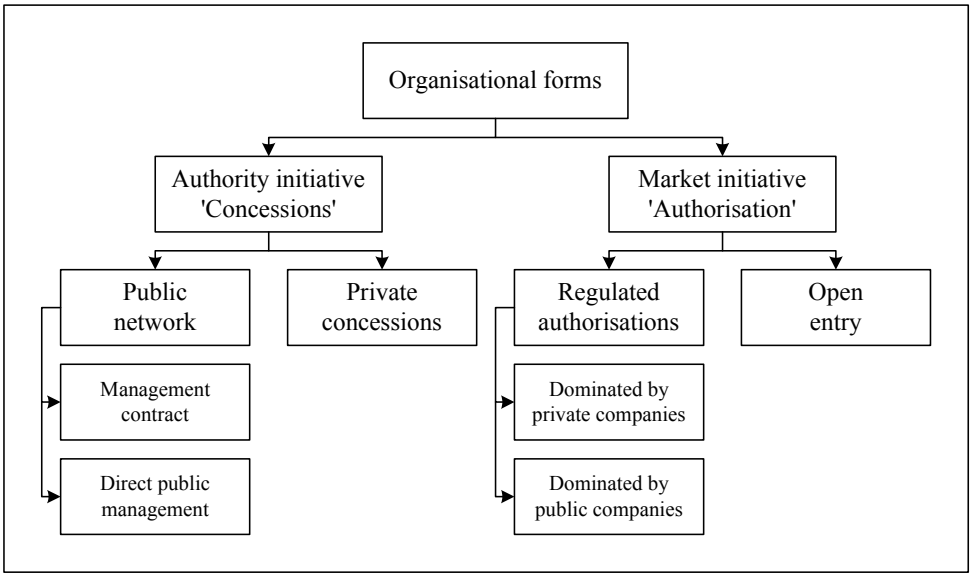


Figure 4-1 Organisational forms in public transport
Source: Velde (1999)

Elaborating on this distinction, Preston (2001a) proposes a simplified classification of three broad types of regulatory and organisational structure in public transport usually found in European countries. The first category is regulated, public-owned monopolies ('the classic model'). This model follows the theory of regulation in that intervention is necessary in order to serve the public interest. The second is limited competition models. These models follow the argument of Demsetz (1968) in that, even though there is evidence of a natural monopoly in a sector, this does not preclude the possibility of having a number of bidders when exclusive operational rights can be given. The final category is deregulated, free-market models. These models reject the theory of regulation and argue that the free market regime is more efficient.

The evolution of regulatory framework is an incremental process resulting from the extensive interaction between theoretical developments and empirical evidence during the course of its reforms. As we discussed above, the interaction between the public interest theory of regulation and the case against regulation (i.e. the Chicago models and the contestability theory) created policy implementations in several public sectors. These cases were then assessed and the new features were elaborated as interactive processes that created a new thought in theoretical points of view.

Regulatory reform is a process of change. From a theoretical point of view, economics plays an important part in analysing the effects of regulation in public transport. Moreover, it plays a part in helping the decision-making required to design the regulatory framework. However, once regulatory reform takes place, the effects of the reform are not fully explained purely by economic analysis. The reasons might

be that the behaviours of actors are not well understood, or that there is uncertainty in the reform process.

4.3 Evolutionary economics perspective

4.3.1 *Critics of mainstream theory*

The study of regulatory reforms is a study of a change process. Generally, the economy of regulation gives us an idea of how to control the market to ensure maximum efficiency, or in other words, eliminate wasteful competition. However, there is a drawback, and that is that the economic approach of institutions to design is focused on outcome rather than on analysing the process; it does not adopt a dynamic approach to institutional growth and change (Willman et al., 2003).

Past research shows that regulatory reform affects the industry structure in several aspects. However, this research tends to compare the before and after effects of regulatory reform rather than actually analyse the reform process. For instance, it states that deregulation in the UK brought the reduction in operating cost to around 40%. This is a comparison of the situation between t_1 and t_2 (see Figure 4-2). What is noteworthy is the evolving process between these two periods.

This study of regulatory designs is based mostly on two economic disciplines, namely welfare economics and industrial organisation theories. In the welfare economic approach, it assumes a free market condition where the agents in the system would maximise their interests. In the industrial organisation approach, it decomposes a market into the *structure*, *conduct*, and *performance* of the market (Shy, 1995). Structure signifies how sellers interact with other sellers, buyers, and potential entrants. Market structure also defines the product in terms of the potential number of variants in which the product can be produced. Market conduct refers to the behaviour of the firms in a given market structure, that is, how firms determine their price policy, sales, and promotion. Finally, performance refers to the welfare aspect of the market interaction. In other words, to determine performance we measure whether the interaction in the market leads to a desired outcome, or whether a failure occurs that requires the intervention of the regulator.

The orthodox[2] economic approach to the design and operation of regulatory systems is prescriptive in the specific sense that the operation of regulatory institutions is judged in terms of their ability to ensure certain outcomes (Willman et al., 2003). Most commonly, the regulatory systems aim to, first, secure the efficient provision of services to consumers at a minimum price, while second, attract private investment by allowing a reasonable rate of return (Stern and Holder, 1999). Furthermore, Nooteboom (2000) emphasises that while economics tend to focus on equilibrium outcomes, management scholars must pay attention to processes because it is their task to provide a basis for intervention. One can only intervene in processes, not outcomes.

[2] The term '*orthodox*' is used by Nelson and Winter (1982). Nooteboom (2000) uses '*mainstream*' to represent the similar meaning. He describes this term as neoclassical or neoWalrasian economics. The term neoclassic economics is also used by Gifford (2003).

Thus, orthodox neoclassical economics studies the following principles: (1) equilibrium outcomes in (2) connected markets, based on (3) rational choice by (4) autonomous agents. In contrast, the studies of evolutionary economics is interested in its virtual antithesis: (1) out of equilibrium process in (2) markets and organisations with significant transaction costs, under (3) conditions of radical uncertainty and bounded rationality, with (4) meaning and knowledge arising from interaction between people (Nooteboom, 2000).

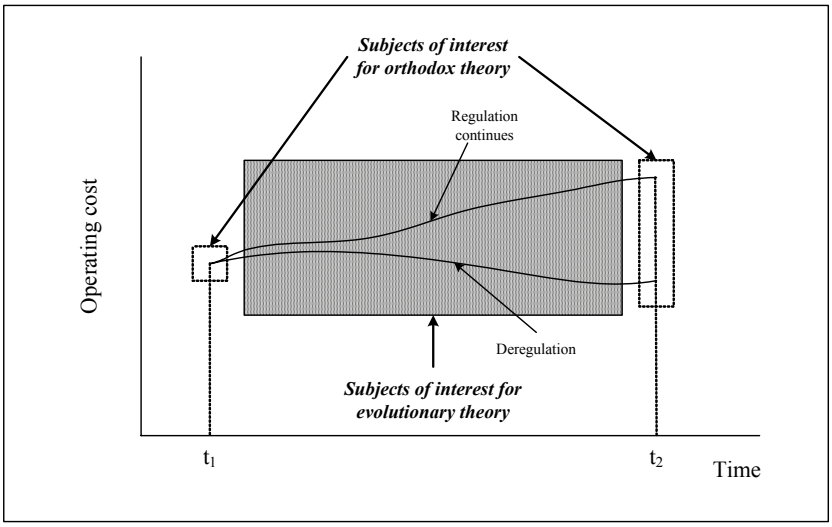


Figure 4-2 Subjects of interest in orthodox and evolutionary theory

The orthodox economic approach considers the process of the regulatory reform as a black box (see Figure 4-2). It imposes some assumptions and interprets the outcomes. The assumptions (in this black box) can be divided twofold. Firstly, it is assumed that the technology is fixed, i.e. the economic agents face the same technological constraint and this constraint is fixed (either constant or gradually increasing over time). This poses a serious question since technological development presents itself often unexpectedly. Secondly, it is assumed that the economic agents in the system are unconditionally rational and also identical among the same group of agents. For instance, the government body is a welfare maximiser and the private operator is a profit maximiser. Further it assumes that the economic agents are identical in that every operator is a profit maximiser and has the same technological production process. However, in reality, the operators have their own strategies in organising the management and they choose to adopt technology or specific technique to be superior in the market. Concerning these two critiques, an alternative theory is needed in which the technology, agent behaviour, and other endogenous forces can be studied explicitly.

Evolutionary economics offers the alternative theoretical point of view to approach the problem that we face in the process of regulatory reforms. As noted above, orthodox economics tends to focus on the outcomes, not processes. However, what we are interested in is how the industry will respond. This question is not what contemporary positive theory analyses. Rather, the analysis compares equilibrium configurations of input, output, and prices under the two market conditions (Nelson and Winter, 1982). This is the first important feature of evolutionary economics: dynamics. Cumulative knowledge and technology are important in this respect. This

includes the uncertainty of technological advancement in the period of consideration. Furthermore, the question also relates to the problem of how agents in the system react. Evolutionary economics assumes that agents have, at best, an imperfect understanding of the environment they live in and of what the future will deliver. This also implies that there will be technological uncertainty in the future. Thus, 'bound rationality' in a very broad sense is assumed (Coriat and Dosi, 1998).

4.3.2 *Evolutionary theory for behavioural changes from regulatory reform*

There are three important concepts that we need to clarify first when we deal with the topic of behavioural changes. These concepts are interrelated; each of them provides an interesting point of view on which the behavioural changes are reflected.

The first concept is the theory of evolutionary economics. This approach studies the process of the economics of technical change. The term *evolutionary* stems from biology. One of the borrowed ideas which is central to the evolutionary approach is the idea of economic *natural selection* (Nelson and Winter, 1982). Market environments provide a definition of success for business firms, and that definition is very closely related to their ability to survive and grow. This theory has been discussed in previous chapters, as it is one of the core theories we are employing in this thesis.

In the evolutionary view, technological development and innovation play an important role in the sense that innovation brings about the changes in the system and influences the selection process. One of the important features of evolutionary thinking is the term *routine*. Routine may refer to a repetitive pattern of activity in an entire organisation, to an individual skill, or, as an adjective, to the smooth uneventful effectiveness of such an organisational or individual performance (Nelson and Winter, 1982).

Nelson and Winter (1982) argue that much of firm behaviour can be better understood as a reflection of general routines and strategic orientations coming from the firm's past than as the result of a detailed survey of the remote twigs of a decision tree extending into the future. They develop an evolutionary theory of the firm where organisational capabilities and behaviours of business firms operating in a market environment are addressed. The firms in their evolutionary theory are motivated by profitability and engaged in the search for ways to improve their profitability, but the firm's actions are not assumed to be profit maximising over well-defined and exogenously given choice sets (Mahoney, 2005). This assumption is based on the theory of bounded rationality (Simon, 1957) which is the second concept that we will discuss.

The bounded rationality or problem-solving approach, as defined by behaviourists who take their lead from the work of Herbert Simon[3], stress some or all of the following elements. Man's rationality is "bounded": real-life decision problems are too complex to comprehend and, therefore, firms cannot maximise over the set of all conceivable alternatives.

[3] See Simon (1997).

The two key attributes to which Simon refers are the cognitive ability and the self-interestedness of human actors. Bounded rationality – behaviour that is intendedly rational but only limitedly so – is the cognitive condition to which Simon refers. 'Frailties of motive' describes the condition of self-interestedness (Simon, 1985). Moreover, the importance of organisational tasks is to formalise the dynamics of organisational evolution through models which explicitly consider the interplay between three inter-related factors, namely: 1) a cognitive representation of the problem(s) the organisation faces; 2) a mechanism of variation, which generates new solutions, new ways of doing things; 3) a mechanism of selection, implemented through various kind of incentives and reward mechanisms (Dosi et al., 2003).

The concept of bounded rationality is also a foundation in the study of organisation theory. Simon (1997) suggests that the term organisation refers to a complex pattern of human communications and relationships. The relationship between the organisation theory and bounded rationality is that organisational behaviour is the theory of intended and bounded rationality – it is about the behaviour of humans who satisfice because they do not have the ability to maximise. While neoclassical economic man maximises – selects the best alternative among all those available to him – organisational man satisfices – looks for a course of action that is satisfactory or good enough. Economic man deals with the real world in all of its complexity, whereas organisational man perceives a drastically simplified model of the real world (Simon, 1997). The implication that the decision makers are bounded by rationality is essential to this thesis. They have limited information and they lack the capability to process the information that they do posses. The implication of the concept of the behavioural theory of organisation will be presented in Section 4.4.

The third concept is transaction cost economics. The transaction cost economics approach is the product of two fields of economic research, namely the new institutional economics and the new economic of organisation (Williamson, 1998). A key conceptual advancement for both was the push beyond the theory of the firm as a production function (which is a technological construction) into a theory of the firm as a governance structure (which is an organisational construction). Williamson (1985) argues that firms, markets, and relational contracting are important economic institutions. These economic institutions are also the evolutionary product of a series of organisational innovations.

To understand this point, Williamson (1998) set out the four levels of social analysis as shown in Figure 4-3. The top level is the social embeddedness level. This is where the norms, customs, mores, traditions, etc. are located. The second level is referred to as the institutional environment. The structures observed here are partly the product of evolutionary processes, but design opportunities are also posed (Williamson, 2000). Going beyond the "informal constraints" of a Level 1 kind, we now introduce "formal rules (constitutions, laws, property rights)" (North, 1990a). The third level is where the institutions of governance are located. Although property remains important, a perfectly functioning legal system, in order to enforce contracts, is not contemplated. Transaction cost operates at Level 3. Finally, Level 4 moves from discrete structural to marginal analysis. This is the level with which neoclassical economics and, more recently, agency theories have been concerned. The neoclassical decision variables are price and output; agency theory deals with an efficient incentive

alignment in the face of differential risk aversion and/or multi-task factors or multi-principal concerns (Williamson, 1998).

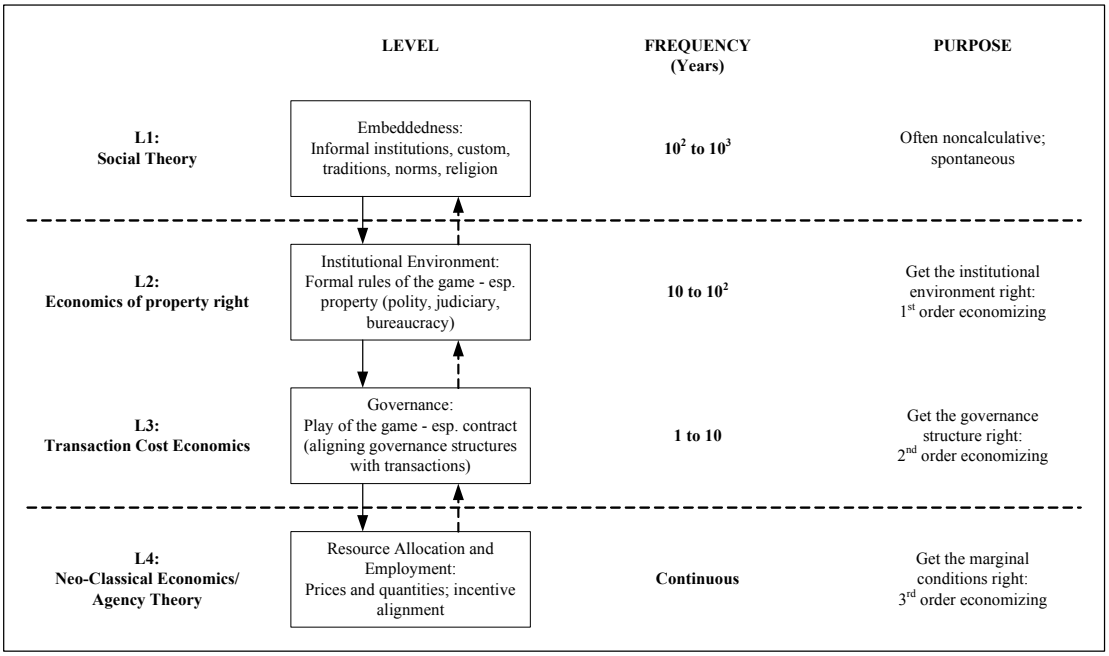


Figure 4-3 Economic of institutions
Source: Williamson (1998)

This thesis will focus primarily on the evolution process in the Level 3 kind, with the interaction between Level 2 and Level 4. This is where the regulatory framework shapes innovation in the public transport sector. If we consider the regulatory reform as a given institutional environment (Level 2), then the process of the reaction from organisations is the organisational activities in Level 3. This process is the result of the interaction between various agents in the systems. North (1994) emphasises that it is the interaction between institutions and organisations that shapes the institutional evolution of an economy. As previously stated in Section 2.6.1, if institutions are the rules of the game, organisations and their entrepreneurs are the players[4]. Furthermore, Level 4 will interact with Level 3 as the result of the change of governance structure. The detailed arrangement of price, quantity, quality, and other incentives will be determined as a feedback reaction between these two levels.

The transaction cost economic theory gives the general framework in which the regulatory reform takes part. It is also important to verify the inside mechanisms associated in each level. Two main features are the decision-makers in the system and the process at each level. The useful theories are evolutionary economics, which assumes the system to be dynamic, and the bounded rationality, which assumes that economic agents in the system have a bounded rationality. This is the link between the transaction cost economic and the behavioural theory of the firm as we described above.

[4] Williamson (1998) adds that the institutional environment is the rules of the game and the institutions of governance are the play of the game.

4.3.3 *Theoretical similarities and differences*

In previous section, we described the theories of evolutionary economics, bounded rationality, and transaction cost economics. It can be seen that there are some similarities and differences in the underlined assumptions that differ from the orthodox economic theory. Dosi and Marengo (2000) present an interesting comparison between three different theoretical perspectives by concentrating on the assumption of agencies in each theory. Table 4-1 shows their comparative appraisal.

Table 4-1 Orthodox agency, transaction costs economics, and competence perspectives: a comparative appraisal

Dimensions of analysis and theoretical building blocks	Orthodox agency	Transaction costs economics	Competence (and evolutionary) perspectives
Problem solving/cognition /knowledge	No	Not so far	Yes (central dimension of analysis)
Incentive governance	Yes (central dimension of analysis) via equilibrium contracting	Yes, possible via organisations as substitutes for equilibrium contracting	Not so far (but see Coriat and Dosi 1998)
Behavioural microfoundations	Perfect, far-sighted rationality	Bounded rationality with far-sightedness	Bounded rationality (usually, with 'myopic' attributes)
Organisational behaviour	Strategic (in the game-theoretic sense)	Cost-economising	Driven by routines, heuristics, etc.
Learning	No	Not so far	Yes (central dimension of analysis)
Unit(s) of analysis	- Strategies - Allocation of information - Allocation of property rights	Transactions	- Elementary 'bits' of knowledge - Routines and other elementary behavioural traits
Non-economic dimensions of organisation	Not as original dimensions	No	Power, trust, identity building, etc.

Source: Dosi and Marengo (2000)

This comparison shows that the orthodox theory lacks several crucial elements for the study of regulatory reform. For instance, the orthodox theory assumes that there is no problem-solving mechanism in its agencies, or in other words, the orthodox agency is a processor of information. On the other hand, the evolutionary perspective's agency is a processor of knowledge, i.e. it is also a problem solver. This demonstrates the point that the orthodox agency has no learning component where the evolutionary perspective's agency does, and this fact is a central dimension of its analysis. In sum, the evolutionary perspective can give more explanation to several questions that the orthodox theory cannot answer. Therefore, the introduction of the evolutionary perspective would bring about new viewpoints as well as a better understanding of the process of regulatory reforms in public transport.

The main implication is that the firms do learn and develop their organisational capabilities in order to compete and survive in the market. Innovation is the result of accumulated knowledge and improved capabilities. The regulatory framework in which firms operate is the constraint that determines the firms' innovative activities. With these concepts, we can analyse the behaviour of a firm in the public transport sector with respect to the innovation in which firms engage. Therefore, we can further explore the process of innovation in public transport.

4.4 Institutional and organisational aspects for innovation and regulatory reform

In the study of public transport organisational forms, Velde (1999) makes a distinction between authority initiative and market initiative (which we discussed already in Section 4.2). This distinction specifies two different categories of the organisation of the supply of public transport services and relates closely to the regulatory framework where the services are operated. In authority-initiated regimes, transport authorities have the legal monopoly of initiative, i.e. autonomous market entry is legally impossible and all production or market entry is the result of a one-side authority initiative to produce or request the production of services. In the market-initiated regimes, the supply of transport services is based upon the principle of autonomous market entry resulting from a market process with only a limited regulatory requirement at the entrance.

The above model combined with the distinction of actors involved in the public transport systems forms a graphical representation that is used extensively in the MARETOPE Project (2000, 2002). In general, three (groups of) actors are identified, namely government (public authority), operator (public or private), and user (actual and potential). Figure 4-4 shows a simple case of this organisational model. In the MARETOPE Project, this organisational model is used as a basic tool and is adapted for real-world cases by adding several details to the model. The focus of this approach is the formal and informal interactions between actors. Veeneman (2002) also uses this perspective to analyse the organisation of public transport. He defines the inter-organisation of public transport services in the metropolitan area. The focal point of his study is the interactions between government and operator, amongst operators themselves; and between operator and traveller.

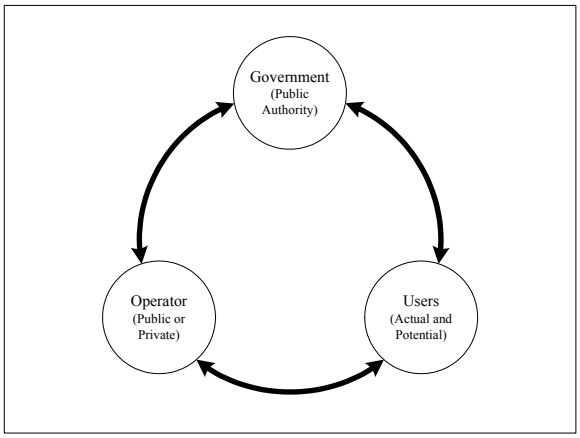


Figure 4-4 Organisational model

However, this model does not implicitly address the incentives and mechanisms of how and why actors participate in the system. Generally, the government controls operators through regulatory framework and the subsidy it gives. In return, the operator offers public transport services to the users (or travellers). And the users participate both by using public transport and controlling the government through the political process. This is a simple explanation as to how the actors interact with each other. But, it still lacks the behavioural explanation of each actor, which is essential for the analysis of innovation in the public transport sector.

This chapter introduces a different organisational model based on the behavioural theory of the firm by Simon (1997). This approach is a more suitable means of analysing innovation in the public transport sector. Simon (1997) explains there are three kinds of participants that can be distinguished: entrepreneurs, employees, and customers (Simon, 1997). Individuals are willing to accept organisational membership when their activity in the organisation contributes, directly or indirectly, to their own personal goals (Simon, 1997). In other words, each participant is offered an inducement for his participation in the organisation; he then makes a contribution in return (Simon, 1957).

Simon (1957) gives a simple example of the system of inducements and contributions. Consider an organisation with an entrepreneur, one employee, and one customer. Table 4-2 shows an example of this system. The customer's contribution of the purchase price is used to provide inducements to the entrepreneurs in the form of revenue. The entrepreneur's contribution provides the employee's wages. The employee's contribution is transformed into goods that provide the employee's wages.

Table 4-2 The system of inducements and contributions

Participant	Inducements	Contributions
Entrepreneur	Revenue from sales	Costs of production
Employee	Wage	Labour
Customer	Goods	Purchase price

Source: Simon (1957)

This example shows the different characteristics of each participant in organisation. In general, the success of organisations is discussed in terms of *organisational* goals and two kinds of *personal* goals. Simon (1997) explains that the organisational goals are of most direct interest to customers. In terms of personal goals, the first personal goal is to obtain rewards associated with organisational growth and success, and the second personal goal is to earn wages and other rewards now associated. He then distinguishes between (1) the motives for individuals' participation in an organisation and (2) the goals and constraints that enter directly as premises into organisational decisions. The term "motives" refers to the aims of the individual, and the terms "goals" and "constraints" refer to premises used in the organisational decision processes.

In the changing regulatory environment, this model is very helpful. The institutional and organisational changes, caused by regulatory reforms, affect the organisational participants' behaviours, i.e. motives, goals, and constraints. Hence, the decision for engaging innovation might be deterred as a result of behavioural change.

We can apply this model to the public transport service. Figure 4-5 shows the conceptual model of the organisation of the public transport service. Note that this is an example in bus tendering where the operator may, or may not have a power to design services.

Participant	Government	Operator
Entrepreneur	Ministry of transport Regional Authority	Manager
Employee	Transport agency Tendering agency	Drivers Other staffs
Customers	Potential passengers	Passengers

Figure 4-5 Organisational model for analysing innovation
Source: Inspired by Simon (1957)

This figure shows the organisation of public transport divided into the three participants (vertically in Figure 4-5): entrepreneur, employee, and customers. Because of the competitive tendering, the operator now splits from the government. This can be seen as a sub-organisation within the public transport organisation. The system of inducement is still applied, but the participants are changed. Thus, motives, goals, and constraints differ to make a new equilibrium within the organisation so that it can survive and succeed in the system.

The difference between this model and the general model used in previous studies (e.g. Figure 4-4) is that the system of inducements can be identified by way of each participant in the public transport organisation. This will help us to clarify the motives, goals, and constraints for the innovation in the public transport in a changing regulatory framework.

This concept is very useful in order to understand the innovation process under a changing regulatory environment. The main point is that the regulatory reforms cause institutional and organisational changes in the system. The actors in the system, in turn, change, adapt, or react to those changes in various ways. The evolution can be seen as a change in organisational goals, motives, and constraints as discussed above.

4.5 Evolutionary perspective on regulatory reform

The economic analysis of the regulatory reform gives us hints in terms of what the equilibrium outcome should look like. However, what is missing is that the reform process is not fully predicted and analysed. In this section, we are looking for a detailed explanation of this process.

Typically, it is understood that the objectives of reform are cost reduction and quality improvement. These objectives are of interest in most economic analysis studies. However, it can also be observed that reform brings about other developments such as the beginning of multinational public transport companies. Thus, there is a need to understand the regulatory reforms from a different perspective in more detail.

From the evolutionary theory discussed above, we can get an idea of how evolutionary framework evolves in the public transport sector. This evolution can be summarised in three observations as follows.

The first observation is that economic agents in the public transport sector are rationally bounded. We have discussed the experiences of the public transport policy in Section 2.2, and that it is only at a period of development which, over time, is inconsistent. In fact, it is still evolving. Preston (2001b) reveals that, in the case of bus reforms in Great Britain, there are regulatory (and ownership) cycles. The objectives of the public sectors, apart from the maximisation of social welfare, have been evolving and are partly influenced by political pressure at both local and national levels. From the evolutionary perspective, public policies evolve partly due to changes in perceived demands and opportunities, changes that may result from the evolution of private technologies and market structures or from other identifiable shifts in objective conditions (Nelson and Winter, 1982). This could explain why we need to consider an alternative approach to examine the process of regulatory reforms.

Many researchers try to understand the difference between each regulatory reform, and the general approach is to compare the before and after effects of the reform. As mentioned above, this kind of analysis simply compares the equilibrium configurations of input, output, and prices under the two market conditions. To better understand the regulatory evolution, one cannot focus solely on economic considerations. Rather, the analysis should include a broader view that can be described using the Williamson social analysis framework (see Figure 4-3), particularly at the Level 1 and Level 2 kinds. For the Level 1 consideration, the people's norm could influence politicians to pursue a certain policy. The politicians themselves may also have their own beliefs. As a result, each country would have its own (cultural) ways to direct the policy. For the Level 2 type, bureaucratic issue could also be included in the analysis. For instance, before the privatisation era, the bureaucratic public-owned company has its own management style which criticises its inefficiency. The decision-makers then decide, within their cognitive ability, to solve this problem, to opt for the privatisation approach. This solution has its pros and cons and the decision-maker must compromise the costs and benefits of stakeholders.

Second, institutional evolution is shaping the industry structure. If we accept North's notation of institutional and organisational levels, institutional evolution is the radical change in the rules of the game. Regulatory reform means the government must set new rules. Consequently, the functions of each stakeholder would also be changed. In the case of privatisation industries, Willman et al. (2003) identify distinct stages in the evolution of the regulatory function: (1) an ad-hoc period; (2) a period characterised by the emergence of a formal regulatory role; and (3) the emergence of more strategic regulatory management. This case suggests that the reform's process is significant and it takes time to reconcile the system. Similar patterns can also be observed at the local transport level as the multinational companies originated from

the trend towards the deregulation (in UK) and tendering of the concessions (in several European countries). While the regulatory regimes are still evolving, the industry structure follows the evolution pattern too.

Third, the organisational responses to the regulatory reform vary significantly. In the case of bus deregulation in the UK, McGuinness et al. (1994) have learned that operators responded differently in the 1985 legislation. As stated earlier, the aims of the l985 legislation were that the operators be more innovative, market-oriented and commercial companies. McGuinness et al. (1994) identify three broad strategic responses: a defensive market for passenger transport, a market sensitive strategy of becoming more responsive to changing conditions within the overall travel market, and a commercial strategy of identifying opportunities for growth and/or diversification.

The variation of organisational responses is found not only on the operator side, but also on the authority side. The trend towards the decentralised approach gives the local authority more power to make a decision on transport policy, including the public transport section. Recently, in Great Britain, Atkins (2003) found that there are three types of local authorities: the champion, the tactician, and the sceptic. This result indicates that the authority also has cumulative knowledge and perception. This is in line with the works of Velde and Leijenaar (2001) and Velde and Pruijmboom (2003) in that authorities have informational and behavioural barriers. Another question pertains to what makes the organisations (either public or private) different.

Clearly, organisational changes play an important part in explaining the behaviour of actors in the public transport sector. The capability and learning elements are of importance in this respect. In order to respond to the changing environment, organisations search and acquire knowledge and capabilities to better adapt. In this process, innovation is used as a strategic tool to achieve an organisation's goal. One explanation is that firms learn and develop their capabilities. This assumption directly corresponds to the evolutionary economics perspective we discussed earlier which states that firms do learn and develop their capabilities to compete and survive in the market. In the next section, we discuss the concept of capabilities and learning in more detail.

4.6 Concept of dynamic capabilities and learning

4.6.1 *Dynamic capabilities*

The concept of dynamic capabilities is developed by Teece and Pisano (1994) and Teece et al (1997). They define dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. Dynamic capabilities thus reflect an organisation's ability to achieve new and innovative forms of competitive advantages given the path dependencies and market positions.

The firm's processes and positions collectively encompass its capabilities or competences (Teece and Pisano, 1994, Teece et al., 1997). The relationship and characteristic of competences/capabilities must be recognised. A difficult-to-replicate or difficult-to-imitate competence/capability can be considered a distinctive

competence. Hence, competences and capabilities are intriguing assets, as they typically must be built because they cannot be bought. Dynamic capabilities are the subset of the competences/capabilities which allow the firm to create new products and processes, and respond to changing market circumstances (Teece and Pisano, 1994).

Teece and Pisano (1994) elucidate that the competitive advantage of firms lies within its managerial and organisational processes, shaped by its (specific) asset position, and the paths available to it. Managerial and organisational processes refer to the way things are done in the firm, or what might be called the organisation's 'routines', or patterns of current practices and learning. Position refers to firm's current endowment of technology and intellectual property, as well as its customer base and upstream relations with suppliers. Paths refer to the strategic alternatives available to the firm, and the attractiveness of the opportunities which lie ahead.

Organisational and managerial processes
Organisational processes have three roles: coordination/integration (a static concept); learning (a dynamic concept); and reconfiguration (a transformational concept).

- Coordination/integration: Managers coordinate or integrate activity inside the firm. How efficiently and effectively internal coordination or integration is achieved is very important. This is also applied for external coordination. Increasingly, strategic advantage requires the integration of external activities and technologies.
- Learning: Learning is a process by which repetition and experimentation enable improvement in executing tasks. It also enables the production opportunities to be identified.
- Reconfiguration and transformation: In changing environments, there is value in the ability to sense the need to reconfigure the firm's asset structure, and to accomplish the necessary internal and external transformations. In this regard, benchmarking is of considerable value as an organised process for accomplishing such ends.

Position
The strategic position of a firm is also determined by its specific assets (Teece et al., 1997). Specific assets are specialised plant and equipment, difficult-to-trade knowledge assets, and assets complementary to them, as well as reputational and structural assets. Such assets determine a firm's competitive advantage at any point in time. Teece et al. (1997) identify some examples of these assets as follows.

- Technological assets and complementary assets are related to technological innovation. A firm's technological assets may or may not be protected by the standard instruments of intellectual property law. However, the ownership protection and utilisation of technological assets are clearly key differentiators among firms. Likewise for complementary assets.
- Reputations refer to the information about firms and they shape the responses of customers, suppliers, and competitors. Reputational assets are intangible assets that enable firms to achieve various goals in the market. Their main value is external, since what is critical about reputation is that it is a kind of summary statistic about the firm's current assets and position, and its likely future behaviour.

- For structural assets, the formal and informal structures of organisations and their external linkages have an important bearing on the rate and direction of innovation, and how competences and capabilities co-evolve.

Paths
Paths and technical opportunities are interrelated as follows.
- Path dependencies: Where a firm can go is a function of its current position and the paths ahead. It is also shaped by the path behind. The notion of path dependencies recognises that 'history matters'. Thus, a firm's previous investments and its collection of routines constrain its future behaviour.
- Technological opportunities: the concept of path dependencies is given forward meaning through the consideration of an industry's technological opportunities. It is well-recognised that how far and how fast a particular area of industrial activity can progress is partly due to the technological opportunities that lie before it. However, technological opportunities may not be completely exogenous to industry, not only because some firms have the capacity to engage in or at least support basic research, but also because technological opportunities are often fed by the innovative activity itself.

In summary, Teece and Pisano (1994) posit that the competitive advantage of firms stems from dynamic capabilities rooted in high performance routines operating inside the firm, embedded in the firm's processes, and conditioned by its history. Because of the non-tradability of soft assets like values, culture, and organisational experience, these capabilities cannot be bought; they must be built from within the firm.

The dynamic capabilities approach offers a framework for analysing the innovation in the public transport sector. The public transport organisations (both authority and operator) have their own capabilities that are essential for them to progress in changing environments. Especially for the operator, public transport firms have to build up their competitive advantage through their innovative activities. The questions that this dynamic capabilities approach can answer are how firms can build their competences/capabilities and what incentives there are for the firms to innovate.

4.6.2 *Learning and feedback*

Learning is vital for an organisation in developing its capabilities/ competences. The concept of learning is the way in which an individual or organisation collects information and knowledge and processes it in order to improve performance.

Learning is also a feedback process (Sterman, 2000). In the learning process, we make decisions that alter the real world; we gather information feedback about the real world and, using the new information, we revise our understanding of the world and the decisions we make to bring out the perception of the state of the system as it relates to our goals. This is called a feedback loop.

The feedback loop obscures an important aspect of the learning process (Sterman, 2000). Information feedback about the real world is not the only input in our decision-making. Decisions are the result of applying a decision rule or policy to information about the world as we perceive it (Forrester, 1992). The policies are conditioned by institutional structures, organisational strategies, and cultural norms. These are governed by our mental model. This is a fundamental idea of the System

Dynamics model. Forrester (1961) stresses that all decisions are based on models, usually mental models. In system dynamics, the term 'mental model' includes our beliefs about the networks of causes and effects that describe how a system operates, along with the boundary of the model and the time horizon we consider relevant (Sterman, 2000).

There are several barriers to learning. Among them is the issue of limited information which can be considered in two manners. First, the full information is not available. Often it is the case that the information is not available or we receive estimated values which have to be measured or sampled. The act of measurement introduces distortions, delays, biases, errors, and other imperfections, some known, others unknown, and unknowable (Sterman, 2000). Second, limited information occurs from individual perceptions. This issue relates to the mental models through which we define the system, evaluate, and report. These then condition the perceptions we form. Changes in our mental models are constrained by what we previously chose to define, measure, and attend to (Sterman, 2000).

The issue of limited information has a close link to the bounded rationality we discussed in Section 4.3. Limited information reduces the potential for learning and performance by limiting our knowledge of the real world (Sterman, 2000). Simon (1957) asserts that the capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problem whose solution is required for objectively rational behaviour in the real world. Though we sometimes attempt to make the best decisions we can, bounded rationality means we often systematically fall short, limiting our ability to learn from experience.

We can extend this learning concept into the concept of organisational learning as well. Because all learning takes place inside individual human heads, an organisation learns in only two ways: (a) by the learning of its members, or (b) by ingesting new members who have knowledge in the organisation who previously did not have it (Simon, 1991). Thus, the process of organisational learning is not only a part of the organisational and managerial processes that we discuss in the dynamic capabilities concept, but it governs all parts of the development of competences/ capabilities. Organisational learning determines organisational and managerial processes as well as firm's positions. It also evaluates the path dependencies and technological opportunities of the firm.

Therefore, understanding the dynamic capability and learning process in organisations is useful for analysing the development of the innovative capability of organisations in the public transport sector. Using these ideas can lead to an understanding of how organisational behaviours change and react to changing environments (the regulatory reform) and how the organisations innovate. Here we see that under the organisational learning, processes, positions, and paths are the key elements that determine innovation and shape behaviours of organisations in the public transport sector.

If we look at the tendering case for example, the public transport manager has to adopt his organisational process to the tendering process that will take place in the area. The manager needs to coordinate and integrate his knowledge from various departments of the company in order to prepare the offer. How efficiently and

effectively internal coordination is achieved is crucial here. In order to prepare the bid, the company's assets must be realised. The company positions are considered here as well. Then the manager must understand the company's paths, i.e. the past investments and the company practices in the public transport services. The manager also needs to search for technical opportunities to be used in the tender. All elements, i.e. processes, positions, and paths, are developed by using the company's competence/capabilities which are built through the learning process.

4.7 Innovative capability and learning in public transport

This chapter focuses on the issue of institutional and organisational changes of the public transport sector. In Europe, the public transport industry's environment is perpetually evolving due to the regulatory reform. Reform has a profound effect on both institutional and organisational aspects. These institutional and organisational changes are of importance for innovation in the public transport sector.

Regulatory reform is a process of change. From a theoretical point of view, the orthodox economic approach plays an important part in analysing the effects of regulatory reform in public transport. Furthermore, it plays a part in providing guidance for the decision-making required to design the regulatory framework. However, once regulatory reform takes place, the effects of the reform are not fully explained purely by the orthodox economic approach. The reasons are twofold. Firstly, it assumes that technology is fixed, i.e. the economic agents face the same technological constraint and this constraint is fixed (either constant or gradually increasing over time). This poses a serious question since technological development presents itself often unexpectedly. Secondly, it presupposes that the economic agents in the system are unconditionally rational and also identical among the same group of agents. However, in reality, the operators have their own strategies on how to organise the management and choose to adopt technology or specific techniques to ensure superiority in the market. Concerning these two critics, an alternative theory is needed in which the technology, agent behaviour, and other endogenous forces can be studied explicitly.

Evolutionary economics offers an alternative theoretical point of view to approaching the problem that we face in the process of regulatory reform. In this chapter, we described three concepts that are necessary for the analytical framework of this thesis. The first concept is the theory of evolutionary economics. This approach studies the process of the economics of technical change. Nelson and Winter (1982) develop the evolutionary theory of a firm where organisational capabilities and behaviours of business firms operating in a market environment are addressed. The firms in their evolutionary theory are motivated by profitability and engaged in the search for ways to improve their profitability, but the firm's actions are not assumed to be profit maximising over well-defined and exogenously given choice sets (Mahoney, 2005). The second concept is the bounded rationality or problem-solving approach. Simon (1997) suggests that man's rationality is bounded: real-life decision problems are too complex to comprehend and therefore firms cannot maximise over the set of all conceivable alternatives. The third concept is transaction cost economics. Williamson (1985) argues that firms, markets, and relational contracting are important economic institutions. These economic institutions are also the evolutionary product

of a series of organisational innovations. The transaction cost economic theory gives the general framework in which the regulatory reform takes part. The main implication of these three concepts is that the firms do learn and develop their organisational capabilities in order to compete and survive in the market. Innovation is the result of accumulated knowledge and improved capabilities. The regulatory framework in which firms operate is the constraint that determines the firms' innovative activities. With these concepts, we can analyse the behaviour of a firm in the public transport sector with respect to the innovation in which firms engage.

From this evolutionary perspective, we make three observations of the regulatory reform in the public transport sector. The first observation is that economics agents in the public transport sector are rationally bounded. The objectives of the public sectors, apart from the maximisation of social welfare, have been evolving and are partly influenced by political pressure at both local and national levels. Public policies evolve partly due to changes in perceived demands and opportunities, changes that may result from the evolution of private technologies and market structures or from other identifiable shifts in objective conditions (Nelson and Winter, 1982). Second, institutional evolution is shaping the industry structure. Regulatory reform means the government must set new rules of the game. Consequently, the functions of each stakeholder would also be changed. While the regulatory regimes are still evolving, the industry structure follows the evolution pattern too. Third, the organisational responses to the regulatory reform vary significantly. Empirical evidence in the past has shown that the operators who face regulatory reform contribute strategic responses. An example is that, in the case of bus deregulation in the UK, there were three broad strategic responses: a defensive market for passenger transport, a market sensitive strategy of becoming more responsive to changing conditions within the overall travel market, and a commercial strategy of identifying opportunities for growth and/or diversification.

Organisational changes play an important part in explaining the behaviour of actors in the public transport sector. In order to respond to the changing environment, organisations search and acquire knowledge and capabilities to better adapt. In this process, innovation is used as a strategic tool to achieve an organisation's goal. One explanation is that firms learn and develop their capabilities. This relates to two important concepts to analyse the capabilities/competences development and learning, namely the dynamic capabilities and learning.

Teece and Pisano (1994) define dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. Thus, dynamic capabilities reflect an organisation's ability to achieve new and innovative forms of competitive advantage given the path dependencies and market positions. Second, the concept of learning is the way in which an individual or organisation collects information and knowledge and processes it in order to improve performance. The process of organisational learning governs all parts of the development of competences/ capabilities. Organisational learning determines organisational and managerial processes as well as firm's positions, and it evaluates the path dependencies and technological opportunities of the firm.

Therefore, understanding the dynamic capability and learning processes in organisations is useful in analysing the development of the innovative capability of

organisations in the public transport sector. Using these ideas can lead to an understanding of how organisational behaviours change and react to changing environments (the regulatory reform) and how the organisations innovate. Here we see that under the organisational learning, processes, positions, and paths are key elements that determine innovation and shape behaviours of organisations in the public transport sector.

Chapter 5 Dynamic Capabilities and Learning: An Integrated Approach

5.1 Introduction

As stated in Chapter 3 and 4, innovation plays an important role in improving public transport services. A recent example is the introduction of low floor buses where passengers who are disabled have better access to the bus and, others can board the bus more quickly. Furthermore, the new technique and technology help the public transport operator to improve its performance both technically and financially. For example, the computerised fleet management system allows the full utilisation of the fleet which can reduce cost significantly. This takes place in a dynamic environment, where there are strong influences from regulatory reform of public transport services. Thus, regulatory reform in public transport sector affects the innovation in the sector. Innovation in public transport is also influenced by the behavioural changes of actors (authority, operator, and traveller) in the system. The changes within the institutional setting (competitive tendering regime) create a new role for each actor, especially the interaction between authority and operator. In the past, the public authority formally provided the public transport service through public-owned companies. The authority is now changing its role to control and regulate positions. Consequently, the involvement of private operators is increasing. It is hoped that the shifting of this setting and interaction between authority and operator creates a new opportunity for innovation in the public transport sector.

This chapter presents the analytical framework for the case study from an empirical standpoint. Section 5.2 provides a background for regulatory change and innovation. More explicitly, this section deals with the dynamics of the tendering process and discusses how the learning process is positioned in the tendering process. Moreover, the concept of innovative capability is introduced to analyse both the authority and operators' ability to innovate. Section 5.3 discusses the dynamic process of the tendering. The section begins with an introduction to the tendering process and discusses the indicators for public transport analysis. Then, the dynamic models for authority and operator are proposed. Finally, Section 5.4 proposes the analytical framework for the case study, the innovative capability model.

5.2 Regulatory changes and innovation: the dynamic process

5.2.1 *Regulatory reform in public transport: trend towards tendering*

We revealed in Chapter 2 that the public transport sector is in a transition phase. The European Union (EU) has placed more emphasis on the public transport sector as a means to help the congestion problems. The EU stressed that the public transport

must improve its efficiency, and the quality of the public services has to be improved at the same time. In the course of this development, we see how regulatory reform is used as a tool to enhance both the efficiency of the public transport operations and quality of the public transport services. Regulatory reform creates a wide variety of organisational forms in European public transport. One of the common features is the growing involvement of the private sector in the public transport industry. We could see this as a structural change in the public transport industry.

Technological innovation plays an important role in the transport sector. In Chapter 2, we reviewed the transport mode concept (Zwaneveld et al., 1999), which partitions transport into three components: propulsion system, vehicle concept, and transport concept. Additionally, we pointed out several implications of ICT in the transport sector. Technology seems to be closely connected with the government interventions.

Not only does technological development play an important role in public transport, but so do institutional and organisational developments. The institutional aspect is introduced in the form of regulatory framework. Regulatory reform then results in overall organisational change and the creation of new organisations due to the privatisation and deregulation processes. Thus, it is crucial to understand the role of the organisational aspect in the presence of regulatory reform. In general, there are three major actors involved in the public transport sector: government agency, public transport operator, and passenger. Each actor has its goals, objectives, and expectations from the way public transport services are organised. In this regulatory changing environment, we see each actor adapt its role in order to achieve its goals, especially government agencies and the public transport operators.

The relationship between innovation and regulatory reform is complex. In Chapter 2, we reviewed the complexity of both technological innovation and the institutional and organisational factors in the public transport sector. Then we addressed two important issues: understanding innovation and understanding the behaviour of decision-makers in public transport.

5.2.2 *Innovation in public transport: a characteristic approach*

In Chapter 3, we explained the concept of innovation in public transport. It is clear that identifying and classifying innovation is a difficult task given the multidisciplinary characteristics and various elements involved. The essential perspective is to judge innovation in a broader view. Furthermore, we have to look at innovation as a *process*.

We adopt a broader definition of innovation which covers both technological and organisational aspects of innovative activities. In Chapter 3, innovation in the public transport services is, in this thesis, described in the ‘twin characteristics’ approach. To recapitulate, this approach defines the public transport services as the result of three sets of characteristics: technical characteristics, competence, and service characteristics. Using this approach, innovation can be classified into three groups: service innovation, pure technical innovation, and competence development. Within these three groups of innovation, we classify the innovative capabilities of the public transport system into three categories, namely, innovative capabilities related to 1) infrastructure, 2) vehicle, and 3) service operation.

In Chapter 3, we also defined three levels of innovation to locate where innovation is positioned in time and space. Level I includes an innovation that is new to the industry. Often the technological advances have been proven in other sectors before they are introduced into a new sector. Level II includes an innovation that is new to the country. The boundary of the country is likely to bond some common characteristics. Level III incorporates those aspects at the micro-level, i.e. this innovation is new to the area. This level involves a diffusion of the establishing innovation.

5.2.3 *Institutional and organisational changes*

Regulatory reform brings about the institutional changes in the public transport sector. The new institutional setting that is influenced by the tendering process creates new roles for all actors (authority, operator, and traveller). Particularly, the tendering process allows the authority to give the concession and create a competitive environment for operators in the public transport sector.

Initially, the tendering process generally aims at cost reduction. It is believed that tendering will reduce the subsidy of the public transport service. Cost reduction is typically the result of productivity gain from the reorganisation of public transport firms. However, the authority tends to pay more attention to the quality aspect than cost. For example, there is a Quality Bus Partnership scheme that aims to increase the quality of public transport services. In the Netherlands, the quality elements are explicitly indicated in the tender document. This is in line with the observations we made in Chapter 4 about the economic agents in the public transport sector who are rationally bounded. The public policies evolve due to the changes in public authorities' interests. The changes of the authorities' attention from cost to quality are a good example of this observation.

Innovation and regulatory reform have a close relationship. Regulatory reform affects innovation in the public transport sector. The tendering process creates a competitive situation in which the operators can propose their innovation through their offers. After the bidding process, the operator who loses the bid will be able to innovate again only in the next round of tender. If we are introducing a new type of buses as an innovation, then the renewal of the buses must occur during the concession period. Innovation also plays an important part in achieving the aims of the tendering process.

But, innovation still requires the cooperation between authority and operator. Although the tendering process tends to separate the responsibility between the two, they can still work together in practice to achieve a better quality of public transport services. The challenge is how to manage this process that incorporates both competition (tendering) and innovation.

5.2.4 *Tendering process: an analysis of dynamic capability and learning*

Competitive tendering is now a common practice in public transport service. Thus, this thesis focuses on the tendering process. The main point is the effect of the tendering process on innovation in public transport services. As the variety of reforms exists, the tendering may differ from case to case, and some areas are also an exception to the tendering.

There are several factors that influence the competitiveness of the tendering process. Among these various factors, the type of contract is the most crucial one. In general, tender contracts in the public transport sector are divided by the risks that are associated with production cost and revenue of public transport services. Using the division of those risks, the tender contracts can be divided into three categories: management contract, gross cost contract, and net cost contract. A management contract is the contract that both production cost and revenue risks are borne by authority. A gross cost contract is the contract that shows that revenue risk is borne by the authority and production cost risk is borne by the operator. A net cost contract is the contract that exemplifies that both production cost and revenue risks are borne by the operator. We will discuss in detail the types of contracts and their consequences in Chapter 6.

In public transport tendering, the gross cost contract and the net cost contract are the most typical. For example, local bus contracts in Sweden and Denmark use the gross cost contract. In the Netherlands, Provincie Zuid Holland uses the net cost contract in their three concession areas. The factors that determine the types of contracts vary in terms of the national legislation, the regulatory practice, and the national ticketing system.

The type of contract employed could determine innovation in the public transport sector. The risk division between authority and operator is the key that gives organisations the incentives to innovate. For example, the management contract gives no incentive to the operator to improve the infrastructure and vehicle as the operator has no benefit from that investment. The authority would initiate most of the innovation in this case. Alternatively, if the operator is responsible for both production cost and revenue risks, then the operator might invest only in the revenue-producing aspects. In this case, the duration of the contract is also another important factor as the level of investment depends on the payback period from which the operator can benefit.

As the tendering is a process with changing requirements over time, it requires an adoptive behaviour of all actors involved. Therefore, we apply the concept of dynamic capability and learning that we described in Chapter 4 (Section 4.6) to the tendering process in the public transport sector. The dynamic capability is the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. Three elements are addressed: organisational and managerial processes, positions, and paths. In our case, we consider that the regulatory reform (the tendering process) takes place in a rapidly changing environment. Thus, the dynamic capabilities of the authority depend on their ability to use resources to organise the tendering process in order to achieve their objectives, and control the operation of public transport according to the contracts that are granted. For operators, the dynamic capabilities include the capacity to use and integrate their resources to produce the bid that attains the tender, and also the ability to manage the operation of public transport that grants a profit according to the initial planning in the tendering process. It should be noted that innovation is one of the strategic tools that operators use for winning the tender.

We also need to treat the tendering process as a continuous development process that leads to organisational learning for both authority and operator. Although a tender in

one area may depend on the length of the concession contract, there are several tenders in the surrounding areas that the authority and operators must work on simultaneously. The information and knowledge that the authority and operators acquire during the tendering process are key elements in that they can learn from the tendering experiences. We call this process 'organisational learning'. The process of organisational learning appears in all parts of the development of competences/ capabilities of the organisation. The implication of this learning concept will be fully elaborated in Section 5.4.

5.3 Towards an integrated approach

5.3.1 *Understanding the tendering process*

The introduction of innovation is a complex process. The driving forces for innovation vary, and regulatory reform is one among them. In fact, as we emphasised earlier, one of the objectives of reform is to stimulate innovation.

We described the trend towards competitive tendering in public transport. This trend is important in relation to the innovation in the sector since competitive tendering fosters the implementation of innovation during the tendering process. In the past, competitive tendering aimed to reduce the subsidy of the public transport service. Thus, most operators procured various means of cost saving to compete in the tender. However, the recent trend in the Netherlands shows that the quality of the services is also an important aspect to which the public authority pays attention.

To understand the mechanism behind this tendering process, we identify the objectives of the actors (authority and operator). Under the tendering scheme, the authority has five objectives. The first objective is the financial aspect. This includes the cost of producing public transport services, the pricing system that users pay, and the subsidy to be paid to the operator. The second objective is the vehicle and infrastructure aspect. This is a technical element. The public transport system must be well-equipped with appropriate technological components, both vehicle and infrastructure. The third objective is the service quantity. Authority must determine how the services will be provided to the public. The main task is to ensure that the public has adequate access to the public transport. The fourth objective is the service quality. Authority must make sure that services provided by operators are satisfactory. Finally, the external criteria are to be met. There are several external criteria, such as the degree of competition (operators compete fairly in the tendering process), the transparency of the tendering process, the environmental effect of the system, the contribution of public transport service to the mobility of the area, and the fare collection and control.

In some cases, the role of users is hindered by the authority in the tendering process. The authority tries to include the user in the development of public transport services and also the tendering process through a form of organisation such as a consumer organisation. We might find that the authority consults the user representatives, usually through a local politician, and some public transport services are suggested from this process. However, a formal means of instigating user participation in the development of public transport services is rarely found.

The private operator has a different set of objectives. First, the operator, as a private company, seeks profit. In the economic theory, it usually assumes that a private company is a profit maximisation firm. Second, the operator tries to maintain its presence – or continuity – in the market. In the tendering regime, a way to maintain the continuity is to win the tenders to keep the market share for the company. Third, the operator also has to maintain its reputation in the market. This reputation presents the perception of the public (and also authority) to the company. It implies that having a good reputation may increase the chance to win a tender.

An interesting and crucial element in this study is the process where these two different actors meet. The interaction between authority and operator in this tendering regime occurs in the bidding process. In general, the authority provides the program of demand and/or tender document to the potential bidders. The tender document usually indicates the basic requirements and specifications of the services to be tendered. It also indicates the winning criteria of the tender. This is the crucial element operators must fulfil in order to win the tender. By studying the tender document, operators prepare their offers. At this stage, it should be noted that the innovation is often included in the offer to increase its appeal.

It is important to note that every stage in the tendering process is a learning process. For the authority, the objectives evolve over time. For example, if a subsidy is cut, the authority must decide how to allocate the funds sufficiently and determine what the consequences are for the service quantity and quality. This ultimately leads to learning in the stage of preparing both the program of demand and the tender document. The key element in a tender document is how to design the winning criteria which affect the offers from operators. For the operator, the objectives are adjusted over time. The operator's strategy is laid out according to the current market situation. Thus, both the profit and continuity must be considered before preparing the offer. This is what we call learning to be competitive in the market. Once the objectives of the operator are set, the offer can be prepared. At this stage, the operator can learn from their experiences (both in the tender area from previous tenders and other tenders in other areas) to better prepare a competitive bid.

Accordingly, a generic model for the tendering process can be constructed. Figure 5-1 shows this generic model for the tendering process.

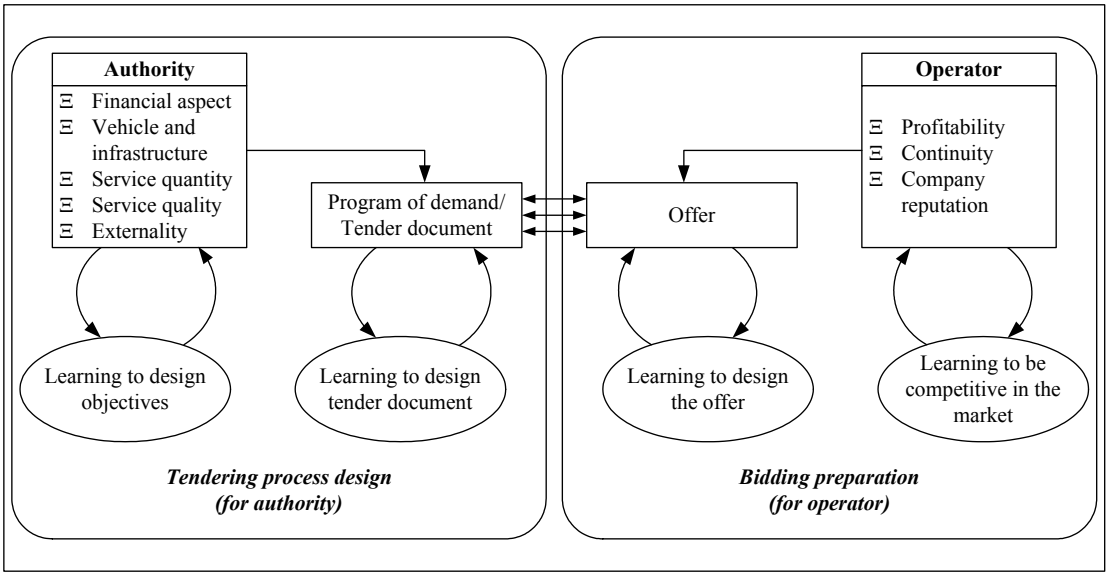


Figure 5-1 Learning in the tendering process

In Figure 5-1, we can see two separate processes. The first is the tendering process design which is done by the authority. The second is the bidding preparation which is done by the operator. And these two processes meet at the awarding of the tender. This diagram simplifies the dynamic process inside each process; the details within each process (tendering process design and bidding preparation) will be discussed in more detail in Section 5.4.

To identify the learning process in regulatory reform, we need to find indicators that show significant changes of the behaviour and knowledge of actors in the system. Hence, we will try to search for the indicator in turn.

5.3.2 *Searching for indicators*

In Chapter 3, we described the twin characteristics approach. This approach allows us to analyse the public transport services in multi-dimensions, i.e. technical characteristics, competences, and services characteristics. We can apply this approach to the tendering process to analyse the innovation and learning in public transport service for both the authority and operator.

Authority:
We can see that the five objectives we described in the previous section are comparable with the twin characteristics approach. The technical characteristics consist of vehicle and infrastructure elements; the competence entails the financial aspect and service quantity element; and the service characteristics are the service quality element. Table 5-1 shows the criteria of the authority according to the twin characteristics approach. In this table, the five objectives – financial aspect, service quantity, vehicle and infrastructure element, service quality, and external factor – are defined in more detail.

Table 5-1 Indicators of the tendering process model for authority

Criteria	Element	Main Factors	Indicator/Measurement
Financial aspect	• Cost (price)	• Subsidy • Service quantity • Service quality	• Cost/vehicle km • Cost/vehicle hr
	• Subsidy	• Cost (price) • Service quantity • Service quality	• Subsidy/vehicle km • Subsidy/vehicle hr
	• Contract length	• Tender design • Quality of services	• Average contract length (years)
Service quantity	• Frequency (time of day)	• Financial aspect • Number of vehicles	• Vehicle hr (DRU) • Vehicle km
	• Network density (network design)	• Financial aspect • Number of vehicles • Demand	• Number of lines • Number of stops
Vehicle and infrastructure element	• Number of vehicles	• Financial aspect • Number of vehicles • Demand	• Number of vehicles
	• Accessibility of vehicle	• Financial aspect • Low floor vehicles (service quality)	• % of low floor vehicles
	• Vehicle maintenance	• Financial aspect • Comfort and ride quality (service quality)	• Customer satisfaction survey
	• Infrastructure investment	• Financial aspect • Service quality	• Infrastructure investment
	• Infrastructure maintenance	• Financial aspect • Service quality	• Customer satisfaction survey
Service quality	• Reliability	• Investment in scheduling system • On board vehicle communication	• Punctuality • Customer satisfaction survey
	• Accessibility	• Low floor vehicles • Network density • Stop/station density	• % of low floor vehicles • No. of lines/km^2 • No. of stops/km^2
	• Comfort and ride quality	• Average age of vehicles • Vehicle maintenance • Driver behaviour • Other services	• Average age of vehicles • Customer satisfaction survey
	• Safety and security	• On board security camera • Extra security personnel	• No. of crime incidents • Reports from passengers
	• Ticketing system	• Point of ticket sale/payment • Ease of ticketing system • Integrated ticket	• Channels of ticket sale • Degree of integrated ticket
	• Service integration	• Integrated ticket • Service coordination (transfer/connection)	• Degree of integrated ticket • Point of transfer/connection
	• Travel information	• Information at stop/station • On board information • Pre-trip information	• Point of information at stop/station • No. of buses with on board information
External criteria	• Competition	• Transparency of the tendering process • Appropriate contract detail • Appropriate contract length • Considerable number of bids	• Average number of bids
	• Environmental friendly	• Low emission vehicle	• No. of low emission vehicles
	• Contribution to the mobility of the area	• Financial aspect • Number of vehicles • Demand	• Congestion level
	• Fare collection/ control	• Fairness of the system • Social security	• No. of fare dodgers

Table 5-1 presents the criteria (objectives), elements, main factors, and indicator/measurement that the authority must assess in the tendering process. We will see that there are considerable overlaps between objectives, elements, and factors. This shows the interdependent nature of the public transport characteristics which we will discuss in turn.

Here we will discuss the financial aspect which consists of three main elements: cost, subsidy, and contract length. Cost and subsidy have a close relationship. The factors that determine the cost and subsidy are the service quantity and service quality. The indicators in this case are usually defined as a cost or subsidy per production unit, which is a vehicle kilometre or vehicle hour. Another factor, contract length, plays a crucial part in the tender as it determines how long the operator can make a profit from any innovation implemented during the concession. This implies how much effort the operator should make for the innovation. If the contract length is long, it is possible for the operator to invest more for an innovation as they have a greater time frame to operate to make their profit.

Service quantity is a crucial element in the tendering process. The service quantity can be categorised into two elements: frequency and network density. Frequency represents the availability of services throughout the day, which directly affects the waiting time of travellers. Frequency determines the financial aspect (more frequency means more subsidy) and the number of vehicles in use. Although the frequency can be indicated in terms of average frequency (e.g. there is a bus every 10 minutes), when there are variations between routes or operating times, this might divert the average frequency value. In practice, the usual indicators for the frequency are unit of production, i.e. vehicle hour and vehicle kilometre. Network density also determines the financial aspect and the number of vehicles in use. It is usually represented by the network length, number of lines, and number of stops. The issue of frequency and network density, which is known as network design or service design, is essential in the tendering process. In practice, sometimes the authority is accountable for network design, but sometimes the network design is the operator's responsibility. This responsibility determines the incentives to innovate for either the authority or operator. For example, if the operator is responsible for the network design, it is likely to design a network that maximises its profit regardless of the level of service quality (if the authority does not control the service quality).

Vehicle and infrastructure aspects are related to the twin characteristics approach and innovative capability we discussed in Chapter 3. They are technical characteristics. In terms of the vehicle aspect, we define the number of vehicles, accessibility of the vehicles and vehicle maintenance as key elements. As we discussed in Chapter 3, authority can propose or give an incentive for an operator to invest in a new vehicle. The investment in new and/or innovative vehicles depends largely on what benefits the operator will obtain from this investment. One of the key incentives to invest in new vehicles is the contract length, i.e. a longer contract would give more incentive to invest in new vehicles. The authority is usually responsible for the infrastructure, but some financial incentives can be used to collaborate within an infrastructure investment. An example of such cooperation is the Quality Bus Partnership scheme in the UK.

In reference to the service quality, we list seven elements that can be considered: reliability, accessibility, comfort and ride quality, safety and security, ticketing system, service integration, and travel information. As we can see, the service quality has a close relationship with the vehicle and infrastructure elements we discussed above. Higher service quality is usually the result of vehicle and infrastructure improvements. For example, the accessibility is improved due to the use of low floor buses. The travel information is improved due to the investment in information and communication technology.

Finally, we have external criteria that influence the way the authority prepares the tendering process. In this category, we define four elements: competition, environmental concern, contribution to mobility, and fare collection and control. The authority must produce a fair and transparent tendering process which provides appropriate information for the potential bidders. The competitiveness in the tendering process should bring about the better efficiency. For the environmental concern, the European Commission has already set a standard for any public authority to follow in terms of emission, and they leave it to the authority to enhance and promote the use of better, environmental-friendly buses. The contribution to the mobility of the area is also important for the authority, especially in an area where there is a congestion problem. Most authorities prefer the increase in modal share of public transport. Lastly, the fare collection and control is related to the fairness of the system and social security issues.

Operator:
In the previous section, we suggested three objectives for the operator: profitability, continuity, and company reputation. Table 5-2 summarises the criteria, elements, main factors, and indicator/measurement for the operator.

Table 5-2 Indicators of the tendering process model for operator

Criteria	Element		Main Factors	Indicator/Measurement
Profitability (Financial aspect)	• Cost	• Operating cost	• Labour cost • Energy cost • Overhead cost	• No. of staffs • Wage • Energy cost
		• Vehicle cost	• Vehicle investment	• No. of new vehicles • Cost of new vehicles
		• Maintenance cost	• Vehicle maintenance cost • Vehicle cleaning ocst	• Garage • Cleaning contract
		• Infrastructure	• Infrastructure investment cost • Infrastructure access cost	• Type of infrastructure • Cost of infrastructure
		• ICT	• Vehicle scheduling • Automatic Vehicle Location (AVL) • Dynamic travel information	• Cost of ICT equipments
	• Revenue		• Subsidy • Type of contract • Ticket sales (for net cost contract)	• Total subsidy • Total revenue from ticket sales
Continuity	• Total market share		• Number of operating concessions • Contract length of operating concessions	• Number of operating concessions
Reputation	• Company reputation		• Performance	• Number of operating concessions

First and foremost, the main objective for the operator is profitability. The operator, as a private company, seeks profit. There are two main elements that determine the profitability of the firm, namely cost and revenue.

In terms of cost, it can be further divided into four elements: operating cost, vehicle investment cost, maintenance cost, and infrastructure cost. Operating cost is a major cost of the public transport operation. Factors that determine the operating cost include labour, energy, and overhead costs. The main factor is the labour cost. The type and condition of the vehicles determines the vehicle investment cost and maintenance cost. The infrastructure cost depends on infrastructure investment and access costs. The infrastructure investment and access costs are very important factors for railway transport; but, for the bus sector, the infrastructure investment and access costs seem less important. However, there is an increasing amount of attention being paid to the investments in information and communication technology in the bus sector, so it might be relevant in this case.

Revenue is determined by three factors: subsidy, type of contract, and ticket sales. The subsidy and type of contract relate to the financial aspect of the authority (we discussed previously). The ticket sale relates to the demand that the operator forecasts, given the information available to the operator.

Continuity of the business is also an important criterion of the public transport operator. The operator tries to maintain its presence in the market. In the tendering regime, a way to maintain continuity is to win the tenders to keep the market share for the company. Also, the length of concession is another factor that determines the continuity of the company. For instance, a long contract-length concession can be vital to the operator in that the operator might seek less profit (than it usually asks for) in order to win this concession.

Finally, the operator also has to maintain its reputation in the market. This reputation presents the perception of the public (and also the authority) to the company. It implies that a good reputation may increase the chance to win the tender. In general, the reputation is represented by firm performance, which is usually indicated by how the company operates according to the contractual agreement. This is closely related to the way authority monitors the public transport operation.

5.4 Dynamic capabilities and learning: an analytical framework

The analytical framework for this thesis is divided into two parts: the dynamic process of tendering and the innovative capability analysis. For the dynamic process of tendering, we set a framework to analyse the decision process of the actors (authority and operator) in the tendering process. The emphasis of this framework is on the effects of varying elements within the system that change over a period of time.

5.4.1 *Tendering as a dynamic process*

In Chapter 4, we discussed the bounded rationality theory and noted that actors in the public transport sector are rationally bounded. The implication to this notation is that, in a real world situation, actors face a complex decision whereby the criteria for the selection are not clear, and are changing over time.

An example illustrating the evolving criteria over time is the criteria that the authority wants to achieve from the tendering process. Figure 5-2 shows an example of the objective-constraint representation of the authority.

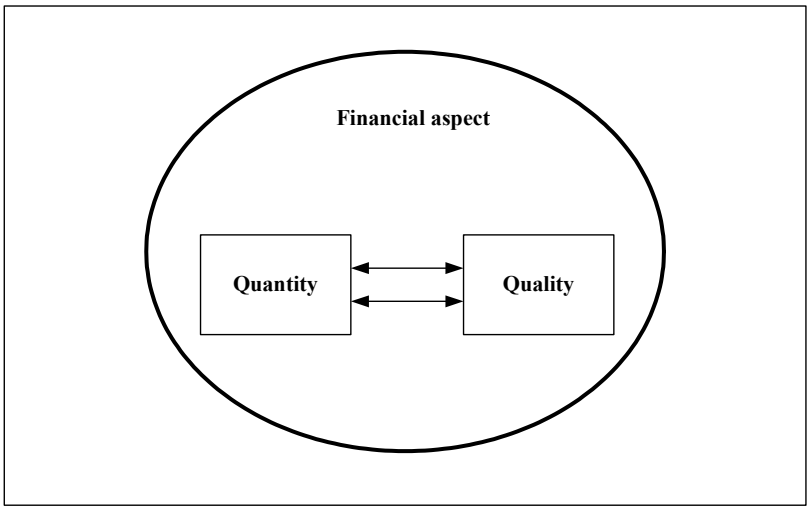


Figure 5-2 Objective-constraint for authority

In Figure 5-2, the authority has three criteria: financial, quantity, and quality aspects. These three aspects are interrelated. However, the emphasis that authority gives to each factor evolves over time. First, the authority might consider the financial aspect as most important since an increasing subsidy in public transport services concerns the central government. Thus, tendering is introduced as a part of the subsidy cutting measure. However, a lower subsidy should not deter the service quantity that is offered. Consequently, it might happen that, given constant quantity, the service quality might decrease. But later, we see the increasing concern on the quality of public transport. So, the balance between quantity and quality is required. At this stage, financial aspects are relegated to constraint rather than objective. However, when it comes to practice sessions, financing public transport is still problematic. This leads us to a new set of framework where the financial and service quality aspects can be combined together.

We discussed that in the tendering process there are two separated processes: the tendering process design, and the bidding preparation (see Figure 5-1). In the subsequent section, we will propose the dynamic models of these processes.

Dynamic model of the tender design of authority:
There are a number of criteria and elements that the authority must take into account when preparing for the tendering process. Based on the criteria, elements, and factors that we discussed in Section 5.3.2 (Table 5-1), we can construct causal relationships between the criteria and elements for this tendering process design as follows.

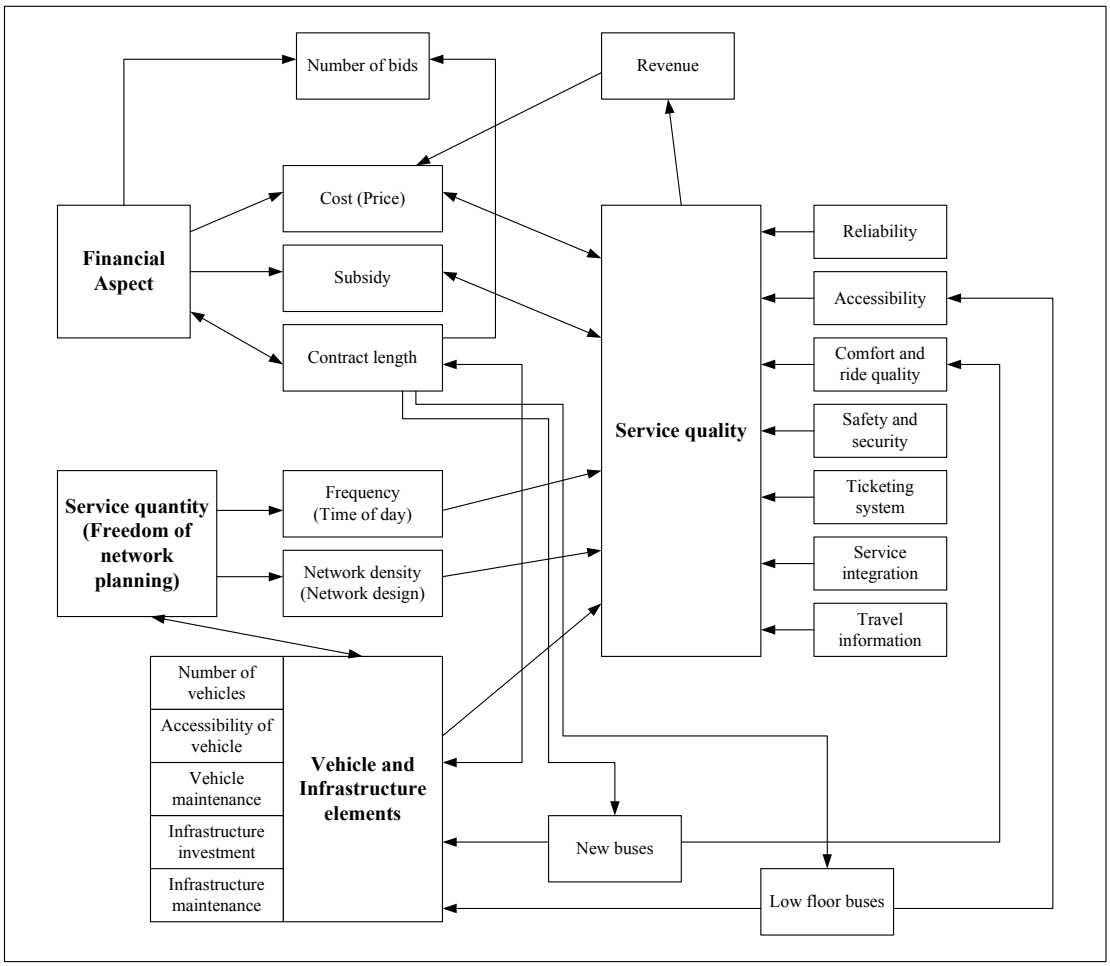


Figure 5-3 Dynamic process model of tendering for authority

Figure 5-3 shows the complex causal relationships between each factor associated with the tendering process. We can see that one element may have several causal relationships with other elements and factors: a change in one element will most likely affect other elements.

For illustrative purposes, we identify a phenomenon that could be found in practice: the knock-on effect[1]. The low floor bus could be considered as an example of the knock-on effect. The introduction of low floor buses results in better accessibility which in turn decreases boarding time. Shorter boarding time means that buses can increase their travel speed. The high speed results in both higher frequency and lower production cost. In terms of quality, low floor buses increase not only the accessibility, but also the comfort and ride quality as well.

Additionally, we will address an ambiguous causal relationship we will address. An example is the relationship between contract length and the number of bidders. On the one hand, longer contracts may attract more bidders, as it is financially attractive. On the other hand, longer contracts imply more investment wherein only big operators can be involved. So there are a few operators involved in the bid.

[1] This is similar to the Mohring effects (Mohring, 1972). This Mohring effects state that as transit frequencies increase, wait times decrease, demand increases, and transit frequencies can increase again.

In sum, the dynamic model of tendering design allows us to analyse the cause-and-effect relationship of the changes in the public transport system. In practice, detailed information regarding all elements may not available, but at least we can see the trend in the development of the tendering design that changes over time in a specific area.

Dynamic model of bidding preparation for the operator:
In the dynamic model of bidding preparation, we focus on how the operator develops and learns in preparing the offer through the repeated tendering process. Figure 5-4 shows a detail of this model.

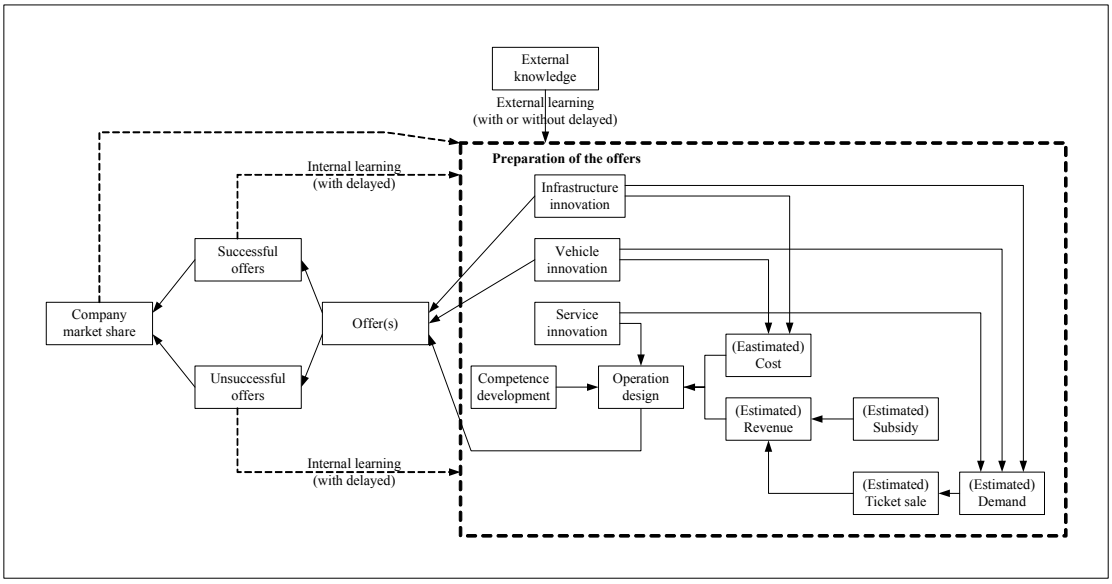


Figure 5-4 Dynamic model of tendering decision for operator

In this model, we focus on how the offer is constructed as well as what the result of the tender is. These two elements represent the main interest of the operators in submitting the bid. In order to prepare the offer, the operator uses both internal and external information and knowledge. The most important internal information is the operation design. Within the operating design, cost and revenue must be estimated. As previously discussed, the major element of operation cost is the labour cost. Further, the investment in new vehicles may play a part in the offer, which incurs an investment cost. In terms of revenue, the subsidy and revenue from ticket sales must be estimated. The service design, together with innovation in infrastructure, vehicle, and service, will form an offer; the result of the tendering process will indicate whether the bids are successful or unsuccessful.

All in all, the decision of the operator when preparing the offer is dependent on the experiences gained from previous tenders and also the external knowledge acquired during the preparation of the offer. This process, the dynamic capability and learning, was discussed in Chapter 4. We will expand on the issue of dynamic capability and learning in the next section.

5.4.2 *Dynamic capability and learning*

Dynamic Capability:
The analysis of technical and organisational capabilities is needed for both authority and operator. Table 5-3 gives examples of those capabilities in the public transport sector.

Table 5-3 Examples of technical and organisational capability

	Technical	Organisational/Competence
Authority	• Infrastructure planning and development • System integration	• Tendering process • Monitoring • Service coordination
Operator	• Vehicle development • Vehicle scheduling • Information technology	• Tendering process • Managerial capability • Marketing

The technical capability of the authority lies mostly in the planning and development of infrastructure. For the organisational capability, the authority needs to design the tendering process. Furthermore, it must also monitor the services that the operator provides and coordinate these services in case there is more than one operator working in the system.

For the operator, the technical capability lies mostly in vehicle development. The utilisation of vehicles is the key in this capability development. For the organisational capability, two elements are important. First, the operator must be capable enough to handle the tendering process well. Second, managerial capabilities are needed to organise public transport services.

Learning:
Organisations should exemplify their learning capability from their experiences in the tendering process. This learning is essential for the innovation because organisations need this opportunity to learn and acquire the knowledge to improve the way they manage the public transport services. Learning can be acquired both through the organisations own experiences, internal learning, or other experiences, external learning. This learning element may be considered as the dynamic capabilities that we defined in Chapter 4 because it is based on the organisation's ability to integrate the internal and external knowledge (and competences) to address the rapidly changing environment of the tendering process.

In public transport organisation, internal learning occurs among both authority and operator. The internal learning of the authority includes both technical and organisational/ competence elements. For example, the authority needs to plan the infrastructure from their own experiences based on the demand for public transport in their area. For the organisational/competence element, in the tendering process, the authority learns how to make the tender document from the previous round of tender. An example for internal learning of the operator is that, for companies that operate in more than one concession, they have an advantage in that they can learn from their previous tenders. The knowledge acquired includes both technical and organisational aspects.

External learning is the way in which an organisation acquires information and knowledge externally to integrate and develop technical and organisational capabilities. External learning is often costly, especially when another external organisation is involved, such as the use of a consulting firm.

Chapter 6 Regulatory Reform in the Public Transport Sector: European Experiences

6.1 Introduction

This chapter aims to review the European experiences on regulatory reform in public transport, with a focus on the tendering process. Moreover, this chapter will provide background information for the case studies in Chapter 7 and 8.

The organisation of this chapter is as follows. Section 6.2 reviews the current development of the regulatory reform of local public transport in European countries. In this section, we will emphasise on the issue of the tendering process and the organisational developments of the public transport sector. Section 6.3 examines the development of the regulatory reform in the Netherlands. The results of the tendering process to date are discussed. In Section 6.4, the regulatory reform in the railway sector is examined. The railway sector in the United Kingdom (UK) and the Netherlands is discussed in detail as well. Finally, Section 6.5 summaries the chapter.

6.2 Regulatory reform of local public transport in European countries

6.2.1 *Introduction*

The regulatory framework of the European public transport sector has changed significantly over the last 15 years. The move towards the Single European Market (SEM) within the European Union (EU) is a particularly important catalyst for this acceleration (Button and Costa, 1999). The SEM was a necessary condition for the creation of liberal transport markets to meet the overall objectives of exploiting national comparative advantages in the production of goods and services within Europe. Additionally, it compelled the need for the co-ordination and planning of transport infrastructure provision.

The EU realise the importance of the public transport sector and it is attempting to increase the efficiency of the system through the introduction of competition. We have witnessed in the past 15 years that the public transport sector, both the bus and railway, has gone through radical changes in terms of its organisational structure.

In this section, we will look briefly at the development of local public transport in European countries. We will begin with the development of the UK bus reform as Britain was considered the first country that began the regulatory reform in the public transport sector.

6.2.2 *The UK bus deregulation*

The UK led the way in significantly deregulating the urban (and rural) public transport market when it introduced the 1985 Transport Act (Button and Costa, 1999). This act set the following objectives for the local bus service in Great Britain: to abolish quantity controls (road service licensing) on local bus services outside London; to restrict subsidy payments in support of public transport for local services to unprofitable routes required to meet social need; and to make fundamental structural changes to public sector bus ownership (McGuinness et al., 1994). What was most vital about this regime was that the operators could determine fares and services on a purely commercial basis, with the exception of those areas that were not commercially feasible, and where socially necessary services were needed.

There are a number of studies that discuss the effects of deregulation in the UK. The main effects of deregulation were the excessive capacity, the decreased quality of bus services, and the increase in real fares (White, 1995). It was the lower quality of services and the increase in real fares that resulted in the sharp decrease of bus ridership. The increase in bus-kilometres seemed to have had very little effect on demand (White, 1997). There are several service dimensions, not only the subsidiary service, but also infrastructure and vehicle investment, in which both operators and local authorities have to take a responsibility (Mackie, 1999). Investment in bus infrastructure dropped dramatically after the year of deregulation as a result of both 'the effective divorce of bus operation from social planning and reforms of funding mechanisms by government' (Huntley, 2001). Thus, there was an effort to stimulate the investment in this gap. After several years, trial projects had been introduced and the Quality Bus Partnerships (QBPs) or Quality Partnerships (QPs) scheme emerged.

The concept of the QP was introduced in the early 1990s. Since then, the QP has been widely accepted by the local governments. In this scheme, QPs exist through partnerships at the local level involving bus operating companies, local authorities, as well as Passenger Transport Executives and Authorities (PTE/PTA). There are two different types of QPs: Quality Bus Partnerships (QBPs) and Quality Contract Schemes (QCSs). The difference between these two is that QPs are based on the voluntary partnerships (i.e. do not legally bind by any legislation), whereas the QCSs are based on statutory contract which ensures that both authorities and operators are legally responsible for any commitments that are made in the contract.

In terms of the effects of deregulation on innovation, Ongkittikul and Geerlings (2006) observed that the UK deregulation presented a radical movement of the innovation. The deregulation had profound effects on all three innovative capabilities[1], i.e. infrastructure, vehicle and service operation. The innovation in infrastructure and vehicle development seemed to have had negative effects, such as the lag of investment in infrastructure and the decrease of the average vehicle age. But, the result of that lag of investment led to the introduction of the Quality Bus Partnerships to improve the infrastructure and vehicle qualities, as we discussed earlier.

It is also worth mentioning that the tendering of the bus services in London differs from the rest of the UK. In London, the provision of service networks is tendered out

[1] See the definition of the innovative capabilities in Section 3.5.

to private operators, but the specification of the type of service to be provided is determined by the regulatory authority (London Transport). The detail of the London tendering regime will be discussed in Chapter 7.

6.2.3 *Current regulatory developments of local public transport*

There is a variety of regulatory frameworks of local public transport in the European countries. The different local public transport modes (e.g. bus, tram, or underground railway) also have different organisational structures. We have seen many public transport organisations undergo the privatisation process. The aim of privatisation is to pave the way for the public transport market into the competitive industry. In Europe, there is an increasing trend towards the tendering in the local public transport service. Competitive tendering seems to be the most effective approach to introducing competition into the public transport sector.

Preston (2001a) proposes a simplified classification of three broad types of regulatory and organisational structure in public transport usually found in European countries. The first category is regulated, public-owned monopolies ('the classic model'). This was the dominant organisational form in Western European countries. However, there may be some cities that have variations on this regulatory structure. Moreover, many countries opt to move towards the second model, the tendering or limited competition model. There are a number of variants in this category. The two most common are the Scandinavian model, based on minimum cost tenders at the route level; this is the dominant form in Sweden, Denmark, and Finland, and the French model (outside Paris), based on network management contracts (Preston, 2001a). The third category is a deregulated, free-market model. This is the dominant form in the UK outside London.

The MARETOPE Project (2002) surveys the recent development of the regulatory system of local public transport in European countries. Table 6-1 shows the summary of this development. The project observes four main groups of countries that share common characteristics with regard to the transition stage and political targets. The first group is a highly deregulated and privatised market. The UK is the only country in this group. The second group comprises countries in transition towards competition by public tendering. Countries in this group are the Scandinavian countries, the Netherlands, France, and Italy. The third group consists of those countries with a mixed public/private regime without public tendering. Countries in this group are Germany, Belgium, Luxembourg, Greece, Portugal, and Spain. The final group is made up of countries in the decentralisation and privatisation process. Countries in this group are mostly Central European countries such as Hungary, Poland, and the Czech Republic.

Table 6-1 The regulatory system of local public transport in European countries

Group	Deregulated and free market	Transition towards tendering	Mixed public/private regime without tendering	Decentralisation and privatisation process
Countries	UK	Scandinavian countries, the Netherlands, France	Germany, Italy, Portugal, Belgium, Luxemburg, Austria	Central European countries
Similarities	• Private initiative • Deregulated market • Tender for loss making lines	• Public tendering introduced • Not yet everywhere applied	• Not (yet) privatisation of (some) public companies • Not (yet) transition towards tendering	• Financial problems at local and regional level • In privatisation process
Differences/ Exceptions		• Scandinavian countries are advances in the tendering process • The Netherlands and France are still in the middle of transition	• Belgium experiments with sub-tendering of operations • Austria and Italy have already legislation to introduce compulsory tendering	• Poland and Hungary started with tendering experiments

Source: MARETOPE Project (2002)

It should be noted that it is not easy to classify the countries into a certain group of regulatory regimes as within many countries a number of different regulatory forms coexist. Especially in the transition countries, many tendering styles are implemented during a trial period. Sometimes, after the first round of tendering, the authority may lock-in to a certain type of tender style and, as a result, it would take years to change the tender style as the contract usually runs for at least a couple of years.

6.2.4 *The competitive tendering contract*

In the competitive tendering regime, the type and detail of the contracts have several consequences on the competition and the operation of the public transport services. In this section, we will discuss two issues: types of contract and contract length.

In general, contracts in the public transport sector are usually categorised by the risks associated with production cost and revenue of the public transport services. Typically, risks are shared between authority and operator in either the public or private sector. Figure 6-1 shows three types of contracts that are usually found in the public transport sector. These types of contracts are the management contract, gross cost contract, and net cost contract. The management contract is the contract stating that both production cost and revenue risks are borne by the authority. The gross cost contract is the contract that warrants that revenue risk is borne by the authority, and production cost risk is borne by the operator. The net cost contract maintains that both production cost and revenue risks are borne by the operator.

		Production risk borne by	
		Authority	**Operator**
Revenue risk borne by	**Operator**	Management Contract	Gross Cost Contract
	Authority		Net Cost Contract

Figure 6-1 Risk division of public transport contracts
Source: MARETOPE Project (2000)

However, the risk division explained in Figure 6-1 is only a simplified description. In reality, there are many intermediate forms of contracts that can be seen. Either product cost risk, revenue risks, or both can be shared by the authority and operator which results in new forms of contracts. Furthermore, the authority can give an incentive for the operator to improve their performance that, again, results in new forms of contracts.

Various types of contracts are used in the tendering regimes. For example, Sweden and Denmark (Scandinavian model) use the gross cost contract. Another example is the French model (which dominant in France outside Paris) which is based on network management contracts. In such cases, the authority normally provides the vehicles and related infrastructure, and firms compete for the right to manage these resources (Preston, 2005). In the Netherlands, Provincie Zuid-Holland uses the net cost contract in their three concession areas (Hoeksche Waard, Goeree Overflakkee; Drechtsteden, Albasserwaard, Vijherenlanden; and Rijn- Bollenstreek, Midden Holland), whereas Provincie Groningen uses the gross cost contract approach. For regulatory purposes, it seems that each country should use the same contract type, but this is not always the case. The reason for this is that the local authority has an impact on the way the contract is arranged. Then, the government gives some freedom through legislation to the local authority to design what is best for an area.

Another important issue in public transport contracts is the contract length. Contract length varies throughout Europe (MARETOPE Project, 2002). It ranges from a few years to 30 years. Among the many reasons for this variation are the investments that are associated with the contract. A high investment contract tends to have a longer contract duration such as a BOT (Build-Operate-Transfer) contract. Table 6-2 gives an example of the maximum contract duration in several countries.

Table 6-2 Contract duration of the local public transport tender

Country	Type of contract	Contract duration
The Netherlands	Publicly tendered contract	Maximum 6 years
France	Standard contract	5 – 15 years
	Build-Operate-Transfer (BOT) contract	Up to 30 years
Germany	Concession	8 years
	Publicly tender contract (practice)	2 – 5 years
Austria	Publicly tendered concession	10 years
Norway	Publicly tendered concession	5 years
UK	Generally (some exceptions)	5 years
Belgium	Current management contract	5 years
	Discussion to prolong the duration to	8 years

Source: MARETOPE Project (2002)

Thus far, there is no generalisation of what the duration of the contract should be. Originally, it was suggested in the proposal for the regulation at the EU level (European Commission, 2000), that the contract should be no longer than 5 years, but with some exceptions for the investments that are made apart from the normal operation. However, this duration was too short and, later, there was a new proposal (European Commission, 2005) recommending that the duration of the bus contracts be 8 years, and for railways, 15 years. In sum, we can conclude that the contract duration should and will vary, as the investment conditions of individual operations differ significantly.

6.2.5 *The presence of multinational companies*

The regulatory reform of the public transport sector creates a wide variety of organisational forms in Europe. One of the common features is the growing involvement of the private sector in service production through either deregulation or competitive tendering regimes. Furthermore, one of the biggest changes in the industrial environment has come in the form of the merger wave and market concentration (Mackie, 2001). In the UK bus sector, the big five companies (see Table 6-3 below) control more than two-thirds of the national market. Additionally, as a result of the privatisation of British Railway in the mid 1990s (which effectively let out the passenger train operations)[2], there is also a sign of market concentration. Roberts (2003) summarises the degree of concentration within, and between, the railway and bus sectors in Britain in Table 6-3 below.

[2] See Section 6.4.2 later in this chapter.

Table 6-3 British railway franchises and bus market shares

Ownership form	Company	Rail franchises (no. of franchises)		Bus market share in 2002 (%)	
		2001	2003	Great Britain	London
Major UK transport groups	National Express	9	9	5.6	0.2
	Stagecoach plus joint venture with Virgin	2 2	2 2	15.7	15.4
	First Group	3	4	22.5	16.6
	Arriva	2	1	14.9	18.4
	Go-Ahead plus joint venture with Keolis	1 1	1 2	7.5	17.5
Other	CGEA (Connex)	2	1	<0.5	2.3
	John Laing	1	1	-	-
	Sea Containers (GNER)	1	1	-	-
	GB Railways	1	0	-	-
	NedRailways/Serco	0	1	-	-

Source: Roberts (2003)

In addition, Velde (2003) observes that the growth of private involvement has led to the development of major international operators. These operators have originated almost exclusively from Britain and France in the past decade. Table 6-4 shows the summary of the major players of public transport in Europe.

Table 6-4 Major players of public transport in Europe and global players

Company	Origin	Number of countries it operates	
		Inside Europe (including its origin)	Outside Europe
Arriva	The UK	7	0
Concordia	Norway	3	1
Connex	France	15	4
First Group	The UK	1	2
Keolis	France	6	1
National Express	The UK	1	3
Stagecoach	The UK	1	3
Transdev	France	5	1

Source: UITP (2003)

We can conclude that the British deregulation of the local bus outside London led to the appearance of new private operators: Arriva, First Group, Go-Ahead and Stagecoach. In France, the new European trend of public transport tendering led to the expansion of French operators: Connex, Keolis and Transdev. Thus far, the most active company is Connex, which operates in 15 countries in Europe and 4 countries outside Europe. We also see that the majority of multinational companies are of both French and British origin. Three companies that are active in the European countries are Arriva (the UK), Connex (France), and Keolis (France). It should be noted that three other British companies (First Group, National Express, and Stagecoach) do not operate in mainland Europe, but rather in North America (Canada and the US).

6.3 Situation of regional public transport in the Netherlands

6.3.1 *Public transport in the Netherlands*

The overall picture of transport in the Netherlands is provided in Table 6-5. As we can see, the dominant transport mode is the passenger car. It accounts for around three quarters of the total distance travelled by the Dutch population. The train and bicycle are equally important in the Netherlands. They account around 6-8% of the market share each mode.

Table 6-5 Total distance travelled by the Dutch population by mode of transport

Mode	1985	1990	1995	1999	2000	2001	2002	2003
Car	107 (74.2%)	125.9 (75.1%)	131.4 (74.7%)	141.3 (75.7%)	141.1 (75.6%)	141.6 (75.5%)	144.2 (76.1)	146.1 (76.5%)
Train	7.7 (5.3%)	11.2 (6.7%)	13.0 (7.4%)	15.0 (8.0%)	15.4 (8.3%)	15.5 (8.3%)	15.5 (8.2%)	14.5 (7.6%)
Bus/Tram and Underground	6.4 (4.4%)	6.9 (4.1%)	8 (4.5%)	7.5 (4.0%)	7.5 (4.0%)	7.6 (4.1%)	7.2 (3.8%)	6.6 (3.5%)
Bicycle	12.2 (8.5%)	13.5 (8.1%)	13.7 (7.8%)	13.1 (7.0%)	13.1 (7.0%)	13.1 (7.0%)	13.0 (6.9%)	13.9 (7.3%)
Walking	3.8 (2.6%)	3.9 (2.3%)	4.1 (2.3%)	3.9 (2.1%)	3.9 (2.1%)	4.0 (2.1%)	4.0 (2.1%)	3.9 (2.0%)
Other	7.1 (4.9%)	6.3 (3.8%)	5.8 (3.3%)	5.8 (3.1%)	5.6 (3.0%)	5.7 (3.0%)	5.5 (2.9%)	6.0 (3.1%)
Total	144.2	167.7	176	186.6	186.6	187.5	189.4	191.0

Note: Distance travelled is in billons of kilometres. The modal shares are in brackets.
Source: AVV Transport Research Centre (2004)

Within the public transport sector, there are two main modes: bus, tram, and metro; and train. Bus, tram, and metro are the main modes of urban and rural public transport, whereas the train is important for inter-urban and intercity transport. We see that the trend towards bus, tram, and metro utilisation has declined since 1995. But the trend in train use increased in 1990 and has declined slightly since 1995. It should be mentioned that the increase in train use in the early 1990s was the result of the introduction of the student public transport card (Openbaar Vervoerkaart voor Studenten) in 1991. This card provided free use of public transport (any mode at any time) for Dutch students[3].

In sum, the public transport situation in the Netherlands is causing some concern as the market shares for train and bus, tram, and metro are declining. Next, we will look at the policy development of the public transport sector in the Netherlands.

6.3.2 *The Passenger Transport Act 2000*

In general, public transport in the Netherlands is organised separately between regional public transport and railway transport. For regional public transport by bus, tram, metro and lightrail, regional authorities have been responsible for organising the public transport services since January 2001, when the Passenger Transport Act 2000 (Wet personenvervoer 2000: Wp2000) came into force (UITP, 2003). There were 35

[3] However, due to the fact that students had excessively used public transport for personal reasons rather than for educational purposes, which was the original intention, the second generation of the student card was introduced in 1994 to restrict the use of this pass.

regional authorities responsible for regional public transport. These authorities were the 12 provinces (Provincies), 7 regional corporations of municipalities in the larger urban regions (so-called kaderwetgebieden), and 16 middle-large cities (Vervoersautorteiten Openbaar vervoer Centrum gemeenten: VOC-gemeenten). However, from 1 January 2004, the responsibility for the regional transport for these 16 cities was transferred to the 12 provinces. Thus, there are 19 public transport authorities that are active at the moment (see Annex 2 for the full list of these authorities).

The introduction of the Wp2000 has been the greatest development in Dutch public transport in recent years. This reform's aim was twofold: more attractive public transport services (especially in areas worst hit by congestion) and an improvement in cost recovery ratios (Velde, 2003). This act decentralised the power to provinces and regional authorities, and competitive tendering of public transport services for concessions was introduced gradually. A time scale of 6 years was chosen in which, at first, some 35% of all bus concessions were to be tendered (Hermans and Stoelinga, 2003). Table 6-6 shows the progress of this reform process.

Table 6-6 The progress (including planned) of the concessions put for tender in the Netherlands

	2002	2003	2004	2005*	2006*	2007*	After 2007*
Provincie[1]	8	4	6	10	6	0	2
Kaderwetgebieden[2]	1	1	1	1	8	5	6
VOC-gemeenten[3]	3	0	4	4	1	2	2
Total no. of concessions	12	5	11	15	15	7	10
Cumulative no. of concessions	12	17	28	43	58	65	75
Cumulative % (n=75)	16%	23%	37%	57%	77%	87%	100%

Note: [1] Province
[2] Regional corporations of municipalities in the larger urban regions
[3] Middle-large cities
* Estimated figures

Source: Appelman et al. (2004)

The tendering process was subject to an evaluation by the Dutch Parliament in 2005. The result of the evaluation was positive[4], and the Parliament agreed to go ahead with the plan that all bus concessions as well as tram and metro concessions had to be tendered by the year 2007. However, there was an exception to the big four municipally-owned companies (GVB of Amsterdam, RET of Rotterdam, HTM of the Hague, and GVU of Utrecht) in that a separate plan should be discussed.

As a result of this act, there has also been reform among the public transport operators in the Netherlands. Prior to this act, before the mid 90s, almost all of the regional bus transport operators in the country were provided by subsidiaries of a national bus company, VSN (later called Connexxion). After that, Connexxion sold its northern subsidiaries to Arriva (the UK public transport company) and its southern subsidiary to Connex (the French transport company) which led to a situation where there were three large companies active in the bus transport market. Note that in the Netherlands, Connex took over the BBA which operated in the Brabant area. To avoid confusion between Connex and Connexxion, Connex is usually referred as

[4] See Section 6.3.4 for the detail of the evaluation of the Wp2000.

BBA/Connex or just BBA. The current market structure will be discussed in Section 6.3.4.

The Wp2000 also covers the issue of the labour force in the public transport sector. Employees who were directly involved in transport provision (e.g. bus drivers) would transfer to the new concession holder if their current employer lost the concession. Employees who were not directly involved in transport operation would transfer to the new concession holder proportionately to the size of the concession (Velde and Leijenaar, 2001). Existing labour agreements and conditions of employment continue to apply to all staff transferring to a new employer. These provisions are valid for a period of ten years.

Thus far, the main implication of the reform in the Dutch public transport market is the tendering process that began in 2002. As we can see in Table 6-6, the tendering process has been implemented gradually, and we could say that the Dutch public transport market is now in an emerging stage. The tendering procedure that is used in the Netherlands is complicated and is still evolving. Next, we will discuss the details of this tendering process.

6.3.3 *The tendering process*

In the Netherlands, the new Passenger Transport Act 2000 (Wp 2000) created a need for more information and knowledge regarding the concession procedure. The tendering process requires considerable practical information. Most local authorities had no previous experience in the tendering process, thus local authorities attempted to gather the information via various channels, such as external consulting firms or government agencies. One of the organisations that provides knowledge for the local authorities is Centrum Vernieuwing Openbaar Vervoer (CVOV)[5].

CVOV (2003) develops the framework for the tendering procedure, which is called 'the concession cycle'. The concession cycle consists of ten steps as follows.

1. Formulating transport policy
2. Formulating public transport policy
3. Definition of the concession
4. Determining the program of demand
5. Determining the tender document
6. Invitation to tender
7. Selection procedure
8. Awarding the concession
9. Managing the concession
10. End of the concession

The relationship of each step is shown in Figure 6-2 and each step is discussed in turn.

[5] From January 1st, 2005, the CVOV changed its name to Kennisplatform Verkeer en Vervoer (KpVV).

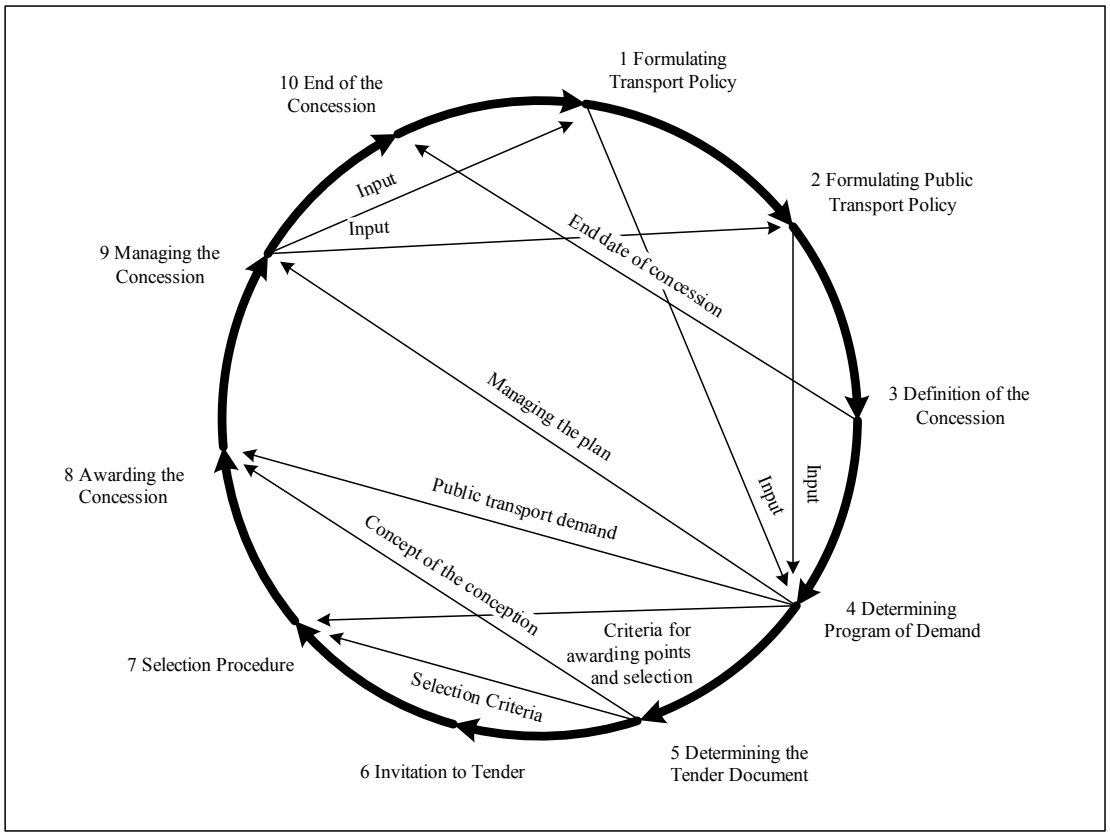


Figure 6-2 Concession cycle
Source: CVOV (2003)

Step 1: Formulating the transport policy
During this first step, the public transport authority formulates the transport policy and stipulates the place of the public transport service. At this stage the public transport identifies the available instruments to realise the policy objective. Thus, public transport can contribute to the prevention of undesirable car use, which results in congestion in the urban areas. However, there are also other employable instruments. For this reason, it is necessary to assess and harmonise the different political perspectives.

Step 2: Formulating the public transport policy
Once the role of public transport is determined in the transport policy as a whole, the goal for the public transport policy can be developed. The public transport authority must realise that this policy is composed of several elements. Not only are the public transport services important, but also other elements such as the infrastructure, the parking spaces, spatial activity, accessibility, and information of the services. The public transport also concerns a number of strategic choices that are related to the actors of the public transport system, namely passenger, operator, and public authority. It concerns the definition of the division of the responsibility between government and public transport companies, and the involvement of the passenger (user). Also, at this stage, the public transport authority must make choices concerning the invitation to tender in later stages.

The following steps (Step 3 to Step 8) of the concession cycle describe the process of the preparing and awarding of the concession. Other aspects of public transport policy follow parallel routes.

Step 3: Definition of the concession
This step aims to identify which means of transportation to use, in which areas, and how long the concession will be.

Step 4: Determining the programme of demand
The public transport authority establishes the programme of demand (Programma van Eisen: PvE) to reflect the objective of the concession. Also, it is stipulated in the PvE which selection and awarding criteria one will use to decide who wins the concession. Developing and determining the PvE asks not only for calculated substantive assessments, but also careful internal and external processes.

Step 5: Determining the tender document
The tender document has been aimed to fulfil the public transport policy to which the concession can contribute. It is built on the PvE in more detail.

Step 6: Invitation to tender of the concession
Once the tender document is ready, the formal tendering process begins according to the European Directive. At this stage, the public transport authority organises a so-called pre-bid meeting in which potential operators can ask their questions.

Step 7: Selection procedure
Assuming that a number of potential operators will respond to the invitation to tender by submitting their offers, the selection procedure begins. On the basis of the selection criteria described in the tender document, the public transport authority chooses the best offer.

Step 8: Awarding the concession
After the tender is awarded, the winning operator will be invited to discuss the concession details. The discussion does not cover what is in the tender document which is already fixed. Rather, the discussion aims for cooperation between the public transport authority and the new operator. Also in this step, the public transport authority grants the concession officially.

Step 9: Management and monitoring of the concession
From the moment that the concession starts, the public transport authority has a new role. The authority will monitor and evaluate the concession according to the concession agreement discussed in the tender document.

Step 10: End of the concession
The maximum length of concession is six years. It is important that the transfer of the contract from the end of the previous contract to the new one is well-planned so the continuity of the public transport services is retained. In the case of a change in operator, new fleets are an important issue because often the new operator cannot prepare new fleets (if it is offered in the bid) in such a short period of time. Furthermore, the transfer of personnel is also a critical issue. The transfer of the

backroom staff is a difficult task as some staff is not full-time. When this occurs, the transfer cannot take place. This issue is to be dealt with on a case-by-case basis.

The tendering process is a time-consuming process. CVOV suggests that the length of the tender process should be about 18 months (from Step 3 to Step 9). From the defining of the concession (Step 3) to determining the program of demand (Step 4) takes around 6 months. Then, from determining the program of demand to awarding the concession should be around 6 months. Once the decision is made in terms of who wins the concession, there should be a gap of 6 months for the operator to start the concession. Clearly, the entire tendering process must be planned in advance, and it requires considerable resources and knowledge.

In practice, the given guidelines for the tendering process are just suggestions. There is considerable variation. The tendering process of the train concession seems to be longer than that of the bus, especially from the awarding of the concession and the start of the concession. Although the average time gap between the awarding of the concession and the start of the concession is around 7 months, there are considerable differences in various circumstances depending largely on the authorities' experience in the tendering process. Table 6-7 shows the average time gap between the awarding and start of the concession in the Netherlands. As the train concession tends to announce the winning bid well in advance, this table excludes train concessions from the calculation.

Table 6-7 Average time gap between awarding and start of the concession

	No. of concessions	Gap between awarding and start of concessions (months)		
		Average	Min.	Max.
Concessions started in 2002	12	4.5	2.1	7.7
Concessions started in 2003	6	7.1	4.8	11.2
Concessions started in 2004	8	6.2	5.2	8.0
Concessions started in 2005	7	7.3	4.0	9.4

Source: KpVV (personal communication) and KNV (2005)

As we can see, the year 2002 shows a rather short time between the awarding of the tender and the day that the concession starts. This may due to the fact that most authorities had not much experience in tendering process. But after 2003, this time gap increased to the level that CVOV suggested, i.e. around 6 months. The main problem if this time gap is too short revolves around the preparation of the new operation, especially when the operator must bring in new vehicles. For instance, in one of the tender areas in the Provincie Zuid-Holland, the time gap between the awarding and start of the concession was too short, so the new buses were not ready by the time the concession started. Thus, the services commenced with very old buses. This issue will be examined in more detail in the case study in Chapter 7.

6.3.4 *The current market situation and the tendering process*

The tendering process started in 2001 and the concessions were in operation at the beginning of 2002. Regional public transport authorities are responsible for the tendering process for public transport services in its areas and for the subsidy it receives from the government. According to a summary report by the Koninklijk Nederlands Vervoer (KNV, 2005), there were 29 concessions (only bus concessions)

that put out for tender between 2002 and 2004. It should be noted that KpVV identifies 67 concessions to be put out for tender.

With respect to the results of the implementation of the Wp2000, the Evaluation Report of the Wp2000 (Groenendijk et al., 2005) summaries the developments since the implementation of the Wp2000 in January 2001. It stated that the original objectives of the Wp2000 were: 1) to increase the growth of public transport use, and 2) to increase the cost recovery ratio of the public transport operation (i.e. ratio of the revenue to the total cost of the public transport services). First, the report found that both objectives had not been realised according to their assessment. The expected growth in the public transport use has not been achieved in either the tendering or non-tendering areas. The explanation for this difficulty is that the factors of the public transport use lie outside the influence of the Wp2000, such as the growth of car ownership and demographic and economic developments of the economy. Second, as a result of a decrease in public transport use, the cost recovery of the public transport operation has not yet been fulfilled. This development came mainly from the fact that the passenger growth has declined, and thus revenues also decreased.

Nevertheless, the Evaluation Report also revealed positive developments in some aspects. In some areas, the use of public transport was increased, especially in the large cities. There were a number of public transport infrastructure projects that started to operate in the past years, thus these projects contributed to the growth of the public transport use. Furthermore, the production costs of the public transport services have dropped considerably since the implementation of the Wp2000. In the areas where the authorities put the public transport services out for tender, the production costs, in terms of cost per vehicle-kilometre, were reduced by 10 – 20%. Up until the beginning of 2005, there were only 40% of the (potential) bus concessions that were put out for tender. Therefore, further efficiency improvements can be expected (Groenendijk et al., 2005).

A major concern in the tendering process is the market concentration problem. The Wp2000 aims to stimulate competition in the sector. However, the number of bidders in the tender was rather small. In many cases, the tender leads to the competition between three big companies namely Arriva, BBA-Connex, and Connexxion. Currently, these three big companies dominate the bus tendering market. These companies are usually referred as ABC companies. These three companies account for around 90% of the bus tendering market in the Netherlands. Table 6-8 shows the market situation.

Table 6-8 The current situation of the bus tendering market in the Netherlands

Company	2002	2003	2004	Total concessions (Market share)
	No. Concessions won	No. Concessions won	No. Concessions won	
Arriva	5	2	1	8 (28%)
BBA-Connex	3	2	2	7 (24%)
Connexxion	3	3	5	11 (38%)
Others	1	0	2	3 (10%)
Total	12	7	10	29 (100%)

Source: Calculated from KNV (2005)

There were some issues regarding the concession. The authority that gives the concession can decide whether the network design (and development) should be done by the authority itself or by the operators. However, in most cases, the network that was agreed upon in/during the concession cannot be changed. This hinders the innovation in the sector (Groenendijk et al., 2005).

In the tendering process, the Program of Demand (PvE) and the tender documents (Bestek) are important. The Evaluation Report suggested that the tender documents were described in every detail. This left little room for the operators to come up with new ideas, i.e. limiting the innovative capabilities of the operators[6]. Furthermore, there was a problem with the transparency of the tendering process. One might expect that, in general, the information of the tendering process should be made available to the public. However, this was not the case. The offers from bidders were kept confidential because of the commercial sensitivity which, in fact, decreases transparency of the system. This limits the creativity and knowledge development in the bus industry.

In addition, the Evaluation Report stated that the position of individual travellers weakened after the implementation of the Wp2000. Under this new law, the authority and operator can change the public transport services (usually timetable of the services) after consulting with the consumer organisations. However, it was criticised that all user groups of the public transport were not proportionally represented in the consumer organisations. This limits the degree of user participation in the public transport services.

6.3.5 *Fares and revenue allocation*

Since 1980, the Netherlands has maintained a national system for urban and regional public transport fares (Ministerie van Verkeer en Waterstaat, 2003). With the exception of most train trips: this covers virtually the entire public transport network. The main advantage of this system is that the passengers can travel throughout the country using the same ticketing and pricing system.

Pricing is based on the number of geographical zones 'crossed', which are uniform over the same ticket category (Ministerie van Verkeer en Waterstaat, 2003). A 'zone' (the Netherlands is split into 2,200 zones) is on average about 4 to 4.5 kilometres in cross-section. A ticket entitles a passenger to travel on all forms of public city/regional transport operating within the zones paid for. It should be noted that, especially in urban areas, there might be several transport companies operating. There are several types of tickets that are used in this system. The first type is the period ticket which is valid for one-week, one-month or one-year. The second type is the 'strippenkaart' ('strip card'), which is a presale ticket. The strip card or strip ticket, sold from numerous outlets across the country, consists of a number of parallel strips that are validated, generally by the passengers themselves, in a special stamping-machine on the tram or bus. There is also an onboard strip ticket, which is sold on the bus and tram, but this ticket costs more than the presale strip ticket. In addition, outside the national system, different fares may be applied by regional

[6] However, our case studies (see Chapter 7) observe different developments. This might due to the fact that our case studies were conducted in 2005, whereas the Evaluation Report used information that was largely collected in 2004.

authorities; this usually happens in a restricted area and is valid within only one transport company.

The important issue is the allocation of revenue from the national ticket sales to the public transport companies. The basic principle of this allocation is that it should be in proportion with the service delivered. The farebox is allocated to transport companies per sales area and per ticket group – or to be slightly more specific to public transport concessions. A regular national survey, called the WROOV system, was introduced to determine the allocation 'keys' (Ministerie van Verkeer en Waterstaat, 2003). This shows the percentage of the farebox that needs to be allocated in each concession.

Over the coming years the Dutch government and regional transport companies will introduce a 'smart' or 'chip' card system (in Dutch: Chipkaart) for the entire public transport network (Ministerie van Verkeer en Waterstaat, 2003). This will put an end to the current national payment system based on paper tickets. It will also put an end to the allocation issue of sales proceeds. Each smart card will provide detailed and accurate information on all journeys actually made.

The development of the smart card began in 2002 when the five public transport companies jointly established one company, Trans Link Systems, to implement a single payment system using the smart card technology. The five public transport companies are: Connexxion, GVB (Amsterdam), HTM (The Hague), the NS (Dutch Railway Company) and the RET (Rotterdam). The pilot phase of the implementation of this smart card involved RET, NS, and Connexxion (rural bus in Rotterdam area). It was trialled in mid 2005. However, there were technical problems that delayed the implementation, and the system has yet to be implemented.

The smart card will change the way Dutch people pay for the public transport services if it is implemented. Clearly, the benefit of the 'zone' system is that it is easy to understand and it reduces the onboard payment or fare collection. However, the smart card could replace this system easily. In fact, currently, most concessions, that are in operation or are being put out for tender, include the possibility of the implementation of the smart card as a part of the concession agreement. The smart card will also make the all-in-one ticketing system possible. At the moment, travellers who use both bus and train must have two separate tickets[7] for each mode. The smart card will be used for all public transport in the Netherlands. Furthermore, there have already been discussions on how pricing can be changed if the smart card is implemented. With this smart card technology, it might be possible to change the pricing system from zone-based to another system, such as distance-based or a combination between distance-based and area (i.e. urban or rural areas). Also, it might be possible to utilise the peak-hours pricing, which does not currently exist in the Dutch public transport[8]. But, the conclusion to those issues remains to be seen until the smart card system is eventually implemented.

[7] Although it is possible to have an annual ticket for both bus and train.
[8] There is a discount card for off-peak travellers, but it is available only for the railway system.

6.4 Railway reform in European countries

6.4.1 *Railway reform in European countries: an overview*

European railway has changed dramatically in the past decade. The privatisation process had been an issue for the railway in most countries in Western Europe. Furthermore, the European Directive 91/440, on the accounting separation of infrastructure and operation, also brought about the industrial restructuring in the European railway sector. There is a considerable difference between these two sectors in terms of infrastructure and services. Recently, this distinction has become a major topic of discussion, especially in the railway industry in which much organisational analysis is presented in many studies.

Nash and Toner (1999) suggest three possible alternative models of organisation in the railway industry, namely the vertically-integrated railway, the internal market approach, and the vertically-separated railway. First, the vertically-integrated railway is the traditional model of railway operations, with one organisation controlling all infrastructures as well as operating and marketing functions. In this model, ownership can be either public or private, and there is the possibility of horizontal separation into area or regional monopolies. In the second model, the internal market approach, railways are separated into different businesses for the purpose of offering products to the consumer; these business purchases service from an operating department organised on regional and functional lines. The businesses are generally defined in terms of market sector – freight, long distance passenger, regional passenger, etc. – so any competition between them for traffic is minimal. Originally, those businesses operated on a financial basis, and operating costs were allocated to the business sectors on the basis that each sector was responsible for the costs of assets (including infrastructure) and staff who were the prime users, while other sectors using those assets paid the avoidable costs. By the early 1990s, this form of organisation had developed to the extent that the maintenance management and operation of the infrastructure as well as rolling stock was being disaggregated to the sectors. This led to the establishment of the third model, the vertically separated railway. Under this model, the entire infrastructure is the property and responsibility of one owner (either publicly or privately owned). Providers of train services are required to pay for access to the infrastructure. European legislation now requires separation, at least to the extent of separate accounting, so that there is the possibility for a degree of open access to the infrastructure for particular types of services.

Using the separating infrastructure and services in railway industries framework, Brooks and Button (1995) find a surprisingly large number of alternative options around the world. The examples of these options are grouped into 5 broad categories as in Table 6-9 below.

Table 6-9 Options of vertical disintegration of railway industries

Options	Countries of example
Public Operations/Private Track	USA
Private Monopoly Operations/Public Track	New Zealand and Argentina
Private Competitive Operations/Public track	UK
Public Operator/Public Track Monopoly	Sweden
Private Operators/Private Partnership Owned Track	Canada

Source: Brooks and Button (1995)

Railway infrastructure is normally owned by the public sector; however, the USA and Canada may be seen as exceptional cases. As indicated before, European legislation now requires separation of infrastructure and services. Nonetheless, in practice, each country has different characteristics. Monami (2000) analyses the institutions of European passenger rail industries, and the results of this study are shown in Figure 6-3.

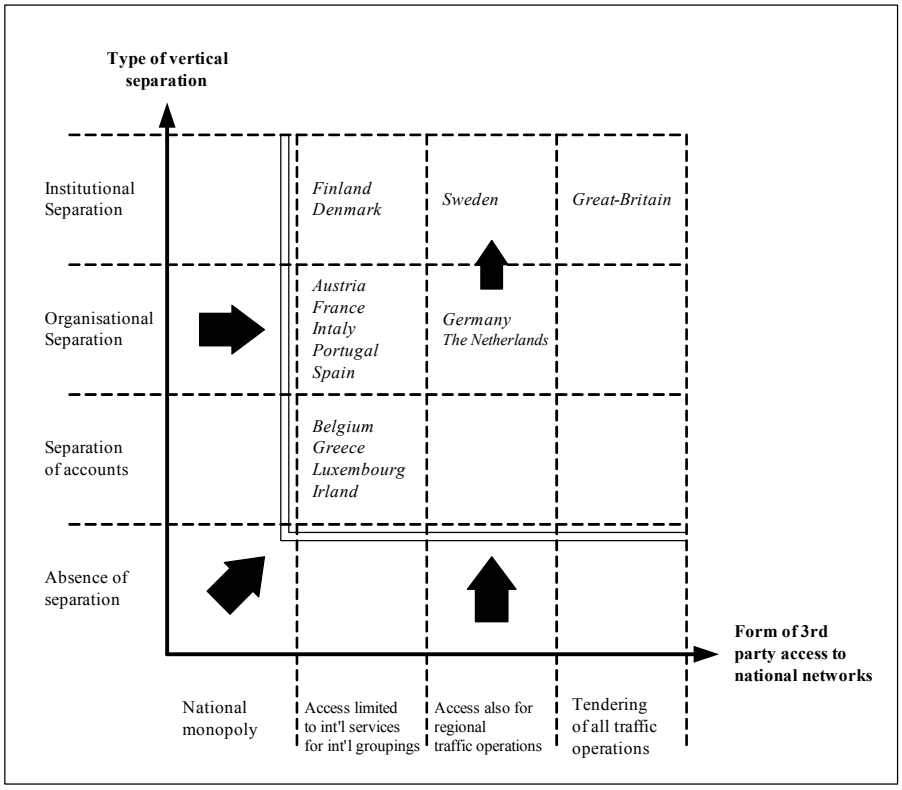


Figure 6-3 Synoptic presentation of the deregulation of passenger rail in the EU
Source: Monami (2000)

Most EU Member states now have accounting separation between operations and infrastructure (NERA, 2004). However, the difference remains in terms of the infrastructure charging. The extent to which infrastructure charges cover total infrastructure costs varies between countries with a number of countries, including Denmark, Finland, and Sweden levying them on a marginal cost basis. For the Netherlands, up until the year 2001, infrastructure charges were set at zero. The government (through ProRail, the Dutch rail infrastructure company) has now introduced charges and plans to increase them steadily until they cover the marginal costs caused by different traffic types by 2007 (NERA, 2004).

It should be noted that a possible form of competition of service operations in the railway industry is the competitive tendering, i.e. competition for the market. Direct competition (i.e. on-track competition where railway tracks are open to all operators to operate at will subject to certain requirements) is not found in practice in the passenger railway sector, although it is common in the freight transport sector. As we can see, European passenger railways are now in a transition period, especially in forming the organisational structure. The nature of these characteristics and the

proper control of government can be designed to gain better efficiency from the railway sector.

Empirical studies of rail tendering are less common than bus (Preston, 2005). In many European countries, experience in the tendering process is limited with the exception of the UK and Sweden. In the UK, the tendering (or franchising) process has taken place for the second time already. Table 6-10 shows an example of empirical cases of railway tendering in European countries. Preston (2005) indicates that the European tenders (except in the UK) are relatively short (5 years or less), the winning firm has no responsibility for infrastructure, and fare and service levels and other aspects of performance are heavily prescribed by the government. In Sweden, local authorities usually bear the revenue risk, and hence, local tenders are awarded on a net cost basis. Germany has a combination of gross and net cost contracts. Elsewhere (the Netherlands, Switzerland, and more recently, Denmark), net cost contracts are norm. However, it should be noted that some tenders can have a long contract period (up to 15 years) if there is a considerable investment in the tender. For example, the tender in Provincie Groningen and Friesland is 15 years long because there is an investment in new rolling stocks[9].

Table 6-10 Example of empirical cases of European passenger rail tendering

Case Study	Length (years)	No. of bidders	Major investment	Maintenance of rolling stock	Maintenance of infrastructure	Contract specification	Award criteria
UK	5-15	3-8	Varies	Rolling stock companies (ROSCOs)	Track authority (Railtrack now Network Rail)	Passenger service requirements Fares Operating performance	Net cost
Germany – VRR (two routes)	5	3/1	No	Franchisee	Track authority (DB AG)	Fares Timetable performance	Gross cost
Germany – VRS (three routes)	15	3/2/2	No	Franchisee	Track authority (DB AG)	Fares Timetable performance	Net cost
Sweden Jönköping Länstågen	4	2	No	Franchisee (heavy maintenance by JLT)	Track authority (Banverket)	Fares Timetable performance	Gross cost
The Netherlands – Groningen and Fryslân	15	2	Yes	Franchisee	Track authority (ProRail)	Fares Timetable performance	Net cost
The Netherlands – Gelderland	5	3	No	Franchisee	Track authority (ProRail)	Fares Timetable performance	Net cost

Sources: Preston (2005), KNV (2005), and case study in Chapter 8

6.4.2 *Railway reform in the United Kingdom*

The UK rail industry has been radically reformed since the beginning of the privatisation process in 1994. The details of this process are well-documented elsewhere[10]. Briefly, the industry was restructured into potentially profitable units that have been privatised by outright sale, and non-profitable units that have been privatised by franchising. The potentially profitable units are the rolling stock leasing companies (ROSCOs), Railtrack, the infrastructure supply companies (ISCOs) and the trainload freight companies. However, a unique aspect of British Rail's

[9] This case will be discussed in detail in Chapter 8.
[10] See, for example, Kain (1998)

privatisation was the transfer of businesses to the private sector that had little chance of making a profit, i.e. the passenger rail industry (Preston et al., 2000). This transfer process has become known as franchising.

The passenger rail industry was split up into 25 Train Operating Companies (TOCs) which were franchised in a series of trenches administered by the Office of Passenger Rail Franchising (OPRAF) between February 1996 and March 1997. For each rail franchise, OPRAF sets minimum service standards (the passenger service requirement: PSR) in terms of frequency, speed, the controlling of certain fares, and, in some cases, other criteria such as reliability and crowding. Generally, PSR was set close to the levels of service before privatisation for franchises received a large state subsidy, but more freedom is given to operators where the franchise is closer to commercial viability.

Since the privatisation process has finished, the structure of the railway organisations has been changed several times. At this moment, we can indicate five groups of the key stakeholders in the UK rail industry (Steer Davies Gleave, 2003b). Figure 6-4 provides an overview of the key stakeholders.

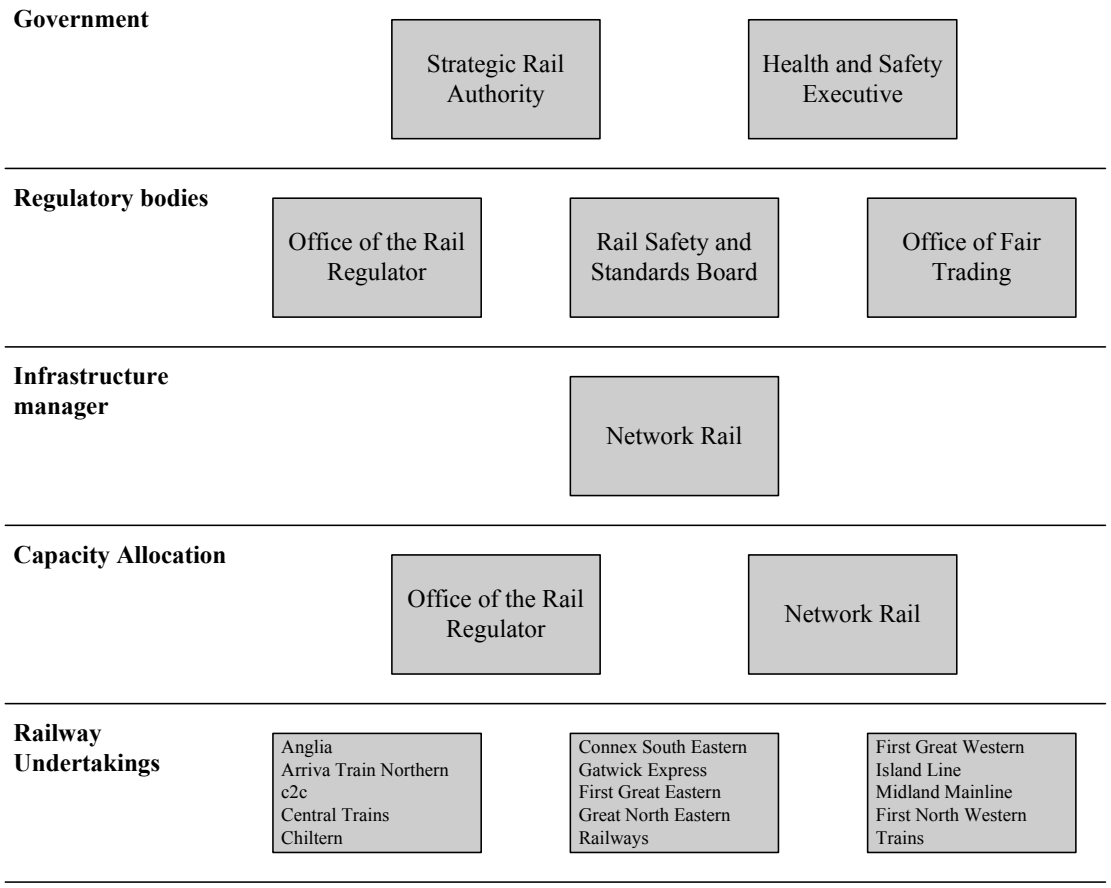


Figure 6-4 Key stakeholders in the UK rail industry
Source: Steer Davies Gleave (2003b)

In the first group, there are two stakeholders from the government. The first stakeholder, who is particularly important, is the Strategic Rail Authority (SRA). SRA provides overall strategic direction for the UK's railways. It is responsible for

the franchising process and manages the franchises. Furthermore, it develops and sponsors major infrastructure projects. It should be noted that, in 2001, the SRA took over the functions of the ORPAF. Another stakeholder, Health and Safety Executive (HSE), is concerned with promoting compliances with health and safety laws as well as developing and reviewing railway health and safety policies (Steer Davies Gleave, 2003b).

The second group is the regulatory bodies. There are three regulatory bodies in the UK's railway system. The first regulatory body is the Office of the Rail Regulator (ORR). The ORR is responsible for ensuring fair and equitable treatment for operators of trains, stations, networks and depots, and for protecting the public interest in holding the privatised, infrastructure provider of the rail network to account for its performance and stewardship of the network, and in doing so, to determine its income for the delivery of its customers' and funders' reasonable requirements (SRA and ORR, 2002). Second, the Office of Fair Trading is an independent competition and consumer protection authority, and works concurrently with the ORR. The third is the Rail Safety and Standards Board (RSSB), which is a non-profit company owned by the railway industry. It is independent of any single railway company, and leads and develops the long-term safety strategy of the industry.

For railway infrastructure, Network Rail owns, manages, improves and upgrades the UK railway infrastructure. It should be noted that in 2001 RailTrack was forced into administration, and then the government transferred the ownership of the UK railway infrastructure to Network Rail. It is a company limited by guarantee, and is a private sector organisation which operates as a commercial business but without shareholders (Steer Davies Gleave, 2003b). For the capacity allocation, the ORR has responsibility for primary allocation of track capacity, which is exercised through the approval of Track Access Agreements between railway operators and Network Rail. Network Rail has responsibility for secondary allocation of track capacity, which is exercised through timetable provisions (Steer Davies Gleave, 2003b).

In reference to the TOCs, since the first round of the franchising process in 1996-1997 up until 2001, there were 25 franchises that had been settled down so that most franchises are currently operated by the big five British transport companies. In the first round of the franchising process, the contracts were awarded in lengths between 5 and 15 years with a median of 7.25 years (Preston et al., 2000). Longer franchises (i.e. 15 years contracts) were awarded on the condition that investment in rolling stock would be undertaken. Because some franchises had a short contract length, they have already ended. Thus, there was a refranchising process in 2002 and 2003. Consequently, there were some changes in TOCs. Table 6-11 shows the development of the British railway franchises.

Table 6-11 British railway franchises in 2003

Ownership form	Company	Rail franchises (no. of franchises)	
		2001	2003
Major UK transport groups	National Express	9	9
	Stagecoach	2	2
	plus joint venture with Virgin	2	2
	First Group	3	4
	Arriva	2	1
	Go-Ahead	1	1
	plus joint venture with Keolis	1	2
Total of the major UK transport groups		20	21
Other	CGEA (Connex)	2	1
	John Laing	1	1
	Sea Containers (GNER)	1	1
	GB Railways	1	0
	NedRailways/Serco	0	1
Total no. of franchises in the UK		25	25

Source: Roberts (2003)

The majority of the franchises' holders are in the five major UK transport groups. This is in line with our previous discussion regarding the concentration of the public transport operators in the UK public transport market.

6.4.3 *Railway reform in the Netherlands*

Since 1995, the Dutch national railway company (Nederlandse Spoorwegen) has been split up into several companies. NS Passengers and NS Cargo are the train operating companies for passenger and freight respectively. NS Rail Infrastructure Management, NS Traffic Control, and Railned deal with track management and planning and control of rail traffic. These three companies are subsidiaries of the NS Holding, but act under the authority of the government (Schaafsma, 1997). However, in 2003, these three companies were reorganised into one company, ProRail.

The key stakeholders in the Dutch rail industry can be divided into five groups (Steer Davies Gleave, 2003a). Figure 6-5 provides an overview of the key stakeholders.

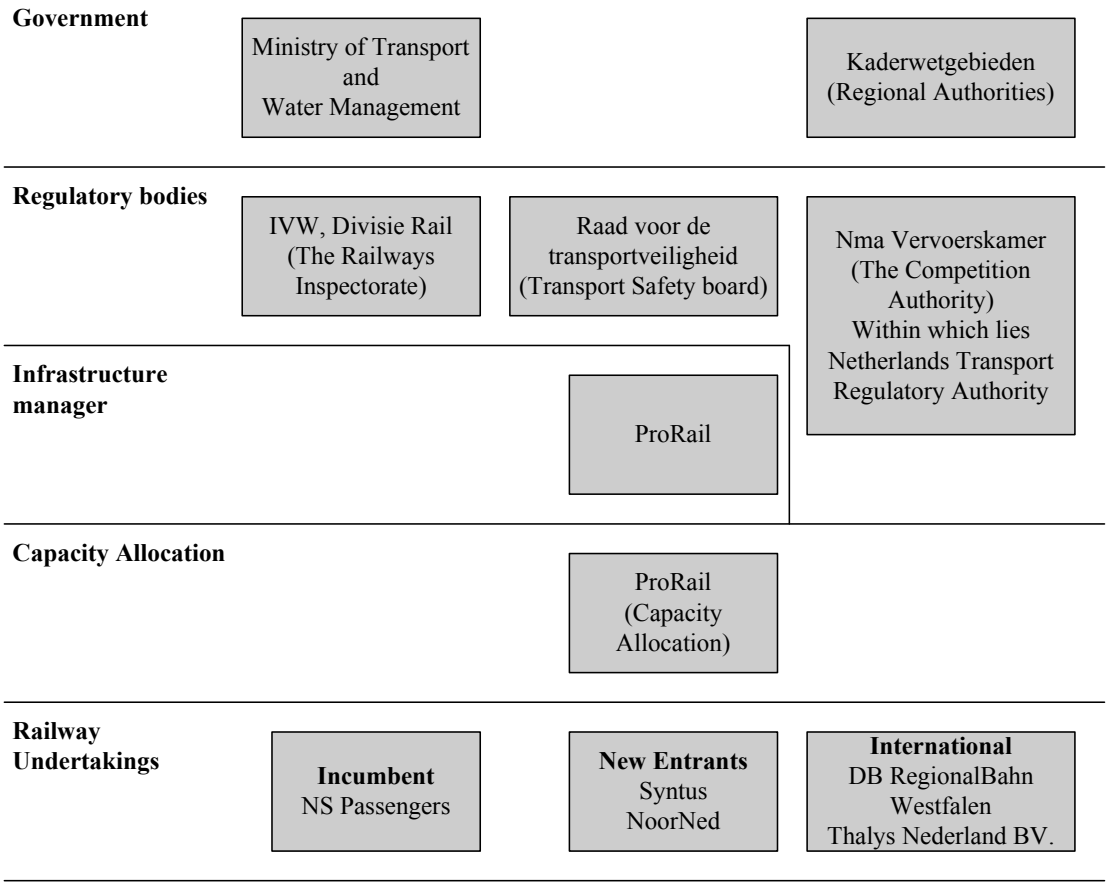


Figure 6-5 Key stakeholders in the Dutch rail industry
Source: Steer Davies Gleave (2003a)

There are two government bodies responsible for the railway in the Netherlands. First, the Ministry of Transport and Water Management (V&W) is responsible for the Netherlands transport policy covering traffic by road, rail, air and sea. In the rail sector, it is responsible for passenger transport concessions, legislation and regulation. The ministry is the sole shareholder of ProRail and NS Passengers. Second, the Regional authorities (see Section 6.3) are responsible for some railway lines under the Passenger Transport Act 2000 that are not to be part of the core NS Passengers network. Five railway concessions are in operation at the moment. They are: Zutphen/Hengelo/Oldenzaal, Zutphen-Apeldoorn, Arnhem-Tiel, Friesland/ Groningen/Nedersaksen (Groningen case: Chapter 8), and Ede/Wageningen-Barneveld-Amersfoort.

There are three regulatory bodies concerning the railway sector. First, Inspectie Verkeer en Waterstaat (IVW), Divisie Rail (The Railways Inspectorate) is an independent government authority within the Ministry of Transport and Water Management responsible for maintaining and improving the level of safety within the Dutch rail industry. Second the Dutch Transport Safety Board investigates transport accidents and incidents in aviation, shipping, rail, road traffic and pipeline transport. Third, the Dutch Competition Authority (Nma Vervoerskamer) is a government agency, accountable to the Ministry of Industry, Employment and Communications. In this competition authority, there is a subsection called the Netherlands Transport Regulatory Authority. This body is set up to supervise the competition in the railway

sector (as well as for other public transport, trams, and bus transport). It is also responsible for overseeing compliance against legally defined standards and obligations.

In terms of railway infrastructure, ProRail takes responsibility for the management and maintenance of rail infrastructure and stations which includes the planning for the revision and extension of the infrastructure, building of rail infrastructure and stations, directing of trains on the network, and the collection of up-to-date information about the rail network. ProRail is also responsible for capacity allocation which is done on an independent basis in accordance with the appropriate domestic legislation.

For the operating companies, NS Passengers is the main operator in the Dutch railway passenger market. NS Passengers is 100% state-owned; it operates across the whole of the Netherlands and carries approximately 320 million passengers annually. In principle, it receives no subsidy. The core network is operated as a commercial business without subsidies. However, there are some lines that are operated by contract with subsidies from local authorities to maintain the social services.

As mentioned earlier, regional authorities are responsible for some railway lines under the Passenger Transport Act 2000 that are not to be part of the core NS Passengers network. Up until now, five railway concessions have been in operation. The operators are NoordNed and Syntus. We will expand later on the case of Groningen which NoordNed is the current operator.

6.5 Regulatory reform in the public transport sector: concluding remarks

The regulatory framework of the European public transport sector has changed significantly over the last two decades. Although there are a variety of regulatory frameworks of public transport, most systems are now moving towards a competitive tendering system. Fundamentally, local public transport (mainly bus) and railway transport are different, especially in terms of industrial structure. In this chapter, we described these two systems separately.

The recent development of the regulatory systems of local public transport in European countries shows that most countries are moving towards the competitive tendering framework. The MARETOPE Project (2002) observed that the only country that is using the deregulated and privatised approach is the UK. Scandinavian countries, the Netherlands and France are in transition towards the competitive tendering. In the tendering regime, various types of contracts are used.

The regulatory reform of the public transport sectors creates a wide variety of organisation forms. One of the common features is the growing involvement of the private sector in service production. Furthermore, one of the biggest changes in the industrial environment has come in the form of the merger wave and market concentration (Mackie, 2001). In addition, Velde (2003) observes that the growth of private involvement has led to the development of major international operators. These operators have originated almost exclusively from Britain and France in the past decade.

For the local public transport in the Netherlands, the introduction of the Wp2000 has been the greatest development in recent years. This act aimed to introduce competition in the public transport market through competitive tendering systems. It decentralised the power to provinces and regional authorities in organising the tendering processes. The tendering process has been introduced gradually since 2002. The Evaluation Report of the Wp2000 (Groenendijk et al., 2005) suggested that the act failed to realise the original objectives. The report found that the expected growth in the public transport use has not been achieved in both the tendering and non-tendering areas. As a result of a decrease in public transport use, the cost recovery of the public transport operation has not been improved either. However, the Evaluation report also revealed some positive developments. In some areas, the public transport use was increased, especially in the large cities. In the areas where the authorities put the public transport services out for tender, the production costs, in terms of cost per vehicle-kilometre, were reduced by 10 – 20%. The major concern in the tendering process is the market concentration problem. The number of bidders in the tender was rather small. In many cases, the tender leads to the competition between three big companies namely Arriva, BBA-Connex, and Connexxion. The Evaluation Report also pointed out some issues in the tendering process. It questioned whether the authority should give the task of the network design (and development) to the bidders or not. Without the right to develop the network, the operator may not be able to innovate. This hinders the innovation in the sector (Groenendijk et al., 2005). In addition, the Evaluation Report observed that the tender documents were described in very detail. This left little room for the operators to come up with new ideas, i.e. limiting the innovative capabilities of the operators. Furthermore, there was a problem regarding the transparency of the tendering process. One might expect that the information of the tendering process should be made available to the public: however, this was not the case. The offers from bidders were kept confidential due to commercial sensitivity which, in fact, decreases the transparency of the system. This limits creativity and knowledge development in the bus industry.

For the railway sector in Europe, the railway organisations have changed dramatically in the past decade. The privatisation process had been an issue for the railway in most countries in Western Europe. Furthermore, the European Directive 91/440, on the accounting separation of infrastructure and operation, also brought about the industrial restructuring in the European railway sector. This Directive made the competition in the railway sector possible. The form of competition of railway passenger services is competitive tendering. As we can see now, European passenger railways are in a transition period, especially in forming the organisational structure. However, in terms of the competitive tendering in passenger railway, experience in the tendering process is limited with the exception of the UK and Sweden.

This chapter described the railway reforms in the UK and the Netherlands in detail. The UK rail industry has been radically reformed since the beginning of the privatisation process in 1994. Briefly, the industry was restructured into potentially profitable units that have been privatised by outright sale, and non-profitable units that have been privatised by franchising. Five groups of stakeholders in the UK rail industry after the privatisation process are: the government, regulatory bodies, infrastructure manager, capacity allocation, and railway undertakings. For the passenger services, there were 25 franchises that had descended so that most franchises are currently operated by the big five British transport companies. The

second-round franchising process began in 2002. For the Netherlands railway industry, the Dutch national railway company (NS) has been split up into several companies since 1995. Also, five groups of stakeholders in the Dutch rail industry can be identified. For the passenger services, NS Passengers is the main operator. However, some parts of the networks were put out for tender+ by regional authorities. Up until now, five railway concessions are in operation.

Chapter 7 Empirical Cases in the Bus Industry: Service-Oriented Innovation

7.1 Introduction

The predominant form of regulatory reform in the bus sector in Europe is the competitive tendering approach. We reviewed the development and economic effects of this regulatory reform in the previous chapter. The current chapter aims to illustrate empirical evidence of the effects of regulatory reform (i.e. the competitive tendering) on innovation in the bus sector. The case studies to be discussed involve two countries: the Netherlands and the UK (London). The regulatory framework in both cases follows the competitive tendering model. The Dutch cases will illustrate an emerging system because the Netherlands has just begun to use the tendering approach in the public transport sector. We will show how innovation is considered in such circumstances. The London case will illustrate a more stable regulatory framework because it has used the competitive tendering model for two decades. We will see the innovation issue that has emerged through the quality improvement scheme in the system. We will then compare and analyse the innovation in both cases.

The organisation of this chapter is as follows. Section 7.2 presents a description of the Dutch case study. Then Section 7.3 analyses the case study using the analysis framework developed in Chapter 5. Section 7.4 makes a comparison of the Dutch case with the London bus tendering system. Finally, Section 7.5 summaries the findings of this chapter and outlines the policy implication of the innovation within the bus sector.

7.2 The Dutch cases

7.2.1 *Introduction*

The tender process in the Netherlands began in 2001 as the result of the Passenger Transport Act 2000 (See Chapter 6). Although every tender that proceeds must follow the EU requirement (Hermans and Stoelinga, 2003), the details of the tender process vary dependent on the public transport authorities who put the public transport services to tender.

The bus sector in the Netherlands is evolving at the moment. The Passenger Transport Act 2000 required that the bus sector should first be put out for tender. In this chapter, we concentrate on three specific cases. The cases have been selected based on two criteria. First, the cases represent the development of the tendering procedure and involve different companies. There are three major companies that are

active in the Dutch public transport market: Arriva, BBA-Connex[1], and Connexxion. Thus, the selected cases should represent at least two of these three major companies. Second, the case study requires an intensive qualitative analysis in which information is gathered through an interview. Both the authority and operator involved in the cases must be willing to participate in these interviews.

According to the selection criteria, we selected three areas. We contacted the authorities and operators to ask for their participation, and they were willing to participate. The cases are centred in two areas in Provincie Zuid-Holland and one area in Stadregio Rotterdam.

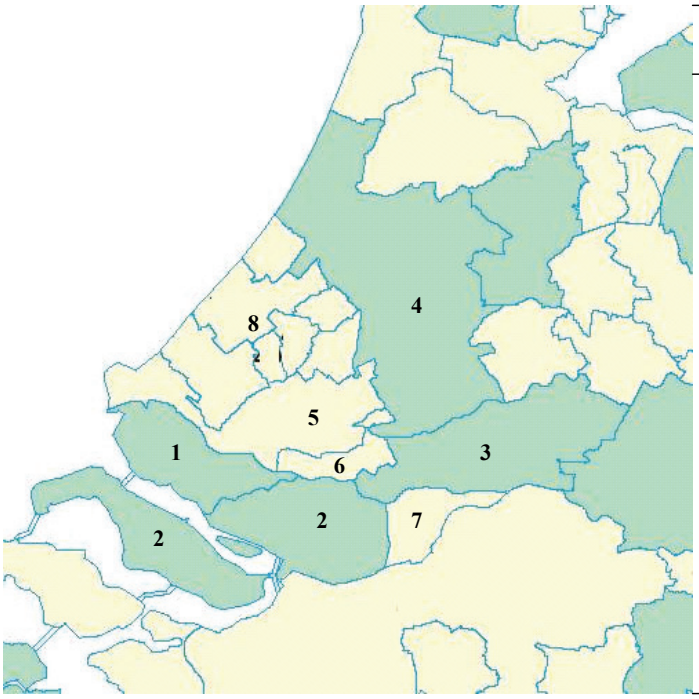
The data collection methods for the cases are twofold. First, the interview method is used to collect qualitative information. We interviewed relevant parties, i.e. authorities who are responsible for the concession area and the company who operates the concession (see Annex 1 for a list of interviewees). The interview is divided into two parts. The first part consists of several open-end questions regarding the tendering process and innovation. The second part of the interview is opened for general discussion regarding the incentives and barriers of innovation in the tendering process. Second, the secondary information is gathered from various publications, such as policy documents, press releases, consulting reports, and tender documents. With these two sources of information, we then analyse the cases according to the analysis framework that we proposed in Chapter 5.

It should be noted that the confidentiality of the information on the concession is a main barrier for analysing the case study. Often, the quantitative data on public transport is not readily available, except the data collected on an ad-hoc basis for specific research. Furthermore, the competitive pressure in the bus tendering market makes companies unwilling to give any financial figures regarding the concession operation. Besides, the authority is obliged to withhold this information even if it is on hand. Most information available is estimated figures.

All cases are located in the Provincie Zuid-Holland area, which is the most densely populated part of the Netherlands. The case study areas include the surrounding urban areas of the Hague and Rotterdam cities. Figure 7-1 shows the map of the areas in the case study. There are three authorities that are responsible in those areas: Provincie Zuid-Holland (PZH), Stadsregio Rotterdam (SRR), and Stadsgewest Haaglanden. PZH is the provincial authority that is responsible for the greater area of Zuid-Holland (South-Holland). PZH is responsible for all public transport services in the above-mentioned areas except in the areas of the region Haaglanden and the region of Rotterdam where it delegates the responsibility to the regional authorities. There are two regional authorities that are in the Zuid-Holland: SRR and Stadsgewest Haaglanden. SRR is the regional authority of the Rotterdam region, which consists of 18 municipalities. Rotterdam city is the second largest city in the Netherlands after its capital, Amsterdam, and it has a large container port. Stadsgewest Haaglanden is the regional authority of Haaglanden, which consists of nine municipalities (including the

[1] BBA-Connex is a subsidiary company of Connex (the French transport company). BBA was previously owned by several local authorities in the southern area of the Netherlands. The company was then sold to Connex prior to the introduction of competitive tendering. BBA-Connex is often referred as BBA to avoid confusion with another Dutch operator Connexxion, which is currently owned by the Dutch government. We will refer BBA-Connex as BBA for the rest of this chapter.

Hague itself). The region Haaglanden is located in the area that surrounds the Hague, northwest of Rotterdam city.



	Concession area	Responsible Authority
1:	Voorne-Putten	SRR
2:	Hoekse Waard/Goeree-Overflakkee	PZH
3:	Drechtsteden-Alblasserwaard-Vijfheerenlanden (DAV)	PZH
4:	Duin- en Bollenstrerl/ Leiden and Rijnstreel/ Midden-Holland (DBL/RMH)	PZH
5:	Rotterdam City (Urban area)	SRR
6:	Regio Rijmond streekvervoer	SRR
7:	Dordrecht	PZH
8:	The Hague	Stadgewest Haaglanden

Figure 7-1 Map of the areas covered in the case study

The timeline of the cases is very important in understanding the development of the public transport tendering process. This set of case studies will illustrate the learning process of the authorities and the operators in the tender procedure and the operation and management of the concessions. We will see that both authority and operator learn from their past experiences, even in a very short timeframe (3 years). Figure 7-2 shows the timeline of our three cases.

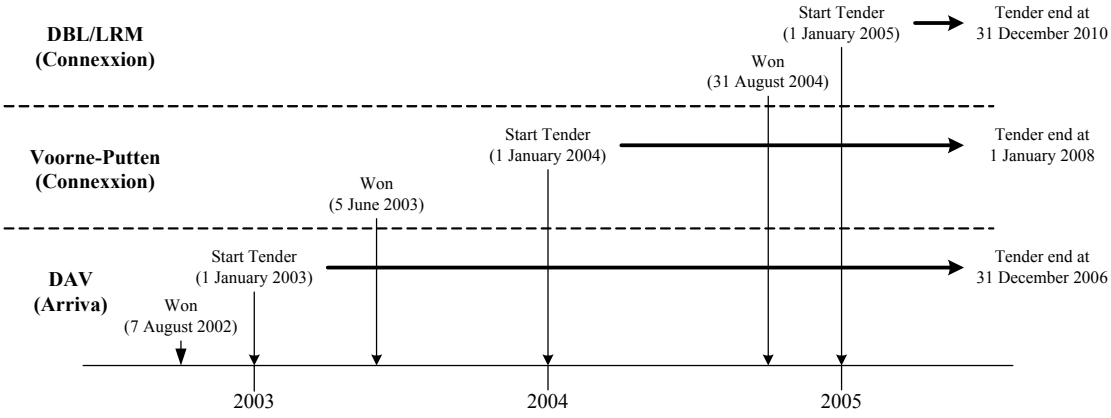


Figure 7-2 Timeline of three concessions in the case studies

The first case is the tender in the Drechtsteden-Alblasserwaard-Vijfheerenlanden (DAV) area. The tender process commenced in mid 2002 and the concession began in 2003. This case was the second bus tender in this area. Therefore, the authority

and operator had little experience in the tendering process. The second case is the tender in the Voorne-Putten area. The tender process started at the beginning of 2003 and the concession began in 2004. The last case is the tender in the Duin- en Bollenstreek/Leiden and Rijnstreek/ Midden-Holland (DBL/LRM) areas. The tender process started in mid 2004 and the concession began in 2005.

Furthermore, the case of the Rotterdam public transport company (RET) is added to understand how the threat of regulatory reform affects the way a monopoly operator reacts to the system. RET is a municipally-owned company that operates metro, tram, and bus lines in the Rotterdam urban area. It is a monopoly operator in this area. However, the public transport services in Rotterdam city are planned to be put out for tender between 2007 and 2012. The plan is to first put the bus service for tender in 2007 and then tram and metro in 2012. The case will discuss the innovative capability of the RET under the pressure of the privatisation process.

7.2.2 *Bus tendering in DAV area (Provincie Zuid-Holland)*

The Drechtsteden-Alblasserwaard-Vijfheerenlanden (DAV) area of the regional government, Provincie Zuid-Holland (PZH), is located near the Rotterdam city on the eastern side. The bus network length of this concession is around 500 kilometres. The turnover of this concession is around €16.4 million (Appelman et al., 2003) of which around 60% is the subsidy.

The tendering process:
The first experience for PZH in tendering occurred in 2001 in the area of Hoeksche Waard/Goeree Overflakkee[2]. The DAV's tender was the second tender that PZH initiated. In this tender, PZH also chose for a competitive tendering with pre-selection, as in the previous tender. The authority selected four public transport companies to make a bid: Arriva, BBA, Connexxion, and SVN. The existing network, service hours, frequencies and connections were the basic requirements in the tendering procedure, which is called a basic package. Each company had to fulfil these basic conditions.

In addition to the basic package, the authority also introduced a quality element into the winning criteria, which was called the plus package. This plus package could be considered as a sort of authority's wish list. Companies could win extra points if they could fulfil the items on this wish list. The wish list was divided into three categories based on mobility function (3 points), quality aspect (2 points) and preferences with a social function (1 point). Other points could be won by having the best ranking on 1) accessibility (3 points); 2) environmentally friendly rolling stock (3 points); and 3) view on mobility (10 points). The authority gave these extra points on the basis of the most innovative proposal. Furthermore, the company suggesting the highest attractive aim in ridership growth on the most important corridors to the neighbouring large cities could win 5 points. Lastly, the company could win 3 points if it offered a lower cost for additional services if the authority requested them during the contract.

The tender document was released in May 2002 and the result of the tendering was announced on August 7th, 2002. The concession started on January 1st, 2003 and will be concluded at the end of 2006. The contract length is 4 years. Although PZH had

[2] This area is located to the south of the Rotterdam city area. See Figure 7-1.

the option to grant the concession for a maximum of 6 years, they decided to grant the concession for only 4 years because they planned to combine this area with the city of Dordrecht, which would be put out for tender in 2006. Moreover, they also intended to have a multi-modal concession, which would combine the bus and regional railway lines; it will probably be tendered in 2007.

Tendering outcomes:
All four companies made offers. Arriva won the concession. PZH stated in their press release that the winning company offered improved public transport services which include the following:

- many new fast services to Rotterdam city;
- many new lines;
- on exiting lines, increased frequency is offered;
- new low floor buses; and
- environmentally friendly buses.

Evaluation and lessons learned:
In a general assessment, a report by the Ministerie van Verkeer en Waterstaat (Ministry of Transport and Public Works) (Ministerie van Verkeer en Waterstaat, 2004) suggested that there is 10.5% more service hours for 6% lower subsidy (compared to the situation before the tender). This seems inline with PZH's expectations.

However, there was a problem at the beginning of the concession with the new buses. This area was formerly operated by Connexxion, and Arriva had to start the concession by taking over staff from Connexxion. The issue was that Arriva could not order the new buses to be ready at that time. The concession had to start with old buses. The main reason for this was that the period between awarding the concession and the start of the concession did not allow enough time (just 4 months) to order new buses. However, this problem was solved, and the authority now seems satisfied with the current operation. In terms of revenue from the concession, Arriva reported that the revenue from this tender did not meet their expectations in terms of what they had initially predicted.

The key lesson from this tender is that, if there is a change of operator, it is crucial to ensure the smoothness of the transfer of the services. It was the case that the new operator, Arriva, needed a greater transition period in the ordering of the new buses, which would have taken some months. It is possible that the incumbent (Connexxion) could withdraw all the buses that are currently being used in the area after the end of their contract, and Arriva would face a problem if unable to find replacement buses in time (either new or standby buses).

Analysis of the tender process:
We can analyse this case using the analysis framework that we developed in Chapter 5. Figure 7-3 shows the analysis of the DAV case.

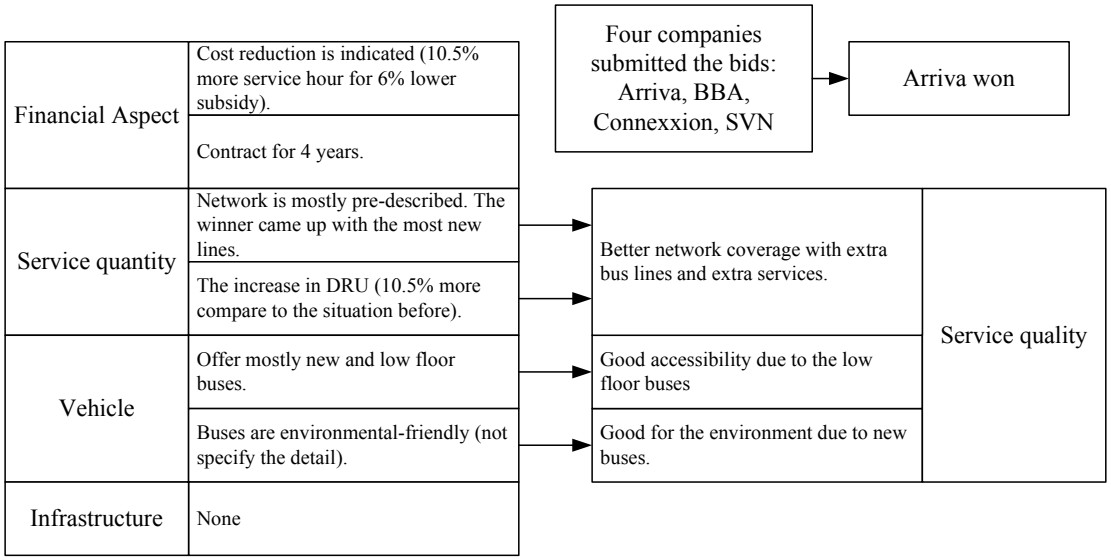


Figure 7-3 Analysis of the tendering process: the DAV case

In terms of competition, the four companies, which were invited to submit their bids in the pre-selection phase, submitted their bids. Three of those companies are major players in the Netherlands (Arriva, BBA, and Connexxion). This case had the highest number of bids among our three cases.

In addition to the improvement from a financial perspective, the quality of public transport services is also improving. The new bus lines and increased frequency give the traveller more service options. Furthermore, the quality of the vehicle has improved. The new low floor buses give more convenient services to the travellers. It should be noted that the issue of infrastructure was neglected in this tendering process.

Authority – innovative capabilities and learning:
In terms of technical capability, PZH has improved the quality of the vehicle through the tendering process. They left some room for the operator to come up with an initiative on vehicles, and they chose the company who offered the new, low floor vehicle. However, they did little on the infrastructure side. It seems that PZH, at that moment, had little knowledge in terms of how to innovate in infrastructure through the tendering process. However, in the subsequent tender, PZH demonstrates that the innovation infrastructure is also important, which we shall see later in the case of DBL/LRM areas.

In terms of organisational capability, this tender is the second tender that PZH organised. The tender process seemed successful. PZH exploited the tendering process using quality elements to induce the investment in the new, low floor buses successfully. However, the issue that PZH neglected was the change in operators which affected the commencement of the concession and resulted in some unfortunate circumstances, i.e. the old bus problems.

In terms of learning, PZH shows that they have used their own experiences in order to exploit the tendering process. It is worthy to note that PZH also allowed Arriva to modify the timetable, which was not originally agreed in the tender document.

However, the results from the freedom PZH gave in terms of network development in this case did not meet their expectations as the ridership growth was only slightly increased.

Operator – innovative capabilities and learning:
In terms of technical capability, Arriva used its facilities wisely and, with their offer on low floor buses, won the concession. Although the low floor buses were not the only element that helped Arriva win the concession, they might be one of the influential factors. It should be noted that other technologies were not included in this tendering, such as dynamic information and smart card technology. The reason would be that this tender was an early one and the operator tended to choose for proven technologies which had low financial risk. Furthermore, the smart card initiative was not yet developed when this tendering process started.

In terms of organisational capability, Arriva showed a disappointing start, as they could not order the new buses in time for the start of the concession. Also, apart from what was established in the tender agreement, Arriva did not initiate any new ideas to the services. This could be that there was no incentive for them to do so. PZH also recognised this point as they have since changed to a new approach of tendering.

In terms of learning, it could be identified that the use of low floor buses was an external learning process. The operators have seen the low floor buses as a new opportunity in this new concession. However, we will assess the learning element of the operator in detail later in Section 7.3.

7.2.3 *Bus tendering in Voorne-Putten (Stadregio Rotterdam)*

The public transport authority is a part of the regional authority of the Rotterdam region (Stadregio Rotterdam: SRR). SRR must cooperate with the regional government (PZH). SRR will have other two areas to put out for tender in the future: the bus service in suburban area (Regio Rijmond streekvervoer; Connexxion is the current operator) and the bus service in the city of Rotterdam (the Rotterdam municipally-owned company, RET, is the current operator[3]). Furthermore, SRR will be responsible for the Rotterdam city area when the RET is privatised (i.e. bus, tram and metro).

The tendering area is the suburban area of Rotterdam, which is called Voorne-Putten. It is located south of the Rotterdam city. The bus network length in this area is around 230 kilometres. Although the exact figure of the turnover of this concession is not available, Appelman et al. (2004) report it to be around €10 - 20 million.

The tendering process:
SRR had no experience in the tendering process before this case. SRR chose to use competitive tendering with pre-selection. It indicates what the selection criteria are based on: the company's experience and performance, quality and process control of the company, and knowledge of the Dutch public transport system and the relevant law and legislation. Three companies (Arriva, BBA, and Connexxion) were invited to make offers.

[3] We will discuss the case of RET later in Section 7.2.5.

The requirement set in the tender document stated that the operator must design the frequency of the bus services to meet the minimum requirements set by SRR. The minimum requirements were based on the situation before the tender took place. SRR required that the quality, such as frequency, information provision, and quality of buses, would not drop. However, SRR indicated that the quality requirement was set in a broader term where the company could make their own initiatives to offer higher quality of public transport services.

The judgment criteria for the awarding of the concession were based on price (subsidy level) and quality of the services. The criteria were divided into four aspects: financial aspect, availability of services, quality of services (during the trip), and other aspects (such as information provision and customer services).

The program of demand was released in December 2002, and the result of the tender was announced on June 5th, 2003. The concession started on January 1st, 2004 and will be finalised at the end of 2007. The contract length is for 4 years.

The tendering outcome:
All three companies made offers. Connexxion won the concession. SRR stated in their press release that they considered not only the number of bus timetable hours and the price of the offer, but also the quality of the services. The tender outcomes can be summarised as follows:

- increased frequency;
- new fast service lines;
- new buses and low floor;
- Euro-3 standard buses;
- customer service; and
- possibility of fast implementation of the smart card (Chipkaart).

Evaluation and lessons learned:
In a general assessment, a report by the Ministry of Transport and Water Management (Ministerie van Verkeer en Waterstaat, 2004) suggested that there was around 18% cost reduction (compared to the situation before the tender). In general, SRR is satisfied with the progress of the current operator.

The lesson from this tender is aimed at the operator. It appears that Connexxion learned that the quality of the vehicle is important for the offer, thus the new, low floor buses were included in their offer. Furthermore, it appeared that, after this tendering process, the authorities were looking for improvements in quality aspects, such as travel information and the smart card technology as well. These quality aspects were then realised by the bidders in the later concessions.

Analysis of the tender process:
We can analyse this case using the analysis framework that we developed in Chapter 5. Figure 7-4 shows the analysis of the Voorne-Putten case.

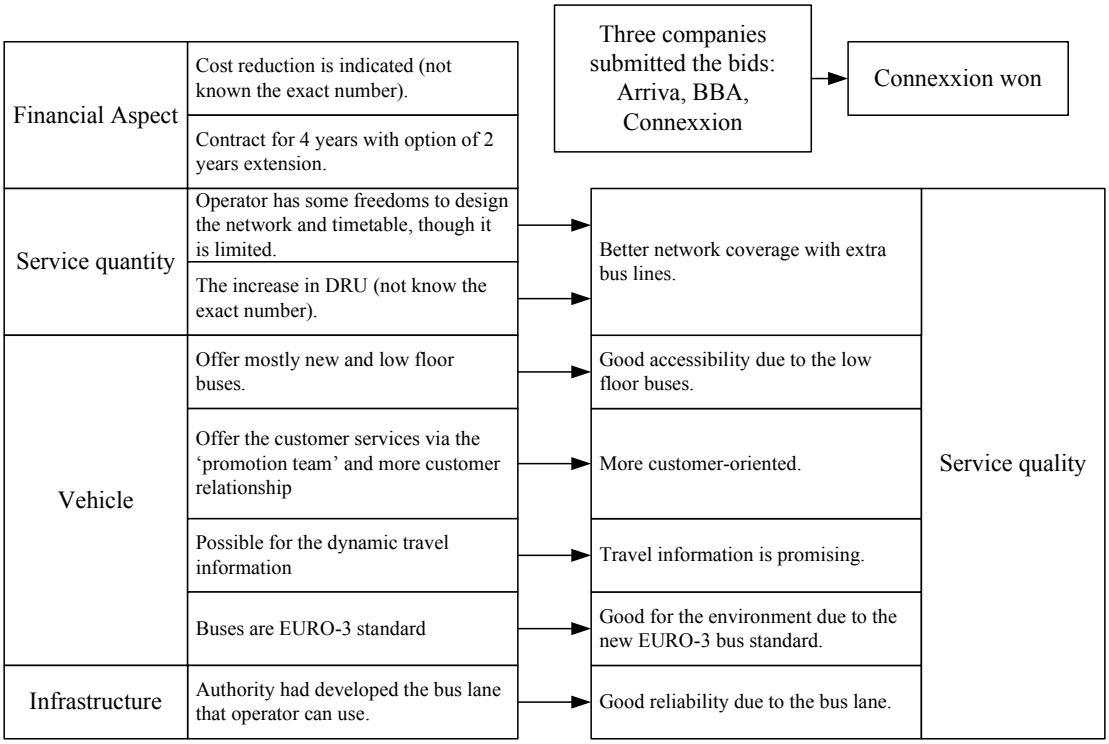


Figure 7-4 Analysis of the tendering process: the Voorne-Putten case

In terms of competition, three companies, which were invited in the pre-selection phase, submitted the bids. These companies are the key players of the Netherlands bus service sectors. Although the number of bids was smaller than the DAV case, the competitive pressure was more or less the same as the previous case because of the presence of the big three (Arriva, BBA, and Connexxion).

Although the financial element was still important for the tender, more quality elements were added. The competition in the tendering process was tense. Connexxion offered more quality items that are related to technological and organisational innovation, such as environmentally friendly buses according to EURO-3 standards, the possibility of the dynamic travel information, and the possibility of implementation of the smart card (Chipkaart). Furthermore, the operator would benefit from the exclusive bus lane that SRR developed which would provide additional improvements to the quality of services that users can benefit from.

Authority – innovative capabilities and learning:
In terms of technical capability, SRR had an advantage in that the exclusive bus lane was developed prior to the tender so the operator could use this facility for express services. This appears to be a very important element for the successful operation in the tender area which attracts more passengers. The role of infrastructure development was later realised in the Evaluation Report of the Wp2000 (Groenendijk et al., 2005). Apart from this, SRR opened up the options for improvement through their tender document which resulted in the new buses. This development follows the same pattern as in the DAV area. Furthermore, SRR considered the possibility of ICT implementation (dynamic travel information).

In terms of organisational capability, this tender was the first tender that SRR organised. The tender process seemed successful. SRR exploited the tendering process using quality elements to induce the investment in the new, low floor buses and the commitment of the operator on the smart card and information provision.

In terms of learning, SRR had limited knowledge for internal learning as this was their first tender. However, SRR showed considerable learning capabilities through an external source which allowed them to organise the first tender smoothly. The external source was a consulting firm that SRR employed to help them to prepare the tender document.

Operator – innovative capabilities and learning:
In terms of technical capability, Connexxion repeated what Arriva did in the DAV tender which proves that the technical capability can be imitated rather easily. But the infrastructure innovation, in terms of information provision cannot be ignored here. In all, Connexxion illustrated innovative ideas that matched SRR's expectations, which helped them to win the concession.

In terms of organisational capability, an interesting development should be addressed here. Connexxion lost several concessions to their rivals, so the strategic reaction was to create a tendering team which was assigned the special task of preparing all offers in the Netherlands. This seems to have helped them considerably. The concession team is also the innovation department where innovative ideas are created to be put into the offers.

In terms of learning, Connexxion learned quickly from their experience in the DAV tender. This was an internal learning. As a result, their offer was improved, and was more competitive. The learning element of the operator will be discussed in more detail in Section 7.3.

7.2.4 *Bus tendering in Duin- en Bollenstreek/Leiden and Rijnstreek/Midden-Holland areas (Provincie Zuid-Holland)*

The 'Duin- en Bollenstreek/Leiden and Rijnstreek/Midden-Holland' area of the regional government, Provincie Zuid-Holland (PZH), is located northeast of the Hague and south of Amsterdam city. This area also includes the city of Leiden. The bus network length of this concession is around 800 kilometres. This concession is very large and accounts for the government subsidy of more than € 25 million per year.

Tendering process:
PZH gained experience from the previous two tenders (Hoekse Waard/Goeree-Overflakkee and Drechtsteden-Alblasserwaard-Vijfheerenlanden areas). PZH's experience was useful in designing the tender process for the new tender area. The area of tender was in fact two combined areas. These areas were Duin- en Bollenstreek/Leiden (DBL), which includes city of Leiden, and Rijnstreek/Midden-Holland (RMH). The company could submit a bid for DBL, RMH, or both areas.

Initially, PZH invited four companies to bid for this concession. However, there were only two operators that offered the bids: Arriva and Connexxion. The reason might

have been that the size of the tender was very large which resulted in only two operators who were capable enough to handle the bid.

For these tenders, the winning criteria were more complicated. The concession was divided into: 1 big area, or 2 separate areas. The winning criteria would then assess all offers in formula. There were 9 aspects to be fulfilled, 1 aspect on price and 8 aspects on quality. The details of these aspects are as follows:

Price aspect:

1. The subsidy per timetable hour

Quality aspect:

2. Development of the new public transport services
3. Development on marketing and communication
4. Accessibility improvement
5. Business plan and the company
6. Social security
7. Setting up of the smart card
8. Setting-up of dynamic travel information on board and at the stops
9. Image of the public transport system

There was a special feature in this tender document related to the financial arrangement. PZH provided around € 1 million (in addition to maximum subsidy of € 24.4 million on the normal operation) on the development of new public transport services (the quality aspect no. 2 above).

The tender document was released in July 2004 and the result of the tendering announced on August 31st, 2004. The concession started on January 1st, 2005 and will be concluded at the end of 2010. The contract length is 6 years.

Tendering outcome:

As mentioned earlier, only two companies, Arriva and Connexxion, made the offers. Connexxion won the concession from the combined offer of both areas. The tender outcomes can be summarised as follows:

- 22.6% more timetable hours;
- all new low floor buses;
- onboard information of the stops in every bus;
- all air conditioned buses;
- dynamic travel information at twenty important stops;
- improved provision of information; and
- fast setting-up of the smart card (Chipkaart).

Evaluation and lessons learned:

It is too soon to make any assessment on the operation in this case as the tender just began at the beginning of the year 2005. However, it should be noted that the duration between the awarding and the start of the concession is again very short, only 4 months, similar to the case of DAV. Yet, there have not been any reported problems with the operation at the beginning of the concession. The reason might be that Connexxion was an incumbent operator (contracted to operate at the area before the tender).

Analysis of the tender process:
We can analyse this case using the analysis framework developed in Chapter 5. Figure 7-5 shows the analysis of the Duin- en Bollenstreek/Leiden and Rijnstreek/Midden-Holland case.

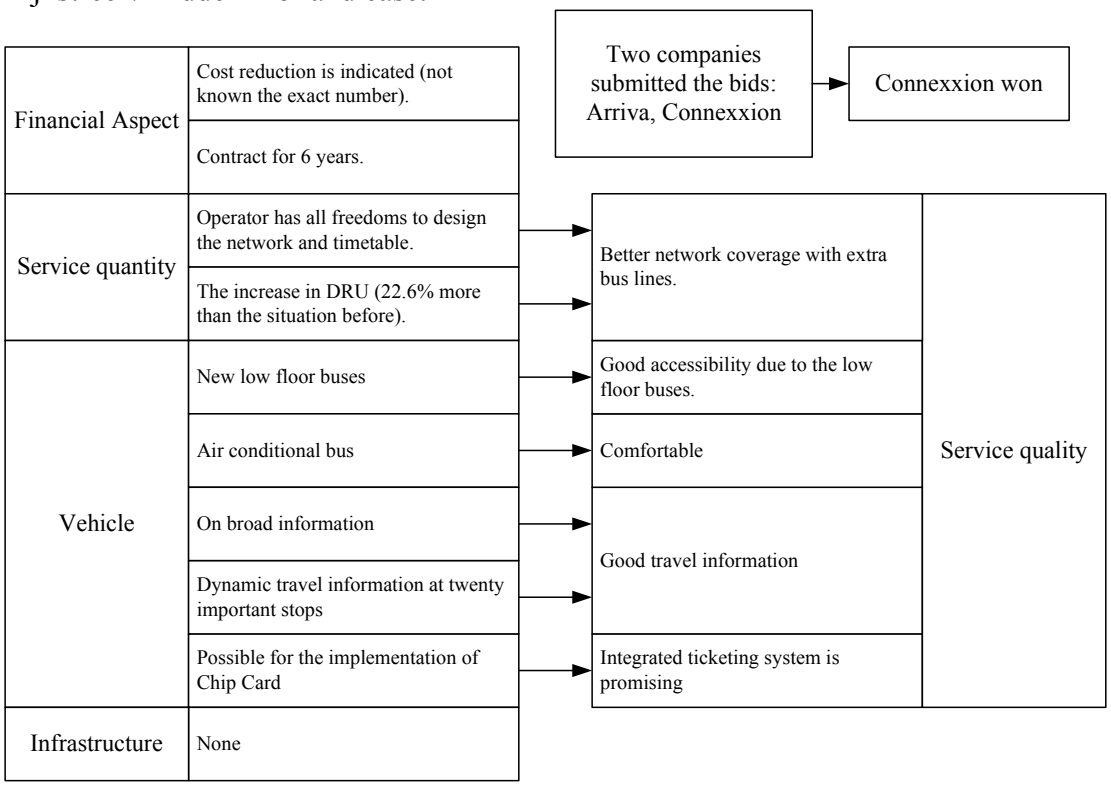


Figure 7-5 Analysis of the tendering process: the DBL/RMH case

In terms of competition, only two companies (Arriva and Connexxion), out of the four companies invited in the pre-selection phase, submitted bids. The reason might be, as suggested previously, that the size of the concession was too large, so the risk involved might have been too high for other operators. However, we might argue that the other operators could also have submitted to only one area, either DBL or RMH. But the operator might have considered that by submitting a bid to only one area, there would be less chance of winning.

Even though there were only two bids, we can still see the positive development in terms of the innovation. In this case, we see that the winning operator, Connexxion, emphasises on both vehicle and infrastructure aspects. Again, the quality aspects are the most important developments in this tender outcome. However, it should be noted that the infrastructure development was not included in this tender.

Authority – innovative capabilities and learning:
In terms of technical capability, PZH was able to indicate the possibility of technical development through their wish list in the tender document. The outcome of the tender regarding the technical capability was very positive. It is shown that PZH considered the importance of the role of information technology, which is explicitly indicated in their winning criteria.

In terms of organisational capability, PZH opted to use the complex tendering process that contains two tenders at a time. This created some difficulties in terms of the number of bidders. The small number of bidders may have implied a lesser degree of competition. However, it might be compensated by a greater degree of investment; the available fund for investment is increased as the size of tender is increased. This fund would give more incentive for the operator to innovate in various aspects, including infrastructure and vehicle elements. Indeed, the result of the tender has shown that the infrastructure in information provision and the vehicles equipped with air conditioning systems were proposed in the bid.

In terms of knowledge, PZH learned a great deal through previous tenders; this is a clear signal that PZH has moved towards a more quality-oriented approach of tendering. Although it may be too early to say that the quality of the public transport services has increased as the concession has just started, the financial incentive through the available investment for the network development can be seen as a good initiative. An illustration of internal learning occurred when PZH decided to add more incentive via extra funds (subsidy) to encourage the operators to come up with a more innovative service design. This transpired after PZH gave some freedom in the concession to Arriva in the DAV area, but Arriva failed to induce more passengers to the network adjustment that it made.

Operator – innovative capabilities and learning:
In terms of technical capability, Connexxion responded well to PZH's initiatives on information technology, i.e. introducing onboard information and dynamic travel information at the bus stops. In addition to this, Connexxion also initiated air-conditioned buses as an extra element which shows the effective work of the tender team.

In terms of organisational capability, the tender team seems to be a working model in this situation as it is capable of initiating the information provision into the bid. Although the authority signals the requirement of information provision through its wish list in the tender documents, the tender team still has considerable work to do to integrate them into the bid.

In terms of learning, Connexxion explored the internal learning through their tender team in this case. They generated a knowledge base for the tendering process. Thus, they could prepare the bid by using their own experience, both from the same authority and from different authorities. In this case, we observed that the bids they prepared in the PZH's areas were improved over time. Furthermore, the relationship between authority and operator was also strengthened. Again, the learning element of the operator will be discussed in more detail in Section 7.3.

7.2.5 *The case of RET*

The Rotterdam public transport company (RET) is the main public transport operator in the Rotterdam urban area. RET operates in a monopoly position and annually carries around 167 million passengers (in 2004). RET operates three modes of public transport: bus, tram, and metro. Table 7-1 shows the detailed information of the public transport systems that are operated by RET.

Table 7-1 Indicators for public transport systems by RET

	1996	1998	2000	2002	2003	2004
Tram						
Number of lines	13	12	9	9	9	9
Length (km)	127.9	126.8	99.9	93.4	93.4	98.3
Vehicle-km (mill.)	6.0	6.0	-	6.2	6.1	6.0
Seat-km (mill.)	618.8	674.1	653.6	679.8	668.0	693.6
Passengers (mill.)	53.2	55.8	58.3	60.6	59.0	53.4
Passenger-km (mill.)	138.6	151.4	159.1	162.0	158.0	147.0
Bus						
Number of lines	44	42	40	36	38	32
Length (km)	440.3	407.7	372.6	422.6	432.7	348.2
Vehicle-km (mill.)	13.0	14.1	-	12.1	11.8	10.2
Seat-km (mill.)	796.5	864.4	753.7	726.1	706.4	602.9
Passengers (mill.)	40.9	40.4	39.3	38.4	35.2	29.7
Passenger-km (mill.)	135.4	136.0	132.7	131.0	121.0	95.0
Metro						
Number of lines	5	5	5	8	8	8
Total length (km)	72.9	72.9	72.9	175.6	175.6	175.6
Vehicle-km (mill.)	12.5	13.0	-	13.7	16.2	17.6
Seat-km (mill.)	1916.0	2051.7	2052.0	2157.0	2570.7	2506.3
Passengers (mill.)	78.9	78.0	83.7	87.9	86.1	84.0
Passenger-km (mill.)	414.4	405.1	431.0	444.0	476.0	463.0
Total Seat-km (mill.)	3331.3	3590.2	3459.3	3562.9	3945.1	3802.8
Total Passengers (mill.)	173.0	174.2	181.3	186.9	180.3	167.1
Total Passenger-km (mill.)	688.4	692.5	722.8	737.0	755.0	705.0

Source: RET Annual Report 1996, 1998, 2000, 2003, 2004

There has been a significant development in the public transport services under RET management in the past decade. For the tram services, the number of lines and network lengths were reduced significantly. Tramlines were reduced from 13 lines in 1996 to 9 lines in 2004, and network length was reduced from 127.9 km. in 1996 to 98.3 km. in 2004. However, the seat-km. was increased during that period. This implies that the tram network is more concentrated in urban areas (the decrease of network length) and operates at a higher frequency. This increase might have taken place so that RET could maintain the level of passengers in the past decade. However, if we compare the current numbers to the year 2000, the number of tram passengers has been reduced by around 10%. It should be noted that there is a plan to extend the tram network; many tram lines are under construction at the moment. The results of the tram network's extension remain to be seen. For the bus services, the number of bus lines and network lengths was greatly reduced. The bus lines were reduced from 44 lines in 1996 to 32 lines in 2004, and the network length was reduced from 440.3 km. in 1996 to 348.2 km. in 2004. This resulted in a 25% decrease in the number of passengers in the past decade. The reasons for the decreases in both bus services and the number of passengers may be twofold. First, the extension of the metro lines (described below) was finished in 2002, and these metro services have replaced the bus services in many areas. Second, there is uncertainty that surrounds the bus services in the Rotterdam urban area at the moment. As the privatisation of RET is being planned, the bus services are likely to be the first to be put out for tender. Thus, these might be reasons for the underdevelopment in the bus services in this area.

The greatest development in the public transport systems in the Rotterdam urban area was the extension of the metro lines. RET runs two main metro lines[4]: the Erasmuslijn (from north to south) and the Calandlijn (from west to east). These two lines were extended from 72.9 km. to 175.6 km. in the year 2002. This network extension boosted the number of passenger-kilometre from 414.4 million in 1996 to 463.0 million in 2004[5].

In terms of innovation, RET has initiated and implemented several innovations in the past decade. We will describe a few examples here. As mentioned above, the public transport network has developed extensively, especially the metro and tram networks. The extension of the metro lines allowed for considerable passenger growth for RET. For the tram systems, there is a new concept called TramPlus that was studied in the mid 90s. This concept aimed to increase the speed of the tram by reducing the number of stops. This means passengers who use the tram may have to walk a longer distance to the tram stops, but they will travel much quicker. This concept of TramPlus is now being implemented on some tram lines. Recently, there have been new trams introduced into the system, such as the low floor tram Citadis/Alstom. This tram also has higher capacity, 150 seats and stands, compared to the old version which had 110 seats and stands. Finally, there are dynamic travel information displays at most of the tram stops. Another important project in which RET is involved is the smart card (Chipkaart) project (see Section 6.3.5). RET is currently testing the Chipcard in the Rotterdam metro system; it is one of the first parties to test this technology.

The major regulatory reform that affects the status of RET is the plan for privatisation. This plan is concurrent with the plan of the implementation of the Passenger Transport Act 2000 (described in Chapter 6). The privatisation of RET is an important step in the statutory level playing field; conflicts of interest between concession grantor (the authority) and company (RET) are forbidden in tendering processes and in the granting of the concession. As long as the RET is still publicly owned, competition cannot be initiated. The main argument for privatisation is the inefficiency of the public-owned company. This inefficiency is the result of increased subsidy.

However, there are also arguments against privatisation. First, privatisation leads to a decentralised system that has poor long-term planning. The privatised firm is a private company that might disregard the public interest that would allow the betterment of public transport services. In terms of the public transport systems in the Rotterdam urban area, it would seem that, after privatisation, the public transport services would be put on tenders in more than one package. This means there will be more than one operator in that area. Thus, a synergy within the system might be missing. The system integration will be reduced if the authority does not have a well-defined plan of the service integration. Furthermore, the private operator is unlikely to innovate in the long term, i.e. an investment that has a long payback period. As the

[4] These two lines form many sub-lines: 5 lines in 1996 and 8 lines in 2004.
[5] We might see that the passenger-kilometre increased by just only 11% but the metro network length has more than doubled; this might be due to the fact that the metro network extension was developed in the suburban area, which has less demand than the established network that serves into the central area of Rotterdam.

length of the contract is usually 5 years for buses, long-term innovation might not occur if there are no significant incentives given to the operators.

In the end, privatisation seems inevitable. The government plans to privatise the municipally-owned companies in the coming years (see Chapter 6). The question now is not 'privatise' or 'not privatise', but rather 'how to privatise?' Last year, the Minister of Transport and Public Works wrote a letter to the Dutch parliament suggesting that all bus services must be put on tender from the first of January 2009, and initially for the railways (including metro and tram in larger cities) from the first of January 2017.

This privatisation process can be considered as a threat to the RET operation. It is stated that buses are used not only for scheduled services, but also as replacement services when tram or metro services are not available, such as accidents, technical problems, or public events (especially for tram services). If bus services are put on tender and RET loses the tender (which is most likely the case), the cost incurred to RET would be significant, especially since it would not have spare buses in such cases. However, RET seems already prepared for this situation. It appears that RET has followed the development of the tenders closely, although it cannot be directly involved in any tender.

Innovative capabilities and learning:
RET shows strong technical capabilities. We previously discussed that RET has developed extensive public transport networks of tram and metro in the past decade. Furthermore, they invested in new vehicles (both metro and tram rolling stocks). However, it is important to stress that network and vehicle developments in metro and tram systems are very slow processes. The planning and construction of the metro and tram infrastructure takes a lot of time, more than 5 years before the systems are even operating.

Another important innovation in which RET is involved is a smart card (see also Section 6.3.5). RET is one of the five companies that established the Trans Link Systems, the company that runs the smart card system. Furthermore, the metro system is one of the systems that will be implemented in a pilot phase (which is in a trial phase at the time of writing). It is apparent that RET will benefit from being the first to have implemented the smart card system.

In terms of organisational capabilities, RET seems slow, almost resistant to the privatisation process. However, RET follows the tendering processes elsewhere. This indicates that RET is preparing for the change as well.

Conclusion:
RET has high technical capabilities in both the tram and metro systems. However, it paid little attention to the bus sector. The competition in the bus sector in Rotterdam city is next on the agenda. Thus, RET must now consider what strategy it will pursue in order to survive in the public transport market. We would suggest that the bus services are complementary to tram and metro, thus the involvement in this sector would be beneficial to the organisation as a whole. Simply leaving the bus market would not be a wise idea. Bus operation can be supplemented to tram and metro services when needed. Furthermore, the bus market is now moving towards the

competitive tendering regime, which results in a growing number of concessions. This means that RET can expand their market in the future. Given the appropriate investment in developing competence in the tendering procedure in conjunction with the advantage of the knowledge in the area, RET should be able to compete with new entrants in the bus service in the Rotterdam city area and expand their market in other areas as well.

7.3 The Dutch innovation model for bus tendering process

In this section, we will discuss two separate aspects. First, the innovation model will be proposed. In this innovation model for the bus sector, we consider two separate actors: authority and operator. These actors are the 'first-order' actors who are involved in the tendering process. Sections 7.3.1 and 7.3.2 will discuss models for authority and operator respectively. Second, in addition to these first-order actors, there are also issues that are directly and indirectly involved in the tendering process. We call these issues the second-order effects. We will discuss three issues revolving around the second-order effects: the infrastructure, the vehicle manufacturer, and consumer organisation. Section 7.3.3 deals with a role of infrastructure, and Section 7.3.4 deals with the vehicle manufacturer and consumer organisation issues.

7.3.1 *The first-order actor I: authority*

We consider the authority as a first-order actor. From the case studies, we found strong evidence in terms of an increased focus on quality aspects. In the PZH area, the authority learned to change during the course of the tender. We observed that the tender result was based more on the better quality of the public transport services. This occurred as the result of the inclusion of quality aspects into the tender document, which was found in all three cases. The cases illustrate clearly that PZH used a combination of price and quality criteria which left the quality initiative to the operator.

Analysing the information we disclosed from the case study, it is possible to map the pattern of the tendering development of PZH as depicted in Figure 7-6 below. It should be noted that we analyse only PZH. As SRR only experienced the tendering process once in the Voorne-Putten area, there is no sufficient evidence on the tendering development.

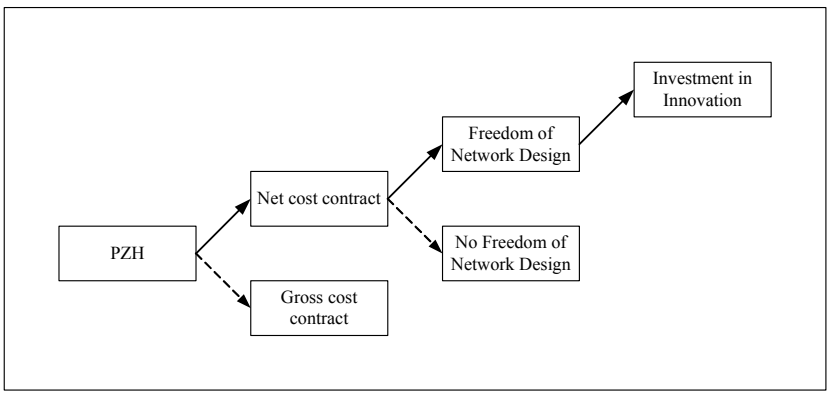


Figure 7-6 The tendering development path of PZH

We see the development path in three steps. First, PZH can choose whether to put the tender for gross cost contract or net cost contract. It appears that PZH followed the path of the net cost contract where the operator is responsible for the revenue risk. Second, PZH chose to give some services design freedom[6]. As noted earlier, in the DAV case, PZH did not originally grant the operator (Arriva) services design freedom. However, PZH changed its strategy to give some freedom to Arriva. At a later concession, PZH gave the freedom of services design to the operator in the tendering process. This indicates that PZH believes that this should benefit the users more than restrict the services design within the authority. Third, we observe that PZH followed a path toward the investment in innovation. PZH chose to go for ICT that required an investment in the infrastructure.

Apart from the tendering development path we discussed above, we also observed the trend towards the inclusion of quality aspects into the tender documents. Both PZH and SRR incorporate the quality aspects as criteria for awarding the concessions. Although quality has a broader definition, authorities tend to anticipate the quality improvement through certain kinds of technological innovation, such as low floor buses, the travel information system, and the smart card. In all, passengers seem to benefit from this improvement, although it is not yet known whether this will sustain in the long-term.

It should be noted that the insertion of the quality aspect is found elsewhere in the Netherlands. Provincie Groningen (PG) also uses the combination between price and quality. However, PG gives less weight to quality than does PZH. Further, PG gives guidelines for the quality aspects that leave little room for the operator to initiate any innovation. Note that PG also uses this for the train concession (see Chapter 8).

7.3.2 *The first-order actor II: operator*

We also consider operators as first-order actors. In this section, we will map the situation in each tendering case based on the model for the operators we constructed in Chapter 5. The model focuses on the observations of each round of tenders, from the years 2002 (DAV case), 2003 (Voorne-Putten case), and 2004 (DBL/RMH case). We will discuss each case in turn.

In the first case (DAV), we observe the strong link between vehicle innovation and the successful bid. Figure 7-3 depicts this pattern. The vehicle innovation (new and low floor buses) included in the offer is a prominent factor for the successful bid,

[6] PZH revealed that, in the first tendering process in Hoeksche Waard and Goeree-Overflakkee, there was indeed no freedom of service design during the tendering-procedure and very limited freedom of service-design during the concession period (only the extra quantities within the so-called plus package). PZH realised that this was too rigid, and for that reason, in the DAV case, they decided to define the existing network at the start of the concession, but to give the new operator (Arriva) full freedom to adjust the network during the rest of the concession period. On one hand, PZH stated that the existing network should be maintained at the beginning of the new concession-period. On the other hand, new operators did not have to design a complete new network during short time of the tendering procedure. Thus, a level playing field for all potential operators was guaranteed. In the DBL/RMH case, although the bidders had no obligation to offer an existing network, in the tender documents and the following information-sessions, PZH told them the existing network was sufficient to fulfil the minimum-demands at that point. Thus, both bidders made offers based largely on that network, in combination with some extra, new lines and major service-extensions on the existing network.

according to our information from the interviews. The idea of this innovation largely came from the external knowledge for which Arriva was looking.

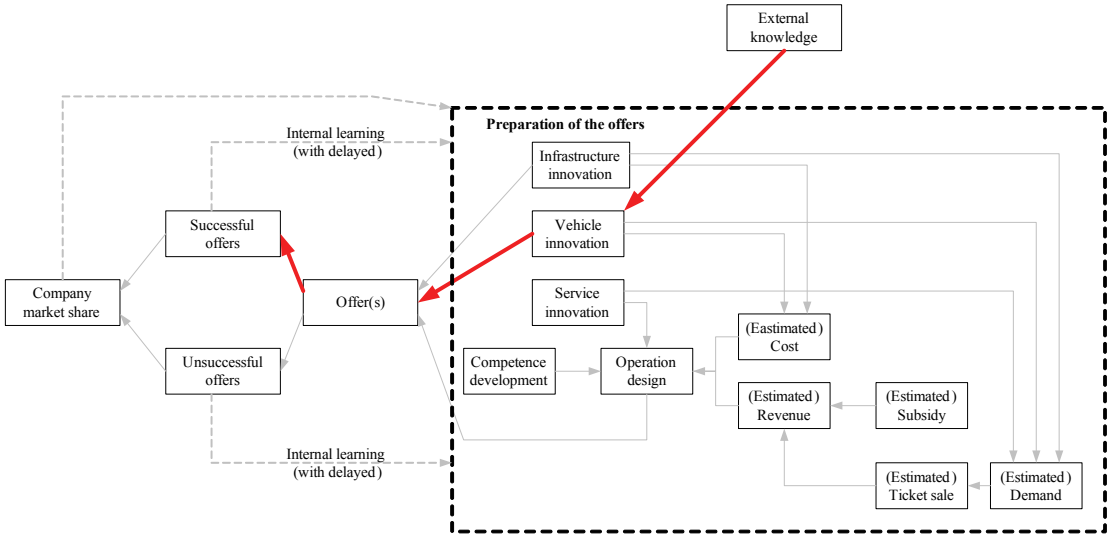


Figure 7-7 The tender development in DAV case (Arriva)

In the second case (Voorne-Putten), we observe a learning element that led to vehicle innovation, which in turn played a part in the successful bid. Experiential learning (the unsuccessful bid in DAV case) instigated Connexxion's introduction of vehicle innovation. Furthermore, the learning element we found came from the competence development within the firm that led to the organisational developments (the tender team). Figure 7-4 depicts this pattern in the Voorne-Putten case.

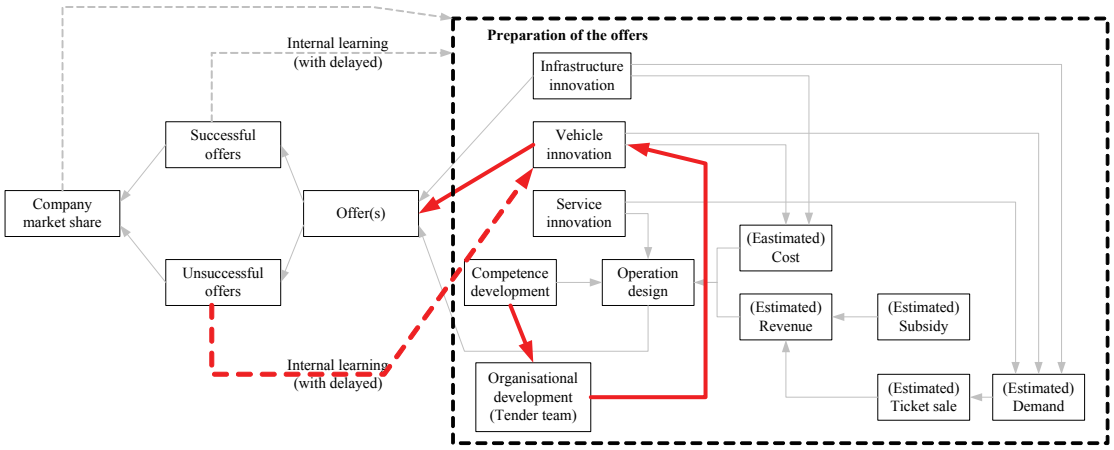


Figure 7-8 The tender development of the Voorne Putten case (Connexxion)

We can see that Connexxion learned from their experience, that the new low floor buses were an important factor in the tender. Thus, they came up with the new low floor buses. It should be noted that the development of the tender team helped them to identify opportunities (in this case the vehicle innovation and other innovations included in the offer) that led to a successful bid.

In the third case (DBL/RMH), we observe a learning element from a successful bid. Figure 7-5 depicts the development of the tendering process in the DBL/RMH case.

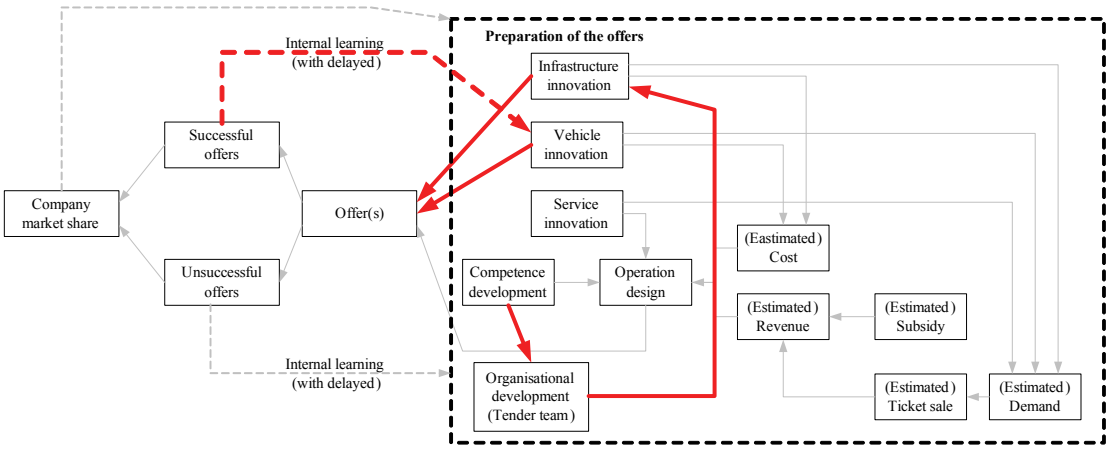


Figure 7-9 The tender development in the DBL/RMH case (Connexxion)

Repeatedly, Connexxion uses their experience by offering the new and low floor vehicle as their strategic tool in winning the concession. Furthermore, not only is vehicle innovation employed, but also infrastructure innovation, i.e. information provision. It should be noted that this is the result of the work of the tender team.

In sum, we observe positive developments in the innovative capabilities of the operators in all three cases. The competitive pressure from the tendering process leads to situations in which the operators must innovate in order to be competitive in the market. One common development that we found is the use of a tender team. Although our cases illustrate only the success of Connexxion's tender team, Arriva's tender team has been successful elsewhere in the Netherlands as well.

Our general observation from the interviews we conducted suggested that operators tend to use innovations as strategic tools to win the contracts. Some gimmicks were used such as a coffee service at bus stops. This illustrates that operators tend to widen the quality aspects of their public transport services to capture more passengers, or to show to the authority that they are willing to innovate in other areas. Although the result of the implementation of such innovations is not yet clear in terms of whether it benefits the passengers or not, it seems that these kinds of gimmicks do work in some cases.

However, we observe that both technological and organisational innovations in the tender are easy to imitate. In terms of technological innovation, we see both the duplications of the new, low floor bus and the travel information system. These kinds of innovations have a very short life-cycle. As one of our interviewees stated, this is because once an innovation is included in an offer that wins a concession, in the next round of tender, whenever it occurs (possibly two to three months from the innovation that was included in the offer), the competitor can easily include it in their offer as well. In terms of organisational innovation, both Arriva and Connexxion have employed the same type of the tender team to handle all tenders in the Netherlands, in both bus and train concessions.

7.3.3 *The second-order effect I: a role of infrastructure*

The issue of infrastructure had been mostly ignored in the tendering process. In all case studies, the role of infrastructure in the concession area was not mentioned. This observation is inline with our assumption in Chapter 3 that the innovative capabilities in terms of infrastructure remain largely the authority's responsibility. Figure 7-10 shows again the level of participation of the authority and operator in different aspects.

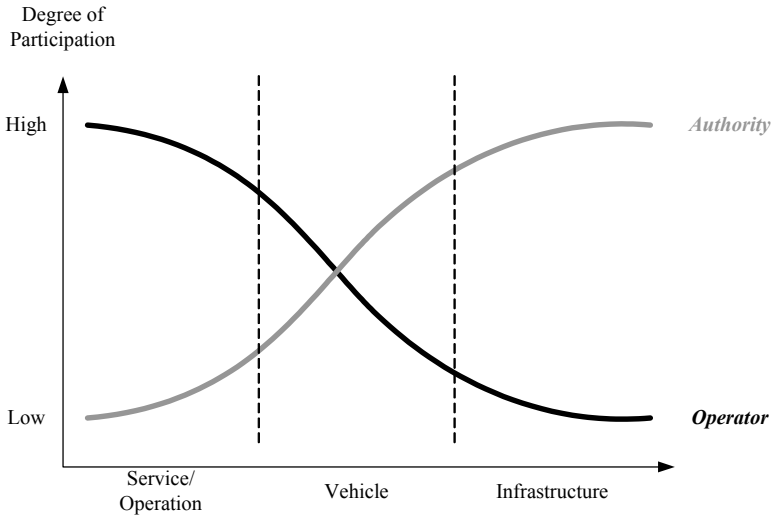


Figure 7-10 Level of participation of authority and operator

The tendering processes in our cases show that the operators were heavily involved in developing the service/operation and vehicle innovation. But, they hardly participated in the infrastructure innovation. This might be due to the fact that the infrastructure issue was not explicitly addressed by the authority. The infrastructure development in the tendering regime must be initiated by the authority. There are several reasons why the operators might not be able to develop the infrastructure by themselves. First, the tendering documents might not allow the operator to initiate an infrastructure development. Most tender documents concentrate on the services, such as frequency and network of operation, and the financial aspect, i.e. the subsidy. They might specify some material requirements, such as new buses or engine types, but hardly mention the infrastructure element. Second, developing the infrastructure might be too expensive to be financially feasible in the tendering period. Even if the tender document allowed the implementation of the infrastructure initiative, it is questionable whether it is practically possible. We did, however, note an infrastructure development in the Quality Bus Partnerships (QBPs) regimes in the UK[7], but this was done with the cooperation between the authority and operator. The tenders in our cases seem to lack this kind of initiatives.

The Evaluation Report of the Wp2000 (Groenendijk et al., 2005) stated that an improvement in the infrastructure is needed if we want to see an increase in the public transport ridership. The infrastructure, such as exclusive bus lanes, will improve the service quality significantly. This is the way to attract more new passengers to use

[7] See Section 6.2.2.

public transport. However, we have not yet seen any significant development of the infrastructure in the tendering process.

The innovation in the infrastructure element must come from the authority initiatives. The operators are not interested in investing in the infrastructure unless there are significant benefits from doing so. The pay back period of investment in infrastructure, such as an exclusive bus lane or guided bus lane, is considerably long, perhaps more than 15 years. However, it is not possible to allow such a long contract in the current setting of the tendering process in the bus sector. The solution might be that the authorities develop the infrastructure by themselves, and let the operator use it under certain conditions, such as with a lower subsidy level or a contribution to the infrastructure maintenance cost[8].

7.3.4 *The second-order effect II: the vehicle manufacturer and consumer organisation*

We were also able to discuss with two external parties who were indirectly involved in the tendering process. They are the consumer organisation (ROVER) and the bus manufacturer (VDL). The issues regarding the effects of the tendering process on innovation with respect to their roles are described as follows.

In the Netherlands, there is an organisation of public transport users called ROVER. In the tendering process, ROVER plays a small role. The role of ROVER can be separated into two parts. The first part is the stage where the authority prepares the program of demand[9]. ROVER is consulted at this stage to give some perspectives on the services they wish to have in the area of concession. The second part occurs during concession period. If the operator wishes to change the public transport services, it needs to consult with ROVER first before it can make any adjustments. However, we observe that ROVER has little influence on the tendering process, as it does not have a formal status within the tendering procedure.

This is in line with the Evaluation Report on the Wp2000 (Groenendijk et al., 2005). It stated that the position of individual travellers has weakened after the implementation of the Wp2000. Although the change in the public transport services during the concession was consulted with ROVER first, it was criticised that all user groups of the public transport were not proportionally represented in this consumer organisation. Unfortunately, this reduces overall users participation in the public transport services.

The tendering process also affects the bus manufacturer. We had a discussion with the Dutch bus manufacturing company, VDL, on this topic. In general, innovation in bus manufacturing is based on two factors: the engine and vehicle design, and the technological add-in items. We observed that tendering seems to affect add-on items, for instance, ICT, new ticketing systems, the automatic vehicle location system. It illustrates that, in the short term, this is a more client-oriented innovation. However, in the long term, the manufacturers may not have the incentive to develop an innovation for the bus sector, as they do not have the financial resources for that.

[8] This is similar to the QBPs in the UK.
[9] See Section 6.3.3 for the full cycle of the Dutch tendering process.

Thus, tendering might be a threat for the innovation in terms of engine and vehicle development.

7.3.5 *Discussion*

The authorities (PZH and SRR) in the PZH area have shown a considerable degree of capabilities development and learning in the tendering process in the past three years. Although the process of tender has just begun in 2002, and only four concessions have been awarded since then, the authorities have utilised the tender process in a positive way. However, one important element that the authorities lack is a monitoring system. The authorities need to be more active in monitoring the public transport services that are provided in an area.

There is an issue regarding the concession specification. This issue is twofold: the size of concession area and the contract length. First, in general, a larger area of concession should induce more innovation, as the operator can afford an investment in innovation from the large turnover of the concession. However, we observed that the concession areas result in a small number of bidders (as in the DBL/RHM case[10]). This creates entry barriers to new, small operators. Second, the contract length also determines the innovation in the tendering process. For instance, the operators usually state that they need to have a contract of at least 6 years in order to be able to invest in the new buses. However, we also see that the longer contract length creates a slower feedback system. This means that, during the concession period, new developments can hardly occur. Once the contract is given, the possibility to have an innovation (in this concession area) is to wait for the next round of the tender. Furthermore, the learning on the parts of both the authority and operator depends on the tendering and the length of the contract. A longer contract might create a situation where both parties learn slowly. This problem is more likely to be found on the authority side rather than the operator side, because operators are often involved in the tendering process in more than one area, probably around 7 – 10 concessions per year. The authority normally has less chance to experience the tendering processes, perhaps only a concession per year (as in the PZH area).

Fares and revenue allocations were also an issue that was often mentioned in the interviews. Most operators complained about the WROOV system (see Section 6.3.5). Although Veeneman (2002) suggested that the WROOV system was able to redistribute revenue and subsidies satisfactorily, including some incentives for operational efficiency, the operators in our cases did not believe so. This is inline with the Veeneman (2002)'s finding that the WROOV system creates a financial uncertainty. It hampered accurate evaluation of travellers' reactions to innovation (Veeneman, 2002). The service improvements did not result in an increase of revenue allocation from the WROOV system.

Interviewees in our cases saw the WROOV system as one of the barriers to innovation, especially in the quality improvement of the services. They pointed out that the WROOV system often allocated revenues in favour of the majors operators in

[10] Although it can be argued that the bidders can offer only one of the concession packages, the bidders might consider that not offering a whole package would reduce their chance to win the concessions. Thus, it might be better not to prepare the offer at all, as the bidding preparation would incur considerable cost.

the big cities (e.g. Amsterdam and Rotterdam). Those operators in the big cities used some tactics to generate information to contribute to an increase in revenue from the system, such as a renewal of annual public transport cards at the reduction rates. It seemed that the operators' efforts to increase the quality (higher frequency, low floor buses) did not affect the revenue that they received from the WROOV system. In some extreme cases, the operators complained that, despite an increase in the number of passengers, the revenue surprisingly decreased. Despite the extensive surveys conducted annually, it would appear that the WROOV system does not reflect the real changes of the number of passengers at the concession level.

The issue of fares and revenue allocation brings us to the point of the type of contracts. The difference between net cost contract and gross cost contract is the revenue risk that is borne by the operator in the net cost contract. In the PZH cases, the authorities employed the net cost contract. Given the WROOV system currently in use, the revenue incentives from the net cost contract are not fully utilised, as the revenue is not properly allocated. An increase in the number of passengers may not result in the increase in the revenue, as you might expect from the net cost contract regime. Furthermore, there might be a delay in terms of the revenue allocation from the WROOV system as well. This then reduces an operator's incentive to attract more new passengers. Nevertheless, we might see a radical change in this aspect, as the smart card system will be introduced in the near future. It is hoped that this smart card system will solve this problem. Thus, the aim of the net cost contract can be realised, i.e. the operators would have an incentive to improve the services to attract more passengers.

Furthermore, the balance between market power and centralised planning is needed to maintain the synergy of the public transport systems. The problem of the service connections has not yet been realised in this area. However, as the public transport services in the Rotterdam city (RET operates at the moment) will be tendered, well-coordinated planning for the services is crucial. There might be a problem if there are different operators in two concessions that are connected, but they are not cooperating with each other. Thus, the authority needs to be careful in designing the tender documents so that they include conditions that clearly enforce the implementation of the cooperation between operators in practice.

Overall, we found that operators have developed their competences in the new competitive environment. We observe positive development of the innovative capabilities of the operators. The competitive pressure from the tendering process leads to situations in which the operators must innovate in order to be competitive in the market.

7.4 London bus tendering[11]

7.4.1 *Introduction*

There have been contrasting regulatory developments in the UK bus market. Outside London, the market has been deregulated since 1985, and within London, there is a system of regulated competitive tendering. These regulatory changes took place at

[11] The London case is based on document analysis of secondary data.

the same time in the UK bus market. Here we compare the tendering case in London to that of the Netherlands.

Prior to the regulatory reform, bus services in the London area were provided by the publicly-owned London Buses Limited. The London Regional Transport Act of 1984 reorganised the sector. The Act designated London Transport as the authority responsible for the provision and procurement of public transport services in the London area, as well as for the development and operation of bus stations and operational maintenance. The tendering process was gradual. The auction took place in 1985, but it was not until 1995 that half of the network was tendered at least once (Cantillon and Pesendorfer, 2006).

The general indicators of the London bus market are provided in Table 7-2. The general trend is that there has been growth in both vehicle-kilometres and the number of passenger journeys in the past decade. In terms of service support, we see some fluctuation in the figures for a number of underlying reasons. The main reason is that, before 1994/95, the London entire bus fleet was in the public sector. The decrease in support in the mid-1990s was a reflection of the sale of the bus fleet to the private sector. In recent years, Transport for London (TfL)[12], as the tendering authority for the network, has increased its bus services by contracts with private sector bus operators (Department for Transport, 2005).

Table 7-2 Indicators of London bus market 1994 – 2005

Year	Vehicle kilometres (millions)	Passenger journeys (millions)	Average fare per passenger kilometres at 2004/05 prices (Pence)	Local authority service support [a] (£ million, 2004/2005 prices)	Cost per vehicle-kilometre (pence/veh.-km., 2004/05 prices)
1994/95	356	1,155	15.9	71	190
1995/96	353	1,193	16.0	38	177
1996/97	342	1,230	16.1	14	188
1997/98	362	1,281	15.7	1	180
1998/99	358	1,266	16.0	14	178
1999/00	366	1,294	16.1	11	178
2000/01	373	1,347	15.3	92	184
2001/02	379	1,422	14.3	201	193
2002/03	406	1,527	12.9	446	215
2003/04	474	1,692	12.3	577	216
2004/05	470	1,782	12.9	545	221
Change 2000/01-2004/05	26%	32%	-16%	492%	20%

Note: [a]London support is funded by TfL. Before 1994/95 the London bus fleet was all in the public sector. The falls in support in the mid 1990s reflect the sale of the bus fleet to the private sector. In recent years TfL, as the tendering authority for the network, has increased its bus services by contracts with private sector bus operators.

Source: Department for Transport (2005) and Transport for London (2006).

With regard to the types of contracts, they were originally put out for tender on a smaller scale, and on a routes-based contract. However, there was an attempt to

[12] In July 2000, London Transport was replaced by a new organisation called Transport for London (TfL), part of the Grater London Authority.

transfer the risk to the private sector, which was a move from gross cost contracts to net cost contracts where the operator bore some of the revenue risk. At first, these contracts were negotiated with the incumbent operators and were not subject to competition. However, this trial seemed not successful, and only gross cost contracts have been offered since 1999 (Toner, 2001).

There are around 800 bus routes operating in the London. Although the detailed statistics of the contract are not publicly available, some literature suggests interesting information. Cantillon and Pesendorfer (2006) indicate that there are around 3.7 routes per contract, but the range of the contracts ranges from 1 route to 21 routes in a single auction. Currently, TfL holds an auction every two or three weeks. Furthermore, Toner (2001) studied the London tender data which has an average of 2.8 bids per awarded tender.

It should be pointed out that the London bus services have achieved the highest number of passengers in recent years. As we can see from Table 7-2, there has been remarkable growth since the year 2000, around 32% growth from 2001 to 2005. We will discuss the underlying reason for this growth later on.

There are over 30 operators in the bus transport services in London. However, more than 80% of the services are provided by five large operators: Arriva Group PLC, First Group PLC, Go-Ahead Group PLC, Metroline PLC, and Stagecoach Group Holding PLC. Table 7-3 shows the market share of London bus services.

Table 7-3 Market share of London buses in 2005

Company	Scheduled mileage (millions)	Market share by Scheduled mileage	Passenger boarding (millions)	Market share by passenger boarding
Arriva Group PLC	54.9	19%	359.1	20%
First Group PLC	43.9	15%	270.9	15%
Go-Ahead Group PLC	50.4	18%	318.5	18%
Metroline PLC	38.9	14%	260.8	15%
Stagecoach Group Holding PLC	45.6	16%	305.6	17%
Total - Big Five	*233.7*	*81%*	*1514.9*	*85%*
Transdev PLC	27.6	10%	161.4	9%
National Express Group PLC	13.3	5%	61.3	3%
Others	12.9	4%	55.4	3%
Total	*287.5*	*100%*	*1793.0*	*100%*

Source: London Assembly Transport Committee Questions on Bus Contracts, 19 January 2006.

An important transport policy development in London is the congestion charging scheme. In February 2003, the London Congestion Charging Zone was implemented. This scheme charges all passenger cars that enter the inner zone of London. The creation of this scheme offered the opportunity to create real improvements in bus service and both a reduction in congestion and improvements in bus services have resulted (Hendy, 2005).

7.4.2 *Innovation model for London case*

London is unique within the UK because it is the only place where local government, namely the Mayor of London and Transport for London, has responsibility for the planning and operation of buses (Hendy, 2005). TfL is also responsible for the

provision of bus stations, stops, bus priority measures, information, performance monitoring, and other support services including transport policing and enforcement. It is clear that the centralised system is one of the factors that contribute to the growth of bus use in recent years.

Hendy (2005) lists key recent policies that account for the success of the London buses as follows:

- Creating a new image
- Social inclusion
- Local economy
- Tickets – Oyster (smart card)
- Congestion charging
- Vehicles – introduction of articulated buses
- Quality investment contracts
- A comprehensive service
- Transport policy and pricing
- Better information
- Environmental improvements
- Better standards for staff
- Funding

A key element of the London bus system is the power of local authority in planning and controlling over fares and services. All policies come from the authority initiatives. This gives a more integrated policy. Next, we will discuss the analysis of innovative capabilities and learning in the London case.

Innovative capabilities and learning:
The authority (TfL) has developed both technical and organisational capabilities. In terms of technical capabilities, TfL has initiated both infrastructure and vehicle innovation. In addition, TfL has focused on service improvements, such as the introduction of the Oyster card (the smart card) system and a comprehensive service. Furthermore, the quality investment contracts can be seen as an organisational development. This brings about a service improvement.

7.5 The Dutch tendering vs. London tendering

This section aims to compare the innovative capabilities of the two cases, PZH and the London areas. But a definite conclusion as to which case is more innovative is beyond our scope as both areas differ in their demographical characteristics and overall transport systems. Nonetheless, this comparison analyses the process of capability development and learning which could contribute some useful lessons in terms of innovation in the public transport sector.

PZH and London are rather different in terms of areas and population. Table 7-4 shows demographical and transport indicators of PZH and London areas. In terms of population density, even with the PZH area being the most populated area in the Netherlands, the London area is far more populated. In fact, the London area is considered a mega city, whereas the PZH area is still a mixture of urban and rural areas. For the transport modal share, the share of public transport (train, bus, tram, and metro or underground) in London (35.4%) is higher that in PZH (17.8%). It shows that travellers in PZH are still car-dependent. It should be noted that, given the high public transport modal share, London should benefit from the economy of scale of the public transport services. Here, the service integration is a crucial aspect. Failure in the service connections may result in a decrease in public transport users.

Table 7-4 Demographical and transport indicators of PZH and London areas

	PZH	London[a]
Population (millions)	3.45	7.43
Area (km^2)	2,818	1,579
Population density (per km^2)	1,227	4,697
Transport mode share (%)[b]		
Car	67.1%	40.9%
Bus, tram, metro (underground)	10.5%	28.3%
Train	7.3%	7.1%
Other modes	15.2%	23.8%

Note: [a] London information came from London Travel Report 2005 (Transport for London, 2006).
[b] Transport mode shares of PZH are calculated from passenger-km in 2002 from ov-monitor data (www.ov-monitor.nl). Mode shares of London are calculated from average number of daily journeys.

Source: See notes in the table

In terms of tendering processes, the main difference between tendering in PZH and London is that the London authority has substantial experience in the tendering process as it conducts tenders every two to three weeks. On the contrary, PZH has only 1-2 tenders each year and just began utilising the tendering process in 2002.

We can compare the innovative capabilities between PZH and London using the analyses we discussed earlier. Table 7-5 shows a summary of this comparison.

Table 7-5 A comparison of innovative capabilities between Provincie Zuid-Holland and London

		Provincie Zuid Holland Case	London Case
Authority	Technical capability	Moderate	High
	Organisational/Competence	High	High
	Learning	Fast	Moderate/bus strong
Operator	Technical capability	Moderate	Low
	Organisational/Competence	High	Moderate
	Learning	Fast	Moderate

In terms of innovative capabilities, both authorities showed a considerable degree of technical and organisational capabilities. In the PZH case, the technical capability is moderate because PZH hardly initiated any technical development, especially in the infrastructure aspect. PZH seems to lack technical capabilities which forces to the operator to initiate the ideas in this area. However, the organisational and competence of PZH is high because they can develop their knowledge to organise the tendering process very well. We see the quality improvement from the operator as one of the successful features in their tendering processes.

TfL has a very high technical capability and organisational competence. In terms of technical capability, TfL initiated many technical developments, including a smart card system. It is a strong commanding authority, which has initiated many innovations that benefit passengers in the public transport system. However, this gives little room for operator to innovate, which results in a weaker operator in terms of technical capability and organisational competence. Compared to the London case, PZH shows a fast learning curve in the tendering process as it utilises the system in a very short period of time.

The operators in PZH tend to have higher innovative capabilities than the operators in London. In London, the operators have little room to initiate any new ideas, as the contracts are based on gross cost. It can be concluded that the operators in London have low innovative capability in infrastructure division. However, the operators in London have moderate organisational and competence capabilities, as they have to improve their service quality in order to compete in the tender.

7.6 Innovation in bus sector: Is tendering good for innovation?

This chapter presented the case study on innovation in the tendering process in the bus sector. We analysed the relationship between the tendering process and innovation with the empirical evidences from the case studies in the Netherlands and in London. In this section, we will categorise our findings into four topics: the tendering process and innovation, the role of innovative capabilities and learning, lessons from the cross-case comparison, and the conclusion. These findings are described below.

The tendering process and innovation

The authorities in the Netherlands are moving towards quality-oriented public transport services. Using the tendering process as a tool, the authorities have achieved better quality of the public transport services. The empirical cases in PZH illustrate the development path in three steps. First, PZH followed the path of the net cost contract where the operator is responsible for the revenue risk. Second, PZH chose to give the services design freedom. This indicates that PZH believes that this should benefit the users more than restrict the service design made by the authority. Third, PZH followed a path toward the investment in innovation. PZH chose to go for ICT that required an investment in the infrastructure.

It is clear that quality is now an important issue in the tendering process in the Netherlands. We observe the trend towards the inclusion of quality aspects into the tender documents. Both PZH and SRR incorporate the quality aspects as criteria for awarding the concessions. Although quality has a broader definition, authorities tend to anticipate the quality improvement through certain kinds of technological innovation, such as low floor buses, the travel information system, and the smart card. In all, passengers seem to benefit from this improvement, although it is not yet known whether this will sustain in the long-term.

On the operator side, we observe that the innovation is used as a strategic tool for winning the concession. Where it is possible, operators tend to widen the quality aspects of their public transport services to capture more passengers, or to show to the authority that they are willing to innovate in wider issues.

In addition, we observe that both technological and organisational innovations in the tender are easy to imitate. In terms of technological innovation, we see the duplications of the new, low floor bus and the travel information system. In terms of organisational innovation, operators in the Netherlands have developed the same type of the tender team to handle all tenders in both bus and train concessions.

The contract specification is a crucial element of the tendering process. This issue is twofold: the size of concession area and the contract length. First, in general, a larger

area of concession should induce more innovation, as the operator can afford to invest in innovation from the large turnover of the concession. However, we observed that the large area results in a small number of bidders. This would create entry barriers to the new small operator to enter the market. Second, the contract length also determines the innovation in the tendering process. For instance, the operators usually state that they need to have a contract of at least 6 years in order to be able to invest in the new buses. However, we also see that the longer contract length create a slower feedback system. This means that, during the concession period, new developments can hardly occur. Once the contract is given, the only possibility of incurring an innovation (in this concession area) is to wait for the next round of tender. Furthermore, the learning of both the authority and operators depends on the tendering and the length of the contract. The longer contract might create a situation where both parties learn slowly. This problem is more likely to be found in the authority side rather than the operator side, because operators are often involved in the tendering process in more than one concession, probably around 7 – 10 concessions per year. The authority normally has less chance to experience the tendering processes, perhaps only a concession per year (as in the PZH area).

Fares and revenue allocations were also an issue often mentioned in the interviews. Interviewees in our cases saw the WROOV system as one of the barriers to innovation, especially in terms of the quality improvement of the services. They pointed out that the WROOV system often allocated revenues in favour of the major operators in the big cities (e.g. Amsterdam and Rotterdam). The operators in the big cities used some tactics to generate information that contributes to an increase in revenue from the system, such as the renewal of annual public transport cards at the reduced rates. It seemed that the operators' effort to increase quality (higher frequency, low floor buses) did not affect the revenue that they received from the WROOV system. In some extreme cases, the operators complained that, despite an increase in the number of passengers, the revenue was surprisingly decreased. Despite the extensive surveys conducted every year, it appeared that the WROOV system did not reflect the real changes in the number of passengers at the concession level. The issue of fares and revenue allocation brings us to the point of the type of contracts. The difference between net cost contract and gross cost contract is the revenue risk that is borne by the operator in the net cost contract. In the PZH cases, the authorities employed the net cost contract. Given the WROOV system currently in use, the revenue incentives from the net cost contract seemed not to fully utilise, as the revenue was not allocated properly. The increase in a number of passengers may not result in the increase in the revenue, as you might expect from the net cost contract regime. Furthermore, there might be a delay in terms of the revenue allocation, from the WROOV system as well. This then reduces an operator's incentive to increase the effort to attract more new passengers. Nevertheless, we might see a radical change in this aspect, as the smart card system would be introduced in the near future. It is hoped that this smart card system will solve this problem. Thus, the aim of the net cost contract can be realised, i.e. the operators would have an incentive to improve the services to attract more passengers.

Overall, we found that operators have developed their competences in the new competitive environment. We observe positive development of the innovative capabilities of the operators. The competitive pressure from the tendering process

leads to situations in which the operators must innovate in order to be competitive in the market.

The role of innovative capabilities and learning

We should see innovation in the bus sector as a process, not a technological advancement. Although technologies, such as low floor buses, dynamic travel information, and the smart card, improve the quality of the public transport services, the mechanism of influencing these technologies through the tendering process is more important for the policy decision-makers. If we could understand the behaviours of the decision-makers in the system, then we would be able to design incentive schemes to induce more innovation that can improve the public transport services.

In sum, we can conclude that the operators react positively to the tendering process. As a result of the tendering processes, the operators offer better public transport services. However, it should be noted that the operators are innovative because winning the tender is the operators' commercial interest. We observed that the authorities used the tendering process as a tool to encourage innovation that is compatible with their commercial objectives from the operators.

However, there are two serious issues that the tendering process in the Netherlands did not cover: the infrastructure provision and the monitoring aspect. First, the infrastructure provision is not incorporated in the tendering process. In all cases, we have found no interest in the infrastructure provision (e.g. bus lane or bus priority initiatives) in the tender documents. The infrastructure development is important for the authority in terms of its ability to compete with the private cars. For instance, the bus priority and exclusive bus lanes would allow faster bus travel time, especially in the traffic-congested area. Although the operators would benefit from this infrastructure in terms of lower operating costs, we did not find this issue important to the operator.

Clearly, the operators are not interested in investing in the infrastructure unless there are significant benefits from such a project. The payback period of investment in the infrastructure, such as a guided bus lane, is rather long, probably more than 15 years. It seems impossible to allow such a long contract in the current setting of the tendering process in the bus sector. Alternatively, the authority could develop the infrastructure by itself, and let the operator use it under certain conditions, such as a lower subsidy level or a contribution to the infrastructure maintenance cost. This kind of innovation must come form the authority's initiative.

The second aspect is the monitoring issue. We observed that the authority relied upon the operator to provide the public transport operation. Information regarding the performance of the operator is hardly available. This makes the assessment and comparison issues very difficult. Thus, in terms of service quality and operating performances, it is not easy to identify the progress.

Lessons from the cross-cases comparison

In comparing the London and PZH areas, the London case illustrates a strong centralised policy. The coherence between the public transport policy and the general transport policy in the area is one of the successful factors in the recent growth of the

public transport ridership. Innovative capabilities of the London authority (TfL) are high, and its learning element is moderate but strong. One lesson that we can learn from the London case is that the public authority should consider not only the policy in the public transport sector, but also the transport policy as an integrated system.

Furthermore, the authority should also take initiative as a system integrator. The public transport concessions should not be operated independently. The authority should provide an incentive to the operators to cooperate in terms of service integration. This integration should be encouraged both between concessions and between modes. This integration covers not only the transfer facilities, such as the integration between bus stops and train stations, but also the timetable integration as well.

Conclusion

The tendering process leads to the service-oriented innovation. The operators adopt their strategies to widen the quality aspects of the public transport services in order to win more concessions. However, the operators concentrate only on the aspects that suit their commercial interests (profitability and continuity). This leaves an important task to the authority to facilitate a tendering process that influences the operators in innovating in a way that benefits the society.

Chapter 8 Empirical Cases in Railway: Is Innovation an Issue?[1]

8.1 Introduction

As we discussed in Chapter 6, the organisation of European railways is rapidly changing due to competition. In the passenger railway sector, direct (on-track) competition is not practically plausible, thus only competitive tendering can be used. The current chapter will illustrate empirical evidence of the effects of tendering (or franchising in the UK) on innovation in the railway sector. The case studies to be discussed involve two countries: the Netherlands and the UK. The regulatory framework in both cases follows the competitive tendering model. Additionally, we will look at the roles of infrastructure managers and rolling stock developments in the railway sector in this changing regulatory environment.

The organisation of this chapter is as follows. Section 8.2 analyses the railway tendering case in the Provincie Groningen and surrounding areas in the northern part of the Netherlands. Section 8.3 analyses the railway franchising case of Merseyrail Electrics in the UK. Section 8.4 examines the role of infrastructure managers in the tendering process. Section 8.5 discusses the relationship between technological innovation in rolling stock and regulatory reform. Finally, Section 8.6 analyses to what extent an innovation can play a role in the railway sector.

8.2 Tendering railway services in the Netherlands: the Case of Groningen

8.2.1 *Introduction*

The Netherlands has little experience in railway tendering. Since 2000, only 5 concessions have been put out for tender, and the majority of those were small concessions, mostly regional train services. The first train concession included the regional train services in the northern part of the Netherlands in the areas of Provincie Groningen (PG) and Provincie Friesland (PF) (see Figure 8-1). Each Provincie Authority has a public transport division which prepares the public transport planning.

The Groningen case is interesting because it was a pioneer of the decentralisation of the railway services in the Netherlands. The first tender began in 1999 and the concession started in 2000. The contract lasted 5 ½ years. The second round of tender commenced in 2005 and the concession will start in 2006. This current

[1] Section 8.5 of this chapter is partly based on an article in the *Journal of the Eastern Asia Society for Transportation Studies* (Ongkittikul and Geerlings, 2005).

concession is a 15-year contract. The details of the first and the current concessions are described in the next section.

Figure 8-1 Map of the Provincie Groningen and Provincie Friesland
Source: http://en.wikipedia.org/wiki/Image:Netherlands_map_large.png

The data collection methods for the Groningen case are twofold. First, an interview method was conducted to collect qualitative information. We interviewed the authority who is currently responsible for the concession area (PG in this case[2]) and the company who will be operating the concession (Arriva in this case). In addition to these main actors in the tendering process, we interviewed the infrastructure company, ProRail, focusing primarily of the role of infrastructure managers in the tendering process. Each interview session was divided into two parts. The first part consisted of several open-ended questions regarding the tendering process and innovation. The second part of the interview was open for general discussion regarding the incentives and barriers of innovation in the tendering process. The secondary source of information consists of various publications, such as policy documents, press releases, consultancy reports, and tender documents. With these two sources of information, we analysed the cases according to the analysis framework that we proposed in Chapter 5.

8.2.2 *The previous concession*

In 1995, during the reform of the Dutch national railway company (Nederlandse Spoorwegen: NS) (see Chapter 6), the Ministry of Transport and Public Works and NS Passengers agreed that the subsidy from the government would gradually be reduced over time. Moreover, from mid-1998, NS Passengers had the freedom to modify otherwise unprofitable train services. In order to preserve these social services, the government created additional contracts. NS Passengers ran thirty different train services offered by the Ministry of Transport and Public Works on March 20th, 1996. Despite these contracts, future NS Passenger services reduced in

[2] Although both PG and PF awarded this railway concession, PG was the authority that organised the tender. Thus, we will refer PG as the authority in this case.

number. Consequently, the government chose to use the competition 'for' the track, through the tendering process to resolve the problem.

In 1998, PG and PF agreed to experiment with the decentralisation of the railway. The contract services previously operated by NS Passengers were put out for tender. In 1999, the invitation to tender was introduced to cover the three regional train services in Groningen. The tender procedure was conducted and the result of the tendering process was that NoordNed[3] would operate these lines from June 1st, 2000 to December 11th, 2005. PF and the Ministry of Transport and Public Works also had an agreement with NoordNed to work with train service line between Leerwarden and Groningen. This agreement was finished at the end of the timetable 2005 (11 December 2005[4]).

The concession in 1999 was rather experimental. PG had little experience in the train tendering process, so they opted for a short-term contract (5 ½ years). This short-term contract constrained the operator from making any major investments in rolling stock and infrastructure. Later, PG stated that it had a bad experience with the old material (rolling stock) from NoordNed. As a result, in the second round of concessions, they opted for new rolling stock. Next, we will discuss the tendering process in that concession.

8.2.3 *The tendering process*

When PG began to discuss the tendering process for the three train services in Groningen, the Ministry of Transport and Public Works suggested that it might be possible to put the train services in the northern part of the Netherlands together at once. In a discussion with the relevant parties, an agreement was reached that the tender would be divided into three separate packages. Two packages included train services in Groningen and Friesland, and the other package entailed train services between Groningen and Leer (a city in the western part of Germany). The parties involved in that concession were PG, PF, the Ministry of Transport and Public Works, and the regional authority of Germany (Landesnahverkehrsgesellschaft Niedersachsen: LNVG).

The three packages were divided as follows. Package A consisted of two railway lines: Leeuwarden – Harlingen Haven and Leeuwarden – Stavoren. Package B involved of one railway line: Groningen – Leeuwarden. Finally, Package C consisted of three railway lines: Groningen – Roodeschool, Groningen – Delfzijl, and Groningen – Nieuweschans – Leer (Germany). The bidders could make an offer on all of the packages or any of them separately.

The tender document in this case is dissimilar to the tender documents we discussed in the bus cases (in the Provincie Zuid-Holland cases). In this case, the service requirements were described meticulously, which left little room for the operator to come up with new ideas. As mentioned earlier, PG opted for new rolling stock due to

[3] It should be noted that NoordNed in the first concession (2000–2005) was a consortium of two parties: Arriva and NS. But later Arriva took over all the shares of the company and became the sole shareholder to prepare for the bid in later concessions.

[4] The railway timetable of the Netherlands (and most parts of Europe) changes around 11-13 December every year. Therefore, concessions usually start on this date.

their bad experience in the previous concession. With the help of the Ministry of Transport and Public Works, PG put forward a proposal for a long-term contract (15 years) including an investment in new rolling stocks. The requirement for the new rolling stocks was explicitly stated in the tender document. In addition, some other quality elements, such as the accessibility issue and the implementation of the smart card (Chipkaart), were indicated. Based on a one hundred point scale, ninety points were to be awarded for the price aspect, and ten points were to be awarded for quality. It should be noted that the contract of this concession was based on a net cost contract basis. The train tariffs are generally based on NS Passenger train services' tariffs.

The tendering process started in mid-2003 and the result of the tendering was announced on March 29th, 2005. The concession started on December 11th, 2005 and will conclude at the end of 2020. The contract length is 15 years.

PG anticipated offers from 3 or 4 companies, but only two companies participated: Arriva and BBA-Connex. Originally, there were three companies that had expressed their interest. The other was Connexxion who decided, in the end, not to make an offer. The result was that Arriva won the concession for all three packages. The tender outcomes can be summarised as follows (as stated in the Arriva's press release):

- New rolling stocks: air-conditioned, low floor (same height as the platform).
- Implementation of the smart card by January 2006[5].
- Coffee service onboard.
- Improvement of social security on the train: cameras onboard and presence of staff at the stations.
- Travel information provision
- More public bicycle services (OV-fietsen[6]) and treintaxi[7] services.
- The trial of the mobile stations: an innovative development whereby a movable (temporary) platform can be used.

The procurement process for the new rolling stock takes time. Arriva planned to have the first new rolling stock by November 2006 and expected to have all new trains by September 2007.

In general, the authorities (PG and PF) were pleased with the tendering result. Thus far, Arriva has begun to operate the concession, but the new trains have yet to arrive. Therefore, it is too soon to make any assessment on the operation at this time.

8.2.4 *Innovative capabilities and learning*

Next, we will discuss the innovative capabilities and how the authority and operator learned from this case. It should be noted that there is less evidence in reference to the learning element as we focus only on one case. A more thorough and accurate analysis would necessitate more cases.

[5] There was a delay as a consequence of the implementation of the smart card at the national level. The new schedule is now at the beginning of 2007.
[6] OV-Fietsen is the bicycle rental service at the train station.
[7] Treintaxi is the shared-taxi service at the train station.

Authority
PG shows a considerable degree of development in terms of its technical capabilities. Although it had assistance from various partners (including ProRail) in terms of the compatibility of new equipment (such as new rolling stock), it showed a great deal of radical decision-making when preparing the proposal for the tender documents.

In terms of organisational capabilities, PG utilises the tendering process very well. Because they prescribed service characteristics in great detail, they acquired what they demanded. The major element in this tendering process is the new rolling stock. PG explicitly described in the tender documents that the new rolling stock must be equipped with high accessibility, i.e. low floor trains.

Operator:
In this case, Arriva shows very high technical capabilities of bringing in new rolling stock. Furthermore, ICT and the smart card system are also included in the offer. The new rolling stock is low floor. They are, in fact, the first low floor trains to be used in the Netherlands. There are some issues revolving around the implementation of the new vehicles, however. For example, ProRail casts some doubts in reference to the differences in the height of the platforms on the train lines. As the new trains have not yet arrived, the solution to this problem remains to be seen. Moreover, there is an issue with the implementation of the mobile station. At the moment, ProRail will not allow Arriva to implement this concept due to safety regulations. We understand that there is still some discussion between the two parties revolving around this issue.

Another concern in this concession is that Arriva chose to contract out the maintenance activities to a German company (Voith Railservices Ltd.) for two reasons. Arriva stated (in their press release) that it requires the highest demands in the maintenance of their trains; Voith Railservices Ltd. met those demands. This was somewhat of a surprise, however, since Nedtrain, a subsidiary of NS, is a monopoly in terms of the maintenance activities in the Netherlands. Arriva also stated that more competition in the maintenance market would strengthen the railway sector.

In addition, the new trains will be delivered by a relatively small manufacturing company, Stadler (Swiss based manufacturing company), rather than the big companies. We anticipate that the rolling stock order of this concession is rather small, compared to a large contract order from the national railway. Nonetheless, the innovation issue of the new rolling stocks is fascinating because the low-floor train is a new concept. It is wise to implement the new technology on a small scale in the beginning. In this way, we slowly learn from the implementation of the low-floor train, and apply that knowledge in the years to come.

Infrastructure company:
In this case, ProRail is the infrastructure provider. The network in this concession is mostly a regional network with some points that connect to the main routes. In terms of capacity allocation, ProRail has received a complaint from Arriva regarding delays at some parts of the network where there was a great deal of NS train traffic. It is possible that NS trains, which are both regional and intercity trains, are delayed, which in turn cause a delay among Arriva trains, which are regional trains.

In the tendering process, ProRail plays a small, rather passive role in the innovation. In principle, ProRail provided advice to both the authority and the operator regarding the technical aspects of the tracks and stations. It provided information on the capacity of the tracks that was included in the tender. From our discussion with ProRail, we observed that the bidders (potential operators) often discussed with ProRail, both formally and informally, the possibility for innovation that could be included in the offers. The bidders also asked about the capacity of the tracks, as that information was crucial in designing a timetable in the offers. However, ProRail had and has no initiatives to innovate on a particular concession. The ProRail innovation program was based primarily on the Dutch network. We will elaborate on the role of the infrastructure managers in Section 8.4.

8.2.5 *Discussion*

In general, both parties, the authorities and operator, have shown a great deal of innovative capability throughout the tendering process; much innovation was proposed and implemented from this tender. We observed the learning process from the standpoint of both the authority and operator. The authority learned from their previous experience that new rolling stocks are needed in order to improve the service quality. The authority then saw an opportunity for a new rolling stock investment and came up with the 15-year contract. This long-term contract seems suitable for the rolling stock investment.

There were some barriers at the operational level when the concession began. Arriva's proposal for the implementation of a mobile station was not approved by ProRail to be implemented. ProRail was concerned about the safety issues related to this concept. This issue is still being discussed. This is just one example of the complexity of railway operation. Also, we observed that the interdependence of the infrastructure and vehicle (rolling stock) complicates the tendering process in the railway sector, especially in terms of the technical elements. Because the railway system is less flexible, the implementation of the innovation, such as changes in infrastructure or the traffic management system, may be slower than in the bus sector. Furthermore, the result of the low floor train still remains to be seen, as it has not yet been implemented.

We observed the passive role of ProRail in the tendering process. In general, ProRail provided the technical information concerning the tracks and stations in the concession area. Formal and informal discussions were conducted between the bidders regarding potential innovations to be included in the offers. Clearly, the role of ProRail needs to be addressed more explicitly in the tendering process; their playing field level in this process needs to be identified. We will discuss this issue later in Section 8.4.

8.3 Franchising a long-term contract: the case of Merseyrail Electrics[8]

8.3.1 *Introduction*

As described in Chapter 6, the privatisation of the UK railway system began in the mid-1990s, and the railway passenger services were put out for tender (franchising) in 1996. Originally, the Office of Passenger Rail Franchising (OPRAF) administered the franchising process. But later, there was a reorganisation of the railway government bodies. The Strategic Rail Authority (SRA) took over the functions of the ORPAF in 2001.

The Merseyrail Electrics case is interesting because the current operator is a consortium in which a Dutch company is involved. Furthermore, the contract of this franchise is an exceptionally long 25 years.

The Merseyrail Electrics franchise includes passenger rail services between Liverpool and Southport, Ormskirk, Kirkby, Hunts Cross, New Brighton, West Kirby, Chester, and Ellesmere Port (see Figure 8-2). This is a small franchise, just around 121 kilometres of track. The network is also self-contained in nature. The railway system is a third-rail electrification (750V DC) and encompasses 67 stations. The franchise in the first-round was awarded in January 1997 and the contract length was 7 years and 2 months. The first contract was awarded to MTL Trust Holding Ltd., renamed Northern Spirit, which was later relocated to Arriva Train Ltd. (under the name Arriva Trains Merseyside) in February 2000 (Knowles, 2004). We will now discuss the second-round of the franchise in this case.

[8] We have a limited access to the authority side of this case. Thus, most information regarding the Merseytravel and the Public Transport Executives is drawn from secondary data sources.

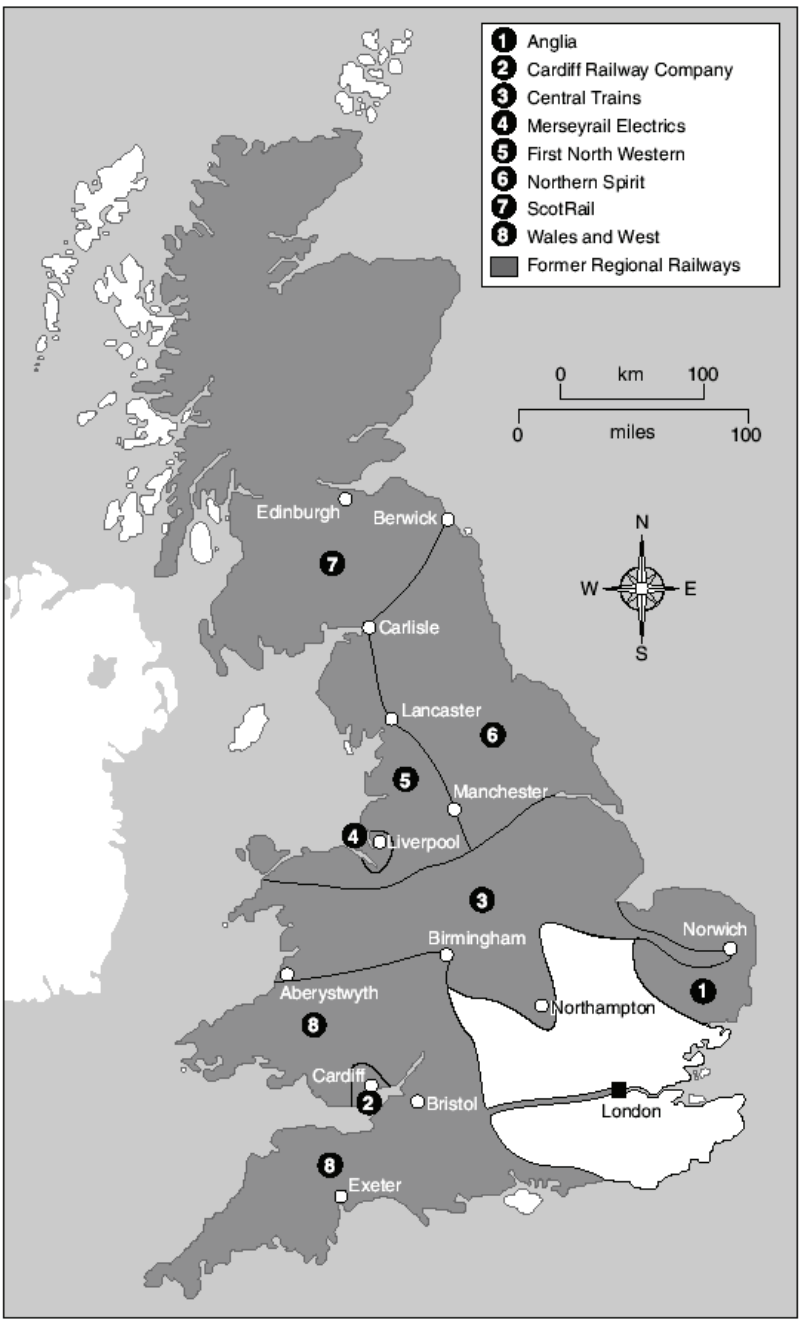


Figure 8-2 Operating territories of the former Regional Railways TOCs
Source: Shaw (2001)

8.3.2 *The tendering process and current situation*

The new franchising process of the Merseyrail Electrics franchise had a unique characteristic. Normally, a franchise is awarded by SRA. However, this franchise was awarded by the Merseyside Passenger Transport Executive (MPTE). The franchising process began in 2002. A number of parties were interested in submitting bids. SRA announced on October 1st, 2002 that they had short-listed three bidders for the new contract: Keolis SA, Serco Ltd/NedRailways, and TRANSDEV Plc/RATP International. The franchise was awarded to Serco Ltd/NedRailways and it began in July 2003. The contract is a 25-year management contract.

This franchise is the only franchise in the UK awarded by a local authority (Merseyside PTE). SRA stated that the self-contained nature of the network, the services, and the market it serves mean that the Merseyrail Electrics network is uniquely suited to greater local control and accountability (SRA, 2003). However, SRR expressed that, as no other network (in the UK) has these unique attributes, there are no plans to transfer responsibilities for other franchises to local Passenger Transport Executives.

The partnership, Serco-NedRailways, is a new partnership. Serco is a public service company operating on a global basis in a diverse range of sectors. NedRailways is a fully-owned subsidiary of NS. NedRailways concentrates on the international railway market. In general, Serco contributes to the function of the public sector management, labour union, and administrative contracts as they have vast experience in the UK, while NedRailways contributes to the technical function of the railway, such as maintenance and fleet operation. This franchise marked the entry of the Serco and NedRailways into the UK heavy rail market. Subsequently, Serco-NedRailways won the new Northern Rail franchise in December 2004.

Since the start of the contract, there have been significant improvements in terms of overall performance. Punctuality has increased significantly (93.8% of train ran on time in 2003/04 compared to 91.4% in 2002/03, 81.3% in 2001/02, and 78.4% in 2000/01). Overall, the PTE is satisfied with the performance of this franchisee.

8.3.3 *Innovative capabilities and learning*

Authority:
In general, MPTE shows a considerable degree of development in terms of its organisational capabilities. This is the only franchise led by the local authority. MPTE opted for a radical 25-years contract which is rather unique in the UK railway market. However, in terms of technical capabilities, it relies mostly on the operator (Serco-NedRailways) and the infrastructure provider (Network Rail).

It should be pointed out that a 25-year long contract is unusual for the UK rail franchise. As mentioned in Chapter 6, the contract length of the first round franchises is around 5 – 15 years, with a median of 7.25 years. But between 1999-2002, the SRA[9] revealed a policy in favour of long-term franchises. Longer franchises ranging from ten to twenty years were expected to encourage substantial private sector investment commitments in rolling stock, track infrastructure, stations, and rail service enhancements (Knowles, 2004). As a result of this policy, SRA awarded a 20-year contract to Chiltern Railways in 2002. This policy also influenced the franchising process of the Merseyrail Electrics. However, after the Hatfield crash[10], SRA changed its direction, as the private sector lost its confidence. The new franchising policy of SRA then concentrated on medium or short-term franchises (Knowles, 2004). However, the issue of the long-term contract was welcomed by

[9] The Shadow Strategic Rail Authority (SSRA) was created in the summer of 1999 and then SRA in 2001. See also Section 6.4.2 for the organisation of the UK rail industry.
[10] In October 2000, a fatal high-speed train derailment at Hatfield, caused by a broken rail, triggered a loss in public confidence in the privatised rail system (Knowles, 2004). 1000 temporary speed restrictions and emergency track work to repair cracked rails and damage caused by flooding made many rail journeys much longer and unreliable. Rail services did not return to normal until the summer of 2001. See also Walmar (2001).

MPTE. We observed that MPTE was pleased with the long-term partnership with the operator (Serco-NedRailways).

Operator:
We were able to discuss the issue of innovation and knowledge exchange with NedRailways regarding the Merseyrail Electrics franchise. The observations are as follows.

NedRailways contributed their knowledge on maintenance and fleet management based on their experience with the Netherlands operation. One remarkable effort is that NedRailways does the maintenance of the rolling stock in-house, which is unusual for a train operation company in the UK. NedRailways stated that the in-house maintenance significantly improves performance, especially in terms of punctuality. NedRailways has also implemented some other activities in addition to the railway operation, such as the business activities in the train station. For instance, they implemented activities that cater to the Dutch public such as a combined ticket sale and specific retail. Furthermore, they are interested in the knowledge exchange in terms of the train traffic control. They stated that they are learning how to integrate the knowledge from the UK and the Netherlands in order to improve performance on both sides.

NedRailways states clearly that, by entering the UK market, it is not looking for profitability alone. It wants a long-term partnership in which it can build up a network of knowledge. Although it is difficult to justify whether this approach is much different from other TOCs in the UK, the technical approach, especially in reference to the maintenance activities, is indeed different. This might elicit an innovative strategy for the tendering process in the railway sector. Nevertheless, we still have to wait and see the result of this concession's long-term impact.

Recently, NedRailways has made an effort to bring infrastructure into their management. As the Merseyrail network is a stand-alone network, NedRailways proposed the model of vertical integration to the Network Rail. However, this issue is unlikely to occur in the near future as it involves a structural change in the relationship between train operating companies and the infrastructure company.

In summary, NedRailways has recently begun to exploit the international market and they have been considerably successful in the UK market. Although it is too early to conclude much of anything in terms of performance, we observe that they are capable of innovating and exchanging the knowledge between two markets. Their approach to bringing back the in-house maintenance activities is contradictory to what other operators in the UK are doing. This is a very promising approach, and it will be interesting to investigate the case further in the years to come.

Infrastructure company:
In this case, Network Rail[11] is the infrastructure provider. It is similar to what we observed in the Groningen case in that, like ProRail, Network Rail plays a rather passive role on innovation in the franchising process. In general, Network Rail

[11] See the development of the UK's infrastructure company in Section 6.4.2.

focuses on delivering the track (with the track's maintenance). The role of Network Rail in the franchising process was only to provide the technical standards.

8.3.4 *The Groningen case vs. Merseyrail Electrics case*

This section compares the innovative capabilities of the Groningen and Merseyrail Electrics cases. This comparison analyses the capability of each actor which could yield some useful lessons in terms of innovation in the railway sector. However, the general conclusions regarding the innovation from the cases cannot be generalised in other railway tendering procedures because we are focusing on only two (rather unique) cases.

A comparison of the learning elements in these cases is limited because the development period of both cases was relatively short, and these were only the second-round tenders (where the first round tenders were more or less experimental). Furthermore, a direct comparison between these cases must be considered carefully. It is important to take into consideration the fact that we are comparing two cases, not two countries.

Using the analyses in the previous sections, we can compare the innovative capabilities between the Groningen and Merseyrail Electrics cases. Table 8-1 shows a summary of this comparison.

Table 8-1 A comparison of innovative capabilities between Groningen and Merseyrail Electrics cases

	Groningen Case	**Merseyrail Electrics Case**
Authority	*PG and PF*	*Merseyside PTE*
Technical capability	Low	Low
Organisational/competence	High	High
Operator	*NoordNed (Arriva)*	*Serco-NedRailways*
Technical capability	Moderate	High
Organisational/competence	High	High
Infrastructure provider	*ProRail*	*Network Rail*
Innovative capabilities	Low	Low

In the Groningen case, both authorities (PG and PF, and MPTE) show a low technical capability and high organisational competence. In terms of technical capability, PG played a small part in making technical decisions. The operator (Arriva) made most of those technical decisions, with the help of ProRail. This was the same in the Merseyrail Electric case where MPTE played a limited role on the technical side. In terms of organisational competence, the authorities in both cases show a considerable degree of development. We consider that both authorities have a high level of organisational competences. Though they both had little experience in the railway tendering process, they facilitated the tendering processes well. In the Groningen case, PG included the new rolling stock requirement in the tender documents and they succeeded in obtaining new rolling stocks. Additionally, they expressed that the accessibility of the trains was a necessity, and the operator offered the low-floor trains. This illustrated the success of this tendering process. In the Merseyrail Electrics case, MPTE succeeded in awarding a long-term contract to the Serco-NedRailways consortium. Thus, we see that both authorities have high organisational capabilities.

The operators in both cases show very high managerial competence; they both introduced innovative management. Arriva introduced a new rolling stock maintenance partner. Contrarily, Serco-NedRailways reverted to former maintenance activities, which were previously outsourced to a third party. The explanation to this reverse decision is that the NedRailways had confidence in managing the maintenance activities more efficiently on their own. They believed that they could bring in their knowledge from the operation in the Netherlands. Additionally, the size of the operation in this franchise is rather small, thus risk associated with the maintenance activities is small as well. It was for those reasons that NedRailways decided to keep the maintenance activities of this franchise in-house. Although the concession operations remain to be seen, the companies were successful in acquiring what they needed.

In terms of the infrastructure providers, we observed that both infrastructure companies were rather passive in the tendering process. In this respect, we need to address the importance of integrated planning for innovation in the sector. The track and train relationship should be strengthened in order to develop successful innovation in the railway sector. Next, we will discuss the role of the infrastructure companies.

8.4 The role of infrastructure companies in the innovation process

The organisation of the railway company was changed by the European Directive 91/440, on the accounting separation of infrastructure and operation. The industry changed in that the government, operator, and infrastructure manager had been separated. In terms of technological development, before the reform in the mid-1990s, the European railways had operated under a national model, where the national railway was the main actor in innovation. For instance, in high-speed train technology, the French railway developed the Train à Grand Vitesse (TGV), and Germany developed the InterCity Express (ICE). But the development of innovation in the railway sector has completely changed since the reform.

The separation of the infrastructure and operation brought about the overall structural change of the railway sector. In several cases, infrastructure managers have retained a closer relationship with national governments (NERA, 2004). The UK is the only country where the infrastructure company was privatised. However, the UK's experience resulted in the entity, Railtrack, being placed in administration because of its severe financial difficulties. The new company, Network Rail, was established in 2002 and does not have shareholders, though for public budgeting purposes it remains in the private sector. As such, it is an unusual entity that relies solely on debt financing. The exact way it will operate remains to be seen (NERA, 2004).

NERA (2004) observed that, in Norway, Finland, the Netherlands, and Denmark, the infrastructure manager is a government agency rather than a commercial company. These organisations do not necessarily prepare accounts according to standard commercial principles. Companies' balance sheets are not normally available in these countries. However, this situation may change. In Denmark, for example, greater independence from government intervention is being planned, with an independently appointed board and public funding arranged through contract (NERA, 2004).

A relevant issue in the area of infrastructure separation is the infrastructure access charges. The regulatory reforms create diversity among the access charge regimes. There is a noticeable gap in the amount infrastructure companies in each country charge for infrastructure usage. Furthermore, the charging rates are also different. For example, the UK infrastructure company, Network Rail, charges €3.66 per passenger train-km on average, whereas the Netherlands infrastructure company, ProRail, charges €1.01 per passenger train-km on average (ECMT, 2005). The access charge will be one of the many factors in designing the tendering process in the railway sectors, which subsequently determines the innovation in the tender.

Schaafsma (1997) identifies four important aspects that should be considered when focusing on the effects of the separation of the infrastructure and operation. The first aspect is the technical interrelationship between track and train. Track and train have technically strong bonds. These bonds are rail-wheel contact, stations, and a traction supply system (if the train is electric). The second aspect is the expensiveness of the means of production; locomotives and infrastructure costs have always been expensive. Another characteristic of infrastructure and rolling stock is their long lives. The planning of the infrastructure alone usually takes years. The third aspect is the central role of the timetable. In a congested train network, the timetable design is crucial to the utilisation of track (including stations) and train. The final aspect is government involvement. As the production costs are expensive, government support is crucial. Furthermore, the government has to subsidise some services that are important to society, such as social services. For these reasons, the government must use the railways as one of its policy instruments.

Based on our case studies, both infrastructure companies played a little role in innovation in the railway tendering process. In the Groningen case, ProRail acted as a government agency in providing the track and stations for the operator (Arriva) to use. ProRail's role in the tendering process is to provide necessary information regarding the infrastructure in the concession area. However, ProRail stated that the signalling system in the concession area was recently upgraded. The train operator can benefit from this upgraded system. It must be stressed that the track and signalling development has been independently planned and implemented from the tendering process.

It is the same situation in the Merseyrail Electrics case. As the network in the Merseyrail Electrics case is independent from other networks, it can be seen that Network Rail has concentrated on the task of providing an infrastructure that meets the operator's demand. Most developments in this case lie in the area of operational management tasks, i.e. the train traffic management.

There were some structural problems in the infrastructure company in the UK railway. These problems trace back to the beginning of the privatisation of the British Railway (see also Chapter 6). Regarding the infrastructure manager in the early stages of the UK railway privatisation, it was sited in Gourvish (2002) that the original intention was to create Railtrack as an engineering-free corporation. Railtrack was to own the track and signalling, but not the engineering activities. It was to function as an access, capacity management, and sales organisation, and it would buy in all its engineering requirements, not only the physical renewals and new construction, but also the detailed inspection and monitoring functions (Gourvish,

2002). In retrospect, Gourvish (2002) pointed out that this situation appeared to have weakened Railtrack's capability to manage the infrastructure properly. Soon after Railtrack went into the administration, Network Rail took over its responsibility. Network Rail is planning to contribute greater direct control of engineering and inspection in-house (Tyrrall, 2003). Since 2002, the performance of the track has improved significantly according to the Network Rail report (Network Rail, 2005). However, we noticed that the role of Network Rail in the innovation process was limited in conjunction with the TOCs and the franchising processes.

In conclusion, the issue of infrastructure was not explicitly addressed in the railway tendering processes. Although the infrastructure managers were involved in the tendering process, their role was limited and rather passive. Most innovation, especially technical innovation, developed separately from the tendering process. This could be one of the drawbacks of the tendering process in the railway sector. Innovation should be developed from both operator and infrastructure manager. This is a challenge for the authority who must incorporate both the operator and infrastructure manager in the tendering process and during the operational phase of the concession.

8.5 Technological innovation in the rolling stock industry and railway reform

8.5.1 *Railway reform and railway technology*

Rolling stock innovation is an essential part in operating a railway. The significant development of rolling stock can be observed with instances such as high-speed rail, lightweight material, and energy-efficient propulsion. The rolling stock supply industry is concentrated in Europe, and the manufacturers of this supply are the major players in this industry. As the railway markets in Europe are moving towards liberalisation, the rolling stock suppliers are also in the midst of a restructuring and concentration process. This development is in line with the observation by Tilière and Hultén (2003).

Tilière and Hultén (2003) proposed a 'European Rail Innovation Model'. Its main characteristics are as follows:

- The collaboration between operator and manufacturer (at the national level) will disappear: this fact leads to a disinvolvement of operators in the early stage of the innovation process. Their role now remains only in identifying functional specifications.
- Research and Development (R&D) will be funded mainly or fully by the manufacturers (operators will not provide any more study contracts for generic technologies).
- Technology will receive only partial validation as operators are not fully involved.
- For commercial contracts, operators are looking for fully-proven technologies.
- The final technology should now be priced by the manufacturer including R&D costs (which is not necessarily in practice for some businesses, such as signalling technology).

In this model, rolling stock plays an important role in the tendering process. We see that, in the Groningen case, new rolling stocks were included in the offers. These new rolling stocks will have a huge impact on the operation and maintenance. As more operators begin to function in the same network, this might create problems for infrastructure companies in utilising the network capacity due to the fact that various rolling stock types would be operating simultaneously.

It is clear that the rolling stock manufacturers will have an important role to play in the tendering process of the railway sector. Next, we will discuss the current situation of the rolling stock industry.

8.5.2 *Production capacity and trend for the rolling stock manufacturers*

Rolling stock suppliers play a vital role in rolling stock development. Most rolling stocks were dominated by domestic manufacturers to fulfil the specific needs of national operators who have their own standards and wishes. However, there have been some changes in recent years; non-domestic companies have entered the market in various forms. In most cases, the non-domestic companies present their products (in terms of knowledge, patents, etc.) to cooperate with domestic manufacturers.

This trend affects the development of the rolling stock in two ways. First, the expansion of the market means the reduction of the unit cost of production. The more rolling stocks that are produced, the greater the likelihood of a lower unit cost. This factor encourages manufacturers to develop technologies according to market needs. However, it is essential to identify which market is a potential one. Second, the domestic manufacturers might see these expansions as threats, and they will sustain their market position by either competing or cooperating.

The reason behind the industry's restructuring is due to the open market of the railway in most European countries. Milz (2002) reveals that, since the introduction of procurement legislation, the price of rolling stock has significantly dropped. In fact, the price of rolling stock has been quoted to have reduced by around 20-30%. Furthermore, operators in different countries are beginning to 'mutually recognise' the specifications. This opens up increased competition. In addition, R&D costs are high, thus railway suppliers often establish joint venture consortia in order to share know-how and risk. In particular, the joint development between suppliers and railway operators will expand because the suppliers want to both reduce technical risk and also find a market opportunity for new technology.

Within the passenger rolling stock market, the big three (Alstom, Siemens, and Bombardier) have dominated the market and account for about 56% of the total market (Ongkittikul and Geerlings, 2005). Note that Bombardier purchased Adtranz (of DaimlerChrysler) in May 2001, which pushed Bombardier into the top of the league of major rolling stock suppliers.

Another significant matter is the worldwide presence of the big three. For example, Bombardier has more than 50 production sites over the world, namely 37 production sites in 16 countries in Europe, 8 production sites in North America, 3 production sites in China, and 2 production sites in Australia. Siemens also has a worldwide presence, though to a lesser extent, with its main facility in Germany, 2 subsidiary companies in China, and one service site in Australia.

There are a number of factors that influence the rolling stock procurement, including technical, organisational, and political factors. Firstly, the rolling stock is highly customised as national or private rail operators continue to have specific requirements and infrastructure constraints. The different technical systems in each country; such as different railway gauges, power supplies, or automatic train control systems, lead to different requirements in each case. The standardisation of railway systems would lead to a decrease in the cost of rolling stock production, and also, in the case of international operators, the cost of extra equipment that allows trains to operate in different systems. Yet, the cost of infrastructure standardisation is much higher and it requires a considerable amount of time to adopt such a standard. Notwithstanding, the case of ERTMS (European Rail Traffic Management System) is a good example of the implementation of a standard that would lead to lower costs and interoperability; however, the final outcome is unclear at this moment. The EU regulation has played a dominant role in setting this standard (demand pull).

Secondly, government support and local manufacturing (localised) railway operators have been characterised by their need for local, state/regional and central government funding in order to maintain their financial performance. As a result, rolling stock orders depend on the level of government support in railways, and order selection may favour suppliers with local manufacturing bases, thus creating and/or sustaining local employment.

Thirdly, the reforms of the railway sector in recent years have also affected the rolling stock procurement. In many countries, deregulation of the industry and privatisation of the railway sector have changed expectations and introduced new customers faced with the competitive pressures of the private industry. These new railway enterprises include private operators, leasing companies and private sector infrastructure owners. While presenting major opportunities for development for suppliers, the changing nature of the customer base can also generate new performance expectations from the contractual relationship. However, customers (train operators in this case) in competitive markets tend to concentrate on their core business and increasingly outsource maintenance of the trains.

In addition, one characteristic of the railway system is that there is a strong relationship between infrastructure and rolling stock. This relationship is the most important issue for both train operators (who manage the rolling stock) and infrastructure managers. Thus, the decision of new rolling stock procurement must be closely consulted with the infrastructure manager in terms of both technical and administrative matters.

Milz (2002) depicts an interesting development of the rolling stock industry. Figure 8-3 shows rolling stock supply's industry activities. He reveals that there is a reduction in the number of market actors regarding the system integrators in which the big three are the dominant players. Furthermore, there is increased competitive pressure from Asian and American players in the component market.

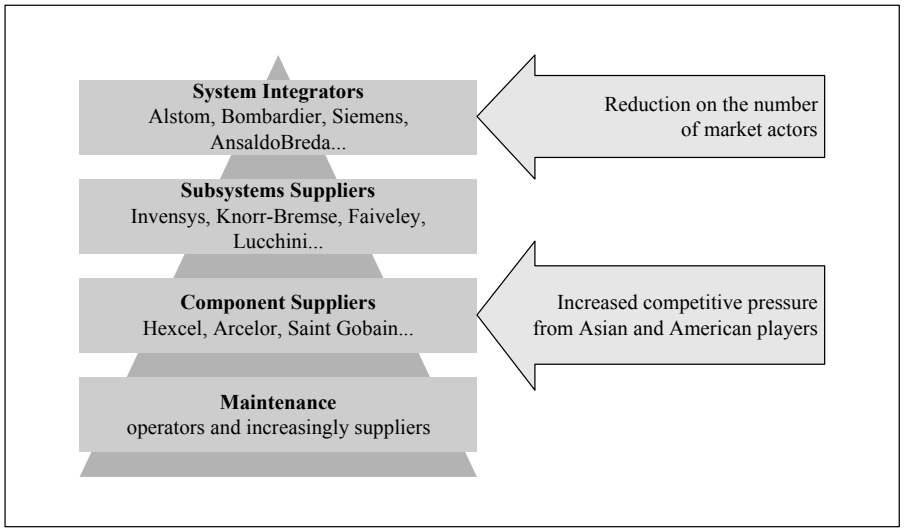


Figure 8-3 Rolling stock supply's industry activities
Source: Milz (2002)

The driving force of this concentration is that the competition between manufacturers and the pressure from the railway deregulated market requires a reduction in the rolling stock investment. Milz (2002) reveals that, since the Public Procurement Directive and the opening of the Rail and Public Transport Markets, the prices of new rolling stock have decreased by more than 40%. This has led companies to restructure, merge or exit the market.

The globalisation of the manufacturers exists in various forms, such as establishing the overseas production sites, taking over domestic manufacturers, or bidding in joint ventures for the rolling stock supply. Many mergers and acquisitions have taken place in Europe and North America. However, the rolling stock production is still localised, either produced by local manufacturers or multinational manufacturing firms with a joint venture with the local firm. Furthermore, in less-developed railway manufacturing industries, orders placed with established European and Japanese companies often include requirements for technology transfer. For example, an order of TGVs from Alstom by South Korea stipulated the involvement of local firms.

With respect to rolling stock production, the suppliers also adopt modularisation and/or standardisation of products to reduce their costs. This is due to the fact that Europe is aiming towards the harmonisation of European railway systems. As discussed earlier, the railway systems in European countries are different. Therefore, the supplier may decide on a modular design that may cover roughly 80% of the universal product, with 20% room for customised design.

Modularisation is similar to the term 'platform-based products' that is used by the EU Commission. The Commission (European Commission, 2001a) also observes this trend towards the platform-based products. In the past, the development and manufacturing of rail technology products took place in close collaboration between suppliers and customers (which are railway national companies), with customers having a strong and direct influence on the products to be manufactured and the selection of the firms producing them. These products may be called 'tailor-made products'. The trend is now for rolling stock suppliers to offer their own set of

products, which are referred to as "platform-based products", from which customers can choose. The purpose of this is to serve all customers from a limited number of platforms rather than to design and produce completely new vehicles for each project. Even where national or customer-specific technical requirements differ, a platform-based approach allows manufacturers to obtain economies of scale and scope for those parts of the train that do not require customisation. We expect that the degree of customisation will be reduced from 100% to around 20%. This process began in the 1960s, when each customer ordered rolling stock and equipment based on its own unique specifications.

European Commission (2001a) summarises the development of the platform-based products as follows. Siemens was the first supplier to introduce a platform-based LRV product, in Potsdam in 1996. At the same time, the existence of platform-based products exerted significant price pressure on competitors and resulted in an overall decrease in price. At present, all major European manufacturers have developed their own platform-based product lines. Alstom, for instance, is promoting its Citadis (trams), Metropolis (underground trains), X'Trapolis, and Coradia (regional trains) platforms. ADtranz (which now Bombardier) has begun to offer its Incentro (trams), Movia (underground trains), Itino (regional trains), and Crusaris (intercity trains) platforms. AnsaldoBreda has developed a platform in the tram sector called Sirio. Siemens' product portfolio includes the Combino (trams), MOMO (underground trains), and Desiro (regional trains) platforms. Bombardier's Cityrunner (trams) and Talent (regional trains) product lines are also platform-based.

It is clear that competition between manufacturers leads to a market for a standard product. Tilière and Hultén (2003) indicate that the standard product provides more efficiency in terms of R&D efforts with increased value for operators. However, there are several disadvantages. First, there are higher financial risks for R&D investment because of the lack of research contracts funded by operators. Second, technical risks are higher as the operator plays a small role in the validation process (and is not as involved as before in the early stages in the innovation process). Thus, system integration done by the operator and the infrastructure company is becoming more complex. Finally, there are higher commercial risks, such as the captive nature of the national markets of non-standardisation rolling stocks that tend to disappear.

8.5.3 *The role of rolling stock development in the tendering process*

In most tendering processes, in both the bus and railway sectors, vehicle innovation is an important element. In the railway sector, the new rolling stock must be compatible with the existing infrastructure. For this reason, the separation of the operator and the infrastructure company has a profound effect on the investments in rolling stocks.

Regulatory reform affects the way each actor in the railway industry participates in rolling stock innovation. The operators (and authorities who award the contract) have to shift their roles from technical to functional. They are no longer the shareholder in technological development as they were before, letting manufacturers do their roles in specifications (Tilière and Hultén, 2003). However, this shift leads to a complicated situation in terms of system integration. The number of partners and decision-makers is significantly increasing, and therefore the implementation of innovations is now more complex.

However, the tendering process in the railway sector is resulting in a trend wherein operator and authority choose the proven technologies rather than new technologies that might involve a massive risk in terms of technical difficulties and commercial aspects. In other words, the authority and operators are now the technical selectors rather than the technical developers. They focus more on the operational aspect, especially in terms of operational performance.

As we can see from the Groningen case, the authority and operator are the technical selectors. They selected the new low-floor trains. We could expect more investment in new rolling stocks which is the direct result of the tendering process. However, it might be too early to suggest that the railway sector will be comparable with the bus sector in terms of vehicle investment. The difficulty of this investment is that the rolling stock has a longer life cycle, more that 30 years. Generally, the commitment in the investment in new rolling stocks requires a contract of 15 years or longer. Thus, in most cases, the explicit intention for the rolling stock investment is often expressed through the tender document.

In conclusion, a clear strategy for technological innovation in the railway sector is mandatory at the government level. The tendering process in the railway sector leads to a situation where the authority, who gives the concession, and the operators, who operate the railway services, focus on the operational aspect. They are not interested in (and not capable of) developing the technology. This task must be led by the government at the national or international level (for example at the EU level). Furthermore, the infrastructure company should lead the technological strategy because it is directly connected to both track and train development. The implementation of the new type of rolling stocks should be done with the close consultation of an infrastructure manager.

8.6 Opportunities for innovation in the railway sector

This chapter presented the case study on innovation in the tendering process in the railway sector. We analysed the relationship between the tendering process and innovation with empirical evidence from two cases: the Groningen and Merseyrail Electrics cases. In the final section of this chapter, we will outline the findings from our case studies by focusing on the tendering process and innovation, the role of infrastructure managers, the role of rolling stock developments, and our conclusion.

The tendering process and innovation

In principle, there is not much difference between bus and railway in terms of innovation apart from a few fundamental differences, such as infrastructure and the investment level (the life cycle of the vehicle and infrastructure). However, railway is less flexible; the diffusion of the innovation may be slower than that of the bus, especially in terms of the traffic management system and the infrastructure provision. Clearly, the innovation in the train system needs cooperation from all parties, including the infrastructure company. However, currently, the role of the infrastructure company is not explicitly elaborated.

In this chapter, we also compared the innovative capabilities of the Groningen and Merseyrail Electrics cases. These cases illustrated two unique examples of railway

tendering in the Netherlands and UK. The Groningen case presented a transition system, from a short-term contract to a long-term contract (with investment in rolling stock). The Merseyrail Electrics case presented an exceptionally long contract (25 years). However, it should be noted that the observations made in this chapter are not ubiquitous in all railway tenders, as both cases are rather unique. This comparison was made between two cases, not two countries.

In terms of the authorities' innovative capabilities, both authorities (PG and PF, and MPTE) show a low level of technical capabilities and high organisational competence. In terms of technical capabilities, authorities played a limited role in developing the technical side. The operator, in consultation with the infrastructure manager, made most of the technical decisions. However, the authorities in both cases show a considerable degree of development in terms of their organisational capabilities. Although they both had little experience in the railway tendering process, they facilitated the tendering well.

The operators in both cases show very high managerial competence. They both introduced innovative management. For example, Arriva established a new rolling stock maintenance partner, and Serco-NedRailways reintroduced the maintenance activities, which were previously outsourced to a third party.

The role of infrastructure managers

In terms of the infrastructure providers, we observed that both infrastructure companies were rather passive to the tendering process. The issue of infrastructure was not explicitly addressed in the railway tendering processes. Although the infrastructure managers were involved in the tendering process, their role was limited and rather passive. Most innovation, especially technical innovation, was developed separately from the tendering process. This could be one of the drawbacks of the tendering process in the railway sector. Innovation should be developed by both operator and infrastructure manager; we need to address the importance of the integrated planning for innovation. Additionally, the track and train relationship should be strengthened in order to develop successful innovation in the railway sector. In order to do this, the authority must coordinate between operator and infrastructure manager in the tendering process and during the operational phase of the concession.

The role of rolling stock developments

In the tendering process in the railway sector, both the operator and authority choose the proven technologies rather than new technologies due to a potential risk in terms of technical difficulties and commercial aspects. As a result, the authority and operators are now the technical selectors rather than the technical developers. They focus more on the operational aspect, especially in terms of operational performance. In the Groningen case in particular, it is evident that the authority and operator are the technical selectors having chosen the new low-floor trains. As a result of the tendering process, we can expect more investment in new rolling stocks. However, it might be too early to compare the railway sector with the bus sector in terms of the vehicle investment. This is due to the fact that the rolling stock has a much longer life cycle, more that 30 years. Generally, the commitment for the investment in new rolling stocks requires a contract of 15 years or more. Thus, the explicit intention for the rolling stock investment is often expressed through the tender document.

A clear strategy in the implementation of technological innovation in the railway sector is necessary at the government level. The tendering process in the railway sector forces the authority, who gives the concession, and the operators, who operate the railway services, to focus more on the operational aspect instead of on developing the technology. The government must manage this task at the national or international levels (for example at the EU level). The infrastructure company should lead a technological strategy that coheres track and train development. The implementation of the new type of rolling stock should be done in conjunction with the infrastructure manager.

In conclusion

A number of conclusions can be drawn from this chapter. First, in the railway tendering process, the authority and operators focus on developing their organisational capabilities rather than technical capabilities. We observed in the railway cases that the authorities were inexperienced in terms of the railway business, but that they can organise the railway tender perfectly.

Second, based on the two case studies, it is evident that the operator and authority select proven technologies rather than new technologies that involve a massive risk in terms of technical difficulties and commercial aspects; they are now the technical selectors rather than the technical developers. They focus more on the operational aspect, especially in terms of operational performance

The tendering process in the railway sector has also induced innovation. However, we should look at the tendering process as a part of the regulatory reform process. The reform in the railway sector resulted in a partition among players, i.e. track and train were managed by different organisations. Thus, the reform effectively introduced new players in the railway sector. For instance, the regional authority, which had no experience in the railway business before, must now organise the tendering process. Nevertheless, the authority managed to complete this task successfully. But, we should place more emphasis on the track and train relationship because this relationship is important for overall railway operation.

Innovation in the railway sector concentrates on vehicle investment and service improvement. This is a direct result from the tendering regimes. Competition for the markets seems to work on a short-term basis. Public transport users benefit from these improvements (new trains, more services, better accessibility). However, the tendering process has paid little attention to the medium-to-long-term development, i.e. in terms of network, new service development (i.e. new lines), and service integration. For that reason, there is a need to emphasise more on the issue of long-term planning of innovation in the railway sectors to incorporate the tendering process as a part of the transport policy.

Chapter 9 Conclusions

9.1 Introduction

The public transport sector is in a transition phase. This is due to the fact that the European Union (EU) is paying more attention to the public transport sector as a means of improving the quality of life especially in urban areas, as we addressed in Chapter 2. The EU stressed that public transport must improve both its efficiency and quality. During the course of this transition, we can see how regulatory reform is actively being used as a tool in the process. Regulatory reform is resulting in a wide variety of organisational transformations in European public transport. One example of a structural change is the growing involvement of the private sector in the public transport industry. In addition, technological innovation plays an important role in improving the public transport service. Many new technologies such as low floor buses, electronic ticketing systems, and dynamic travel information systems have been introduced. However, there is little research that explicitly examines the relationship between regulatory reform and technological innovation in the public transport sector.

Regulatory reform is institutional change. It is also connected to organisational change because it creates new organisational structures due to the privatisation and deregulation processes. Thus, it is crucial to understand the role of organisational development in the midst of regulatory reform. In general, there are three major actors involved in the public transport sector: government agencies, public transport operators, and passengers. Each actor has its goals, objectives, and expectations regarding the way in which public transport services are organised. We see how each actor adapts in order to achieve those goals during regulatory change procedures, especially the government agency and public transport operator.

The objective of this final chapter is to summarise the theoretical developments as well as the empirical findings from the case studies. Section 9.2 is a summary of the theoretical chapters (Chapter 2 – 5). Section 9.3 will discuss the empirical findings (Chapter 6 – 8). Finally, in Section 9.4, numerous recommendations for the future research are discussed.

9.2 Theories on innovation and regulatory reform in public transport

9.2.1 *The research questions*

The main research question of this thesis is:

'What effect does regulatory reform (in the public transport market) have on innovative capability of the actor, and which routes of innovation will prevail?'

In order to answer this research question, we define four sub-questions that would help us understand and address the main research question comprehensively. These sub-questions are:

1) *What is innovation in public transport?*
2) *How does regulatory reform in the public transport sector affect innovation?*
3) *What are the behavioural changes (with respect to innovation) of public transport actors when influenced by regulatory reform?*
4) *What are the policy recommendations for public transport stakeholders on innovation?*

These questions correspond to both the theoretical and empirical parts of this thesis. Each question will be answered in the following sections according to the relevant findings of this thesis. Question 1, which is related to the theoretical finding in Chapter 3, will be answered in Section 9.2.2; questions 2 and 3 concern both theoretical and empirical findings; thus they will be answered in Sections 9.2.3, 9.2.4, and 9.3; and question 4, which is related to the policy recommendations that are drawn essentially from the empirical findings, will be addressed in Section 9.3.4.

9.2.2 *Innovation study for public transport*

Chapter 3 explains the foundation for innovation for the public transport sector. It is clear that identifying and classifying innovation is a difficult task given the multidisciplinary characteristics and various elements involved. It is vital to look at innovation in a broader view; we must look at innovation as a process.

There are many scholars who pay attention to the theory of innovation. An important contribution to that theory is the work of Schumpeter (1939). His model postulates the adoption process of new technology into three stages: invention, innovation, and diffusion. Based on the Schumpeter's idea, Nelson and Winter (1982) added that innovation can occur through a process of variation and selection. Dosi (1988a) expands on that notion by suggesting that the innovation should be based on various disciplinary theories. Not only is innovation itself important, but he stresses the relevance of studying the process of innovation as well. He identifies unique characteristics in the process, such as routines, learning processes, and the need for a paradigm shift. The approaches of Nelson, Winter and Dosi are widely known as the evolutionary theory of technology dynamics.

Another important concept is product and process innovation by Utterback and Abernathy (1975). They describe this form of innovation as an iterative process which states that products will be developed over time in a predictable manner with initial emphasis on product performance, then emphasis on product variety and later

emphasis on product standardisation and costs. Furthermore, they identify in the innovation process many variables that are of relevance: product, process, organisation, market, and competition.

This thesis describes a broader perspective of innovation which focuses on both the technological and organisational aspects of innovative activities (as described in Chapter 3). Innovation in the public transport service is, in this study, characterised by the 'twin characteristics' approach. This approach defines public transport in terms of three sets of characteristics: technical characteristics, competence, and service characteristics. Using this approach, innovation can be classified into three groups: service innovation, pure technical innovation, and competence development. Within those three groups, we can then break down the innovative capabilities of the public transport system into three categories, namely, innovative capabilities related to 1) infrastructure, 2) vehicle, and 3) service operation. These innovative capabilities are guidelines for analysing the innovation process in the public transport sector.

We then analysed the innovation and diffusion process in the public transport sector in more detail. We defined three levels of innovation to locate where the innovation is positioned in time and space. Level I includes innovation that is new to the industry, such as technological advancements. Often, these advancements have been tested and approved in other sectors before they are introduced to a new sector. Level II includes innovation that is new to the country. Level III incorporates those aspects at the micro-level, i.e. an innovation that is new to the area.

The explanation above is the answer to Question 1. Overall, it can be concluded that the process of innovation and diffusion in the public transport sector is complex. The complexity arises from the fact that innovation should be regarded in a broader perspective. The process also involves many actors. When the regulatory change takes place, each actor must find its new role and responsibility. The innovation in public transport refers to the technological and organisational changes in the public transport system. It should be regarded as a process of innovation and diffusion of both technical characteristics and competencies.

9.2.3 *Institutional and organisational changes*

In Chapter 4, the focus is on the issue of institutional and organisational changes of the public transport sector. In Europe, the public transport industry's environment is perpetually evolving due to regulatory reform. Reform has a profound effect on both institutional and organisational aspects. These institutional and organisational changes are of importance for innovation in the public transport sector.

The regulatory reform is a process of change. From a theoretical point of view, the orthodox economic approach plays an important role in analysing the effects of regulatory reform in public transport. Furthermore, it plays a part in providing guidance for the decision-making required to design the regulatory framework. However, once regulatory reform takes place, the effects of the reform are not fully explained purely by the orthodox economic approach.

We described three concepts that are necessary for the analytical framework of this thesis in Chapter 4. The first concept is the theory of evolutionary economics. This approach studies the process of the economics of technical change. Nelson and

Winter (1982) develop the evolutionary theory of a firm where organisational capabilities and behaviours of business firms operating in a market environment are addressed. Essentially, it states that the firms are motivated by profitability and engaged in searching for ways to improve their profitability, but the firm's actions are not assumed to be profit maximising over well-defined and exogenously given choice sets (Mahoney, 2005). The second concept, defined by Simon (1997), is the bounded rationality or problem-solving approach. In sum, it demonstrates that man's rationality is bounded: real-life decisions are too complex to comprehend and therefore firms cannot maximise over the set of all conceivable alternatives. The third concept is transaction cost economics. This notion, proposed by Williamson (1985), argues that firms, markets, and relational contracting are important economic institutions. These economic institutions are also the evolutionary product of a series of organisational innovations. The transaction cost economic theory gives the general framework in which the regulatory reform takes part. The main implication of these three concepts is that, in the long-run, the firms do learn and develop their organisational capabilities in order to compete and survive in the market. Innovation is the result of accumulated knowledge and improved capabilities. The regulatory framework in which firms operate in is the constraint that determines the firms' innovative activities. By combining these concepts, we can analyse the behaviour of a firm in the public transport sector with respect to the innovation in which firms engage.

From this evolutionary perspective, we make three observations of the regulatory reform in the public transport sector. The first observation is that economic agents in the public transport sector are rationally bounded. The objectives of the public sectors, apart from the maximisation of social welfare, have been evolving and are partly influenced by political pressure at both local and national levels. Public policies evolve due to changes in perceived demands and opportunities or changes that may result from the evolution of private technologies and market structures or from other identifiable shifts in objective conditions (Nelson and Winter, 1982). Second, institutional evolution is shaping the industry structure. Regulatory reform means the government must set new rules of the game. Consequently, the functions of each stakeholder would also be changed. While the regulatory regimes are still evolving, the industry structure follows the evolution pattern too. Third, the organisational responses to the regulatory reform vary significantly. Empirical evidence in the past has shown that the operators who face regulatory reform contribute strategic responses. An example is that, in the case of bus deregulation in the UK, there were three broad strategic responses: a defensive market for passenger transport, a market sensitive strategy of becoming more sensitive to changing conditions within the overall travel market, and a commercial strategy of identifying opportunities for growth and/or diversification.

Furthermore, organisational changes play an important part in explaining the behaviours of the actors in the public transport sector. In order to respond to the changing environment, organisations search and acquire knowledge and capabilities to better adapt. In this process, innovation is used as a strategic tool to achieve an organisation's goal. This relates to two important concepts in analysing development and learning, namely the dynamic capabilities and learning.

Understanding dynamic capability and learning processes in organisations is useful for the analysis of developing innovative capability. Using these ideas can lead to the understanding of how organisational behaviours change and react to changing environments (the regulatory reform) and how the organisations innovate as a result of that change. Here we see that under the organisational learning, processes, positions, and paths are key elements that determine innovation and shape behaviours of organisations in the public transport sector.

The explanation above answers the questions 2 and 3 in the theoretical point of view. Question 2 asked 'how does regulatory reform in the public transport sector affect innovation?' The answer is that, based on theoretical study in Chapter 4, regulatory reform changes the structure of the public transport organisation, which then affects the way innovation is introduced. Thus, we observe that the change in regulatory framework results in the new roles of actors in the system. New organisations have different objectives. These objectives are then utilised into firm's innovative capabilities which are essential for innovation in public transport. Thus, the innovative capabilities are changed as a result of the regulatory reform.

Question 3 asked 'what are the behavioural changes (with respect to innovation) of public transport actors when influenced by regulatory reform?' The response is based on the three observations which state that 1) economics agents in the public transport sector are rationally bounded; 2) institutional evolution is shaping the public transport industrial structure; and 3) the organisational responses to the regulatory reform vary significantly.

9.2.4 *Innovative capabilities and learning: an integrated approach*

Based on these theoretical building blocks, we constructed a model for analysing the effects of regulatory reform on innovation in the public transport sector in Chapter 5. Competitive tendering is now a common practice in public transport service. Thus, this thesis focuses on the tendering process as a core process. The tendering process is also the most determinant factor that affects the public transport organisational behaviours. The main interest point is the effect of the tendering process on innovation in public transport services. Nevertheless, as a variety of reforms exists, the tendering may differ from case to case, and some areas are also an exception to the tendering.

There are several factors that influence competition in the tendering processes, and consequently innovations in the tendering outcomes. One is the type of contract that is utilised in the tendering procedure. In general, tender contracts in the public transport sector are divided by risks that are associated with production cost and revenue of public transport services. Using the division of risks associated, the tender contracts can be divided into three categories: management contract, gross cost contract, and net cost contract. A management contract illustrates that both production cost and revenue risks are borne by authority. A gross cost contract shows that revenue risk is borne by authority and production cost risk is borne by the operator. A net cost contract exemplifies that both production cost and revenue risks are borne by the operator (see Chapter 6).

The type of contract employed could determine what innovation is introduced in the public transport sector. The risk division between authority and operator is the key

that gives organisations the incentive to innovate. For example, the management contract gives no incentive to the operator to improve the infrastructure and vehicle as the operator has no benefit from that investment. The authority would initiate most of the innovation in this case. Alternatively, if the operator is responsible for both production cost and revenue (when revenue has risks), then the operator might invest in those aspects that they think will improve their profit. In this case, the duration of the contract is also another important factor as the level of investment depends on the payback period from which the operator can benefit.

As stated before, the tendering process requires all actors to adapt. A firm's dynamic capability is defined by its ability to integrate, build, and reconfigure internal and external competencies in rapidly changing environments. Three elements are addressed: organisational and managerial processes, positions, and paths. In our case, regulatory reform (the tendering process) is a rapidly changing environment. Thus, the dynamic capabilities of the authority depend on its ability to use resources to organise the tendering process in order to achieve their objectives, and control the operation of public transport according to the contracts that are granted. For operators, the dynamic capabilities include the capacity to use and integrate resources to produce a bid that attains the tender, and also the ability to manage the operation of public transport that financially benefits according to the initial planning in the tendering process. Innovation is one of the strategic tools that operators use for winning the tender.

We also need to treat the tendering process as a continuously developing process. Although a tender in one area may be dependent on the length of the concession contract, there are several tenders in the surrounding areas that the authority and operators have to deal with. The information and knowledge that authority and operators collect during the tendering process are key elements. This process, called 'organisational learning,' appears in all parts of the development of competence/ capabilities of the organisation. In the tendering process, organisational learning is very important for both authority and operator.

This leads to the integrated approach based on dynamic capabilities and learning concepts, which were presented in Chapter 5. This model is built for the case of tendering in public transport. Two separate models were introduced for both the authority and the operators. Furthermore, the technical and organisational capabilities are defined, as well as the learning element.

An interesting and crucial element in this study is the process where the authority and operator meet in the bidding process. The interaction between authority and operator in this tendering regime occurs through the bidding process. In general, the authority provides the program of demand and/or tender document to the potential bidders. The tender document usually indicates the basic requirements and specifications of the services to be tendered. It also indicates the winning criteria of the tender. This is the crucial element operators must fulfil in order to win the tender. By studying the tender document, operators prepare their offers. At this stage, it should be noted that the innovation is often included in the offer to increase its appeal.

It is important to note that every stage in the tendering process is a learning process (see Figure 9-1). For the authority, the objectives evolve over time. For example, if a

subsidy is cut, the authority has to decide how to allocate the funds sufficiently and determine what the consequences are for the service quantity and quality. This ultimately leads to learning in the preparation stage of the bidding process. The key element in a tender document is how to design the winning criteria which affect the offers from operators. For the operator, the objectives are adjusted over time. The operator's strategy is determined according to the situation in the market. Thus, both the profit and continuity must be considered before preparing the offer. Taking all these factors into consideration, the operators can learn from their experiences (both in the tender area from previous tenders and other tenders in other areas) to better prepare a competitive bid.

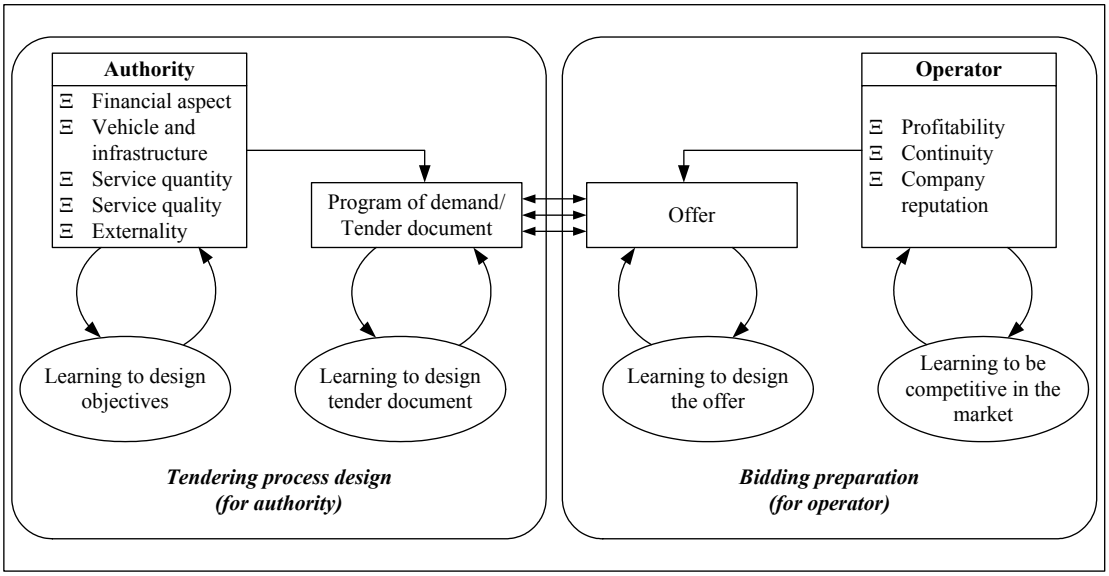


Figure 9-1 Learning in the tendering process

In Chapter 5, we discuss the concept of learning in the tendering process, which is shown in Figure 9-1. This diagram simplifies the dynamic process inside each process; the details within each process (tendering process design and bidding preparation) were discussed in more detail in Section 5.4. This model was then used in the empirical part. Next, we will discuss the results form our empirical case studies.

9.3 The empirical results

The empirical part aims to depict the richness of the information of the process whereby the tendering and innovation interact with each other. Based on the model we introduced in Chapter 5, empirical cases were analysed: the bus and railway cases.

9.3.1 *Innovation in the bus sector*

Chapter 7 presented the case study on innovation in the tendering process in the bus sector. We analysed the relationship between tendering process and innovation with empirical evidence from case studies in the Netherlands and in the UK (London).

In the Netherlands, we conducted three cases all located in the PZH areas. The authorities responsible for the tendering process are PZH and SRR. The results from

our case studies show that the authorities are moving towards the quality-oriented public transport services. Using the tendering process as a tool, the authorities have achieved a better quality of the public transport services. The empirical evidence in PZH illustrates the development path in three steps. First, PZH followed the path of the net cost contract where the operator is responsible for the revenue risk. Second, PZH chose to give the service design freedom. This indicates that PZH believes that this should benefit the users more than restrict the service design within the authority. Third, PZH followed a path toward the investment in innovation. PZH chose to go for ICT that required an investment in the infrastructure.

It is clear that quality is now an important issue in the tendering process in the Netherlands. We observe that both PZH and SRR incorporate the quality aspects as criteria for awarding the concessions in the tender documents. Authorities tend to anticipate quality improvement through certain kinds of technological innovation, such as low floor buses, the travel information system, and the smart card. In all, passengers seem to benefit from this improvement, although it is not yet known whether this will sustain in the long-term.

On the operator side, we observe that the innovation is used as a strategic tool for winning the concession. Where it is possible, operators tend to widen the quality aspects of their public transport services to increase the number of passengers, or to show to the authority that they are willing to innovate.

In addition, we observe that both technological and organisational innovations in the tender are easy to imitate. In terms of technological innovation, we see the duplications of the new, low-floor bus and the travel information system. In terms of organisational innovation, operators in the Netherlands have developed the same type of the tender team to handle all tenders in both bus and train concessions.

As mentioned above, the contract specification is a crucial element of the tendering process. This issue is twofold: the size of concession area and the contract length. First, in general, the operator would better profit from a larger area of concession because it would lead to more investment in innovation. However, we observed that a larger area results in a smaller number of bidders which would create barriers for a new small operator to enter the market. Second, the contract length determines the innovation introduced in the tendering process. For instance, the operators usually state that they need to have a contract of at least 6 years in order to be able to invest in the new buses. However, we also see that the longer the contract, the slower the feedback system. This means during the concession period, new developments can hardly occur. Once the contract is given, the possibility for new innovation (in this concession area) must occur during the next round of tender. Furthermore, the learning of both the authority and operators depends on the tendering and the length of the contract. In other words, a longer contract might lead to slower learning. This problem is likely to be found on the authority rather than the operator side, because operators are more involved in one area. The authority normally has less chance to experience the tendering processes, perhaps only one concession per year (as in the PZH area).

Fares and revenue allocations were also an issue mentioned in the interviews. Interviewees saw the WROOV system as barrier to innovation, especially in reference

to quality improvement. They pointed out that the WROOV system often allocated revenues in favour of the major operators in the big cities (e.g. Amsterdam and Rotterdam). Despite the extensive annual survey, it appeared that the WROOV system did not reflect the real changes in the number of passengers at the concession level. The issue of fares and revenue allocation brings us back to the issue of contract types. The difference between net cost contract and gross cost contract creates a revenue risk that is borne by the operator in the net cost contract. In the PZH cases, the authorities employed the net cost contract. Given the WROOV system, the revenue incentives from the net cost contract are not fully utilised, as the revenue was not allocated properly.

An increase in a number of passengers may not result in an increase in revenue as you might expect from the net cost contract regime. Furthermore, there might be a delay in terms of the revenue allocation from the WROOV system. This reduces an operator's incentive to attract new passengers. Nevertheless, we may still see a radical change with the introduction of the smart card system. It is hoped that the smart card system will resolve this problem and, this being the case, the aim of the net cost contract would be realised.

Overall, we found that operators have increased their level of competence in the new competitive environment. We observe positive development of the innovative capabilities of the operators. The competitive pressure from the tendering process leads to situations in which the operators must innovate in order to be competitive in the market.

In sum, we can conclude that the operators react positively to the tendering process. As a result of the processes, operators offer better public transport services. However, the operators introduce innovation in the tendering process primarily so they can win the tender, while the authorities use the process as a tool to influence innovation that is compatible with their commercial objectives.

Still, there are two serious issues with the tendering process in the Netherlands: the infrastructure provision and the monitoring aspect. First, the infrastructure provision is not incorporated in the tendering process. In fact, in all cases, we have found there is no interest in the infrastructure provision (e.g. bus lane or bus priority initiatives) included in the tender documents. The infrastructure development is important, especially for the authority in order for public transport services to compete with the private car. For instance, the bus priority and exclusive bus lanes would allow faster bus travel time, especially in the traffic-congested area. Although the operators would benefit from this infrastructure in terms of lower operating costs, we did not find this to be a significant issue.

Clearly, the operators are not interested in investing in the infrastructure unless there are significant benefits. The payback period of investment in the infrastructure, such as a guided bus lane, is rather long, probably more than 15 years. Currently, it is not possible for such a lengthy contract in the bus sector. Alternatively, the authority could develop the infrastructure by itself, and let the operator use it under certain conditions, such as a lower subsidy level or a contribution to the infrastructure maintenance cost. This kind of innovation must come form the authority's initiative.

The second aspect, the monitoring issue, is a problem due to the fact that information regarding the performance of the operator is hardly available. We observed that the authority relies on the operator to provide the public transport operation. This makes assessment and comparison issues very difficult; progress of a project, as denoted by the operator, is difficult to identify in terms of service quality and operating performances. It hardly identifies the progress, in terms of service, which is made by the operator.

If we compare the London and PZH areas, the London case illustrates a strong centralised policy. The coherence between the public transport policy and the general transport policy in the area is one of the most successful factors in the recent growth of the public transport ridership. Innovative capabilities of the London authority (TfL) are high, and its learning element is moderate but strong. A lesson that we can learn from the London case is that the public authority should consider not only the policy in the public transport sector, but also the transport policy as an integrated system.

Furthermore, the authority should take initiative as system integrator. The public transport concessions should not be operated independently. The authority should provide an incentive for the operators to cooperate in service integration. This integration should be encouraged between both concessions and modes. Additionally, it should cover not only the transfer facilities, such as the integration between bus stops and train stations, but also the timetable integration as well.

Finally, the tendering process leads to the service-oriented innovation. The operators adopt their strategies to broaden the quality aspects of the public transport services in order to win more concessions. However, the operators concentrate solely on those aspects that suit their commercial interests (profitability and continuity). This leaves the task of influencing operators to innovate in a manner that benefits society to the authority.

At this point, we can answer the research questions (questions 2 and 3) from the empirical perspective, from the bus sectors. Question 2 asked ‘how does regulatory reform in the public transport sector affect innovation?’ Experience from the bus sector tells us that the tendering process, which is a part of the regulatory reform, leads to the service-oriented innovation. In our case studies, the authorities seek to improve the quality of public transport services, and the operators react to this requirement using innovation.

Question 3 asked ‘what are the behavioural changes (with respect to innovation) of public transport actors when influenced by regulatory reform?’ The answer is that both the authorities and operators change their behaviour after the tendering process occurs. In our case studies, the authorities moved toward quality-oriented services. They tried to improve the quality of public transport services by using tendering and this is expressed by the quality aspects that are included in the tender document. The operators also adjusted themselves competitively in the bus market. Although the operators concentrated primarily on their commercial interests (profitability and continuity), they realised that improving the overall quality of public transport is the key to the tendering process in the Netherlands.

9.3.2 *Innovation in the railway sector*

Chapter 8 presented the case study on innovation in the tendering process in the railway sector. We analysed the empirical evidence from two cases: the Groningen and Merseyrail Electrics cases.

In principle, there is not much difference between bus and railway in terms of innovation apart from a few fundamental differences, such as infrastructure and the investment level (the life cycle of the vehicle and infrastructure). However, railway is less flexible; innovation diffusion may be slower than that of the bus, especially in terms of the traffic management system and the infrastructure provision. Clearly, the innovation in the train services needs cooperation from all parties, including the infrastructure company. However, the role of the infrastructure company is not explicitly stressed.

In terms of the authorities' innovative capabilities, both authorities (PG and PF, and MPTE) show low technical capabilities and high organisational competence. In terms of technical capabilities, authorities played a limited role in developing the technical side. The operator, in consultation with the infrastructure manager, made most of the technical decisions. When focusing on organisational competence, the authorities in both cases show a considerable degree of development. They both had little experience in the railway tendering process, but they facilitated the tendering well. The operators in both cases show very high managerial competence.

One of the drawbacks of utilising the tendering process in the railway sector is that most innovation, especially technical innovation, was developed independently from the process. Innovation should be developed from both operator and infrastructure manager. The case studies illustrated that both infrastructure companies were rather passive in the tendering process. In fact, the issue of infrastructure was not explicitly addressed in the railway tendering processes. Therefore, we need to address the importance of integrated planning for innovation in the sector. The track and train relationship should be strengthened in order to develop successful innovation for railway. This is a challenge for the authority who must act as a coordinator for the cooperation between operator and infrastructure management in the tendering process and during the operational phase of the concession.

Currently, the operator and authority choose the proven technologies rather than the new technologies in the tendering process in the railway sector. Thus, the authority and operators are now the technical selectors rather than the technical developers. They focus more on the operational aspect, especially in terms of operational performances as it is shown in the Groningen case where the authority and operator are the technical selectors. They selected the new train type, low floor trains. We could expect more investment in new rolling stocks that is a result of the tendering process. However, it might be too early to suggest that the railway sector will be comparable with the bus sector in terms of the vehicle investment. The difficulty of this investment is that the rolling stock has a longer life cycle, more that 30 years. Generally, the commitment for the investment in new rolling stocks requires a contract of 15 years or longer. Thus, the explicit intention for the rolling stock investment was often expressed through the tender document in most cases. Because the authority and operators are not interested or capable of developing the technology, the government must now lead this task at both the national and international levels.

It is needed to identify a clear strategy in terms of technological innovation in the railway sector at the government level. The tendering process in the railway sector leads to a situation where the authority, who gives the concession, and the operators, who operate the railway services, focus on the operational aspect. They are not interested in (and not capable of) developing the technology. This task has to be led by the government at the national or international levels (for example at the EU level). Additionally, infrastructure companies should assist in leading the technological strategy because their task automatically combines both track and train development. In particular, the implementation of the new rolling stocks should be done with close consultation with the infrastructure manager.

A number of conclusions can be drawn from the empirical findings. First, in the railway tendering process, the authority and operators focus on developing their organisational capabilities rather than technical capabilities. We observed in the cases that authorities were inexperienced in terms of the railway business, but they can organise the railway tender perfectly.

Second, our observation from the case studies is that, in the railway tendering process, both the authority and operator chose proven technologies rather than new ones because there was less risk involved in terms of technical difficulties and commercial aspects. The authority and operators are now the technical selectors rather than the technical developers, and, as a result, they focus more on the operational aspect.

Thirdly, the tendering process in the railway sector has also induced innovation. However, we should look at the tendering process as a part of the regulatory reform process that leads to organisational reconstruction. Thus, reform effectively induces new players into the railway sector. For instance, the regional authority who has no experience in the railway business before now has to organise the tendering process. Nevertheless, the authority managed to complete this task successfully. But, we should place more emphasis on the track and train relationship because this relationship is very important for railway operation.

Finally, there is a need to emphasise more on the issue of long-term planning of innovation in the railway sectors to incorporate the tendering process as a part of transport policy. On a positive note, innovation in the railway sectors concentrates on vehicle investment and service improvement which is the direct result of the tendering regimes. Public transport users benefited from these improvements (new trains, more services, better accessibility). However, competition for the market seems to work on a short-term basis. The tendering process pays little attention to the medium-to-long-term development, i.e. in terms of network, new service development (i.e. new lines), and service integration.

Looking at Question 2 empirically, we can answer how regulatory reform effects innovation by noting that, in the railway sector, reform had a profound impact on the industry structure. New organisations were created as a result of the privatisation process. The separation of infrastructure from operation makes competition in the sector possible. This competition is often a tendering regime. We see, similar to the bus sector, that tendering leads to innovation in vehicle investment and service

improvement. This innovation is a short-term basis where the medium-to-long-term development is neglected.

Question 3 asked 'what are the behavioural changes (with respect to innovation) of public transport actors when influenced by regulatory reform?' The answer to this question is not much different from the bus sector. From the empirical perspective, both the authorities and operators changed their behaviours after the tendering process as well. The quality aspect is now very important for the authorities and operators. Furthermore, other actors, such as infrastructure management and rolling stock manufacturing, change their behaviours as well.

9.3.3 *Comparison between bus and railway sectors*

There are similarities and differences between the bus and railway sectors in terms of innovation in the tendering process. It is often perceived that there should be more innovation in the railway sector than the bus sector. This view exists because railway has a broader scope for innovation than bus does, such as station, track, and rolling stock. It seems that there is much room for technical improvement.

In most tendering processes, we observed that innovation in public transport concentrates mainly on the service and vehicle elements which were more developed in the bus sector. For example, low-floor buses were introduced rapidly in the Netherlands when the tendering process began in 2002. We might view that low-floor buses may no longer be categorised as an innovation anymore since they are now widely used. Nevertheless, we posit that the tendering was one of the catalysts that speed up the diffusion of the low-floor buses in the Netherlands. However, the railway sector seems to elicit a slower response time to the tendering than in the bus sector. This is due to the fact that railway is less flexible, i.e. difficult (or costly) to change. Although the Groningen case provided us with the example of the new rolling stock innovation, it came with specific circumstances, i.e. a long-term contract. This illustrates clearly the difference between railway and bus in terms of the systems' life cycles.

We have to stress that many innovations develop internally, thus we might not perceive them as an innovation. For instance, buses and new rolling stocks are usually efficient in terms of fuel and energy. This engine and fuel technology is continuously improved as well. Still, from an innovation perspective, we have evidence that in the bus sector, innovation is characterised by a short term cycle and, in the railway sector, we observe a longer term cycle, but in the end, the ambition and realised level of innovation is comparable.

Clearly, the length of the contract determines innovation in the public transport sector. In the bus sector, it often perceived that the investment in new fleets is possible with a minimum contract length of 4 years, but preferably 6 years. We observed in the PZH cases that the authorities were pursuing the (rather) long-term contract for the bus tendering (4-6 years) and they received new buses as a result. The railway system needs a longer contract length if the authority wants to have new rolling stocks.

The role of infrastructure is different in the railway and bus sectors. In the bus sector, the infrastructure is not complicated. Generally, buses share road space with other vehicles with some facilities such as bus stops and bus lanes that are exclusive only to

buses. Thus, innovation in the bus sector relies more on the management and organisational development of the infrastructure and the operator rather than on the technical components.

On the contrary, the technical aspect of the railway is rather complicated because it includes the train traffic signalling system, the safety system, and the traction system. It is evident that in the railway tendering process, we cannot underestimate the role of the infrastructure.

9.3.4 *Synthesis and policy recommendation*

In the public transport sector, the tendering process generally leads to innovation. The driving force of this innovation is the competitive pressure from this tendering process. However, types and patterns of innovation vary as the regulatory framework and degree of competition differ.

In the public transport sector, competition leads to the changes in actors' behaviours. Although the regulatory reform in the public transport sector aims to simulate innovation, it does not lead to a better understanding of innovation.

From the synthesis discussed above, we can answer Question 4, which asked 'what are policy recommendations for public transport stake holders on innovation?' These policy recommendations regarding innovation and regulatory reform in public transport can be defined as follows:

First, the most important aspect is the monitoring issue. In order to identify the opportunities for innovation, we need a better understanding of the current situation, i.e. the current performance and identification for improvements. Insufficient monitoring means that information regarding current performance is not known. Also, a comparison between tendering areas is impossible; this leads to a situation where overall improvement is unattainable. A good monitoring system would assist both authorities and operators in identifying a long-term, integrated strategy for the public transport services in all areas. The authorities would be better able to identify service improvement opportunities, such as a new infrastructure plan or a new bus route or network. They can then make suggestions to the current operator or incorporate their ideas into the new concession. For the operators, monitoring would better demonstrate how well they performed. This would provide valuable information in future tendering processes in which operators might be involved.

Second, the government and regional authority should lead in the long-term innovation planning. This should be an integrated approach in which the process of innovation is fully recognised (organisational and institutional elements should be part of it). But also infrastructure development along with the manufacturing industry and infrastructure providers should be part of it. A clear vision on innovation in the long run is very important. The operators seem to be interested only in the short-term profit. Thus, the government must be active in this aspect.

Third, there is also an area where operator initiatives are more effective than the public sector. Clearly, the service-oriented trend in the tendering process proved that the operator could deliver an innovative service given the right conditions. This

should be encouraged, for instance, by creating space in the tender contracts for policy development by the operators.

Finally, innovation in the railway sectors revolves more around vehicle investment and service improvement. This is the direct result of the tendering regimes. Though public transport users benefited from these improvements (new trains, more services, better accessibility), the tendering process paid little attention to the medium-to-long-term development, i.e. in terms of network, new service development (i.e. new lines), and service integration. Unfortunately, competition for the market seems to work on a short-term basis. For that reason, there is a need to emphasise more on the issue of long-term planning of innovation in the railway sectors to incorporate the tendering process as a part of transport policy.

9.4 Recommendations for future research

There are a number of topics for future research that can be identified here.

First, we learned some lessons from the comparison between PZH and London cases. It is relevant that when the four big cities (Amsterdam, the Hague, Rotterdam, and Utrecht) privatise their public transport companies, the lessons from the empirical cases in Chapter 7 will be very useful. Clearly, the models need to adapt to the varying situations in each city in Europe, but their application is promising in a new environment.

Second, as more railway concessions in the Netherlands will be put out for tender, more research is needed to understand how authorities and operators learn from the railway tendering process. We should encourage the transfer of knowledge between concessions. There is much to learn from each other, both the authorities and the operators.

Thirdly, it is remarkable that there is not much research on the effects of innovation in public transport on the users, while the tendering is introduced to attract more users to utilise public transport. This is a crucial element that can help indicate where we should pay extra attention in developing innovation. The interesting question is, 'what kind of innovation do public transport users expect?' Furthermore, it should address the users' perception of the innovation as well.

Finally, it is possible to develop a tool using the Simulation Approach to test behaviours of actors in the public transport sector with regard to innovation. In Annex 3, we provide an example of the simulation model that is based on the System Dynamics Approach. The models examine the case of a deregulated system. As direction for future research, this subject is very promising. The tendering process can be modelled using this approach. The model would provide a decision-support system for both the authority and the operators to participate in the tendering process.

Annex 1: List of Interviewees

Ing. C.A. Braam	ROVER
A. Cnesson	Arriva Nederland
T. van Eck	ROVER
mr. H. Froentjes	OV-bureau Groningen Drenthe
M. Gerritsen	Connexxion Openbaar Vervoer
dr.ir. M.G. van den Heuvel	ProRail
ing. A. Jacobi	Connexxion Openbaar Vervoer
drs. ing. L. Jansen	Provincie Zuid Holland
ing. J.A. Jansen	Connexxion Openbaar Vervoer
drs. G.A. van Kesteren	Kennisplatform Verkeer en Vervoer (KpVV)
R. Köhler	ProRail
drs. R.I.T. Koolen	Kennisplatform Verkeer en Vervoer (KpVV)
ing. M.A.H. Kruis	Arriva Nederland
drs. C. van der Maas	Ministerie van Verkeer en Waterstaat
drs. E. Pelle	TransTec
drs. R. Rippens	Connexxion Openbaar Vervoer
dr.ir. A.A.M. Schaafsma	ProRail
drs. M. Scheerders	RET
drs. M.P. Sloot	Kennisplatform Verkeer en Vervoer (KpVV)
mr.ing A. Stoelinga	Adviesdienst Verkeer en Vervoer (AVV)
drs. W. Sweers	Stadregio Rotterdam (SRR)
ing. T.J. van der Veen	VDL Berkhof
J.A.J. Westerhof	Arriva Nederland
drs. M.A.H. Wieman	NedRailways
D. Wijen	ROVER
E.R. Zijderveld	Connexxion Openbaar Vervoer

Annex 2: List of the Authorities in the Netherlands

Provincial authority	Regional authority (within that province)
Provincie Groningen	None
Provincie Friesland	None
Provincie Drenthe	None
Provincie Overijssel	Regio Twente
Provincie Gelderland	Knooppunt Arnhem-Nijmegen (KAN)
Provincie Utrecht	Bestuur Regio Utrecht (BRU)
Provincie Noord Holland	Regionaal Orgaan Amsterdam (ROA)
Provincie Zuid Holland	Stadsgewest Haaglanden
	Stadsregio Rotterdam (SRR)
Provincie Zeeland	None
Provincie Noord Brabant	Samenwerkingsverband Regio Eindhoven (SRE)
Provincie Limburg	None
Provincie Flevoland	None
12 Provinces	**7 Regional authorities**

Annex 3: System Dynamics Model: From Real World to Model World[1]

Introduction

We conclude that, in Chapter 7 and Chapter 8, innovation evolves and plays an important role in public transport sector. The empirical evidences show that innovation is a complex and dynamic process. This is in lines with our observation that local public transport services in Europe have gone through a fundamental change over the last two decades, moving from a publicly owned heavily regulated industry towards a privately owned competitive industry. This fundamental change is a complex process in that it had sharpened not only the way the local public transport services are provided, but also the behaviours of the stakeholders involved. The effects of this fundamental change were substantial. For instance, the operator who formerly enjoyed a monopoly position now has to face competition, either in the market or for the market.

Decision-making in the regulatory reform process, especially in the case of deregulation, is difficult because there has been neither historical experience to learn from, nor reasonable analogies elsewhere. This inexperience is common to all companies, as well as the regulators, and the political framework in which everybody operates. The challenge for the deregulated company is thus to understand the strength and weakness of the system, and then to develop the company's strategies for competitive exploitation to influence future change (Larsen and Bunn, 1999).

This annex tests the development of a tool, the system dynamics approach, to study the dynamical process of bus service with respect to regulatory reform (through regulation) and innovation. Bus industry has gone under industry reforms mainly from the transformation of public to private operation. The stakeholders involved in the industry have been repositioned dramatically. This change is at fundamental level. This system dynamics approach seeks to depict the microstructure of a system at an operational level with a feedback loop structure. The feedback loop structure of any dynamic system embodies the physical structure of the system, the flows of information characterising the state of the system, and the decision rules of the agents in the system. One important element of any dynamic system's structure is its nonlinear relationship as every significant economic process and institution involves nonlinearity.

[1] This annex is based on a paper presented at 8th TRAIL Congress (Ongkittikul, 2004b).

System Dynamics Models

System dynamics models can be characterized as structural, disequilibrium, behavioural models (Radzicki and Sterman, 1994). System dynamics models seek to portray the microstructure of a system at the operational level. The feedback loop structure of any dynamic system consists of the physical structure of the system, the flows of information characterizing the state of the system, and the decision rules of the agents in the system, including the behavioural decision rules people use to manage their affairs (Radzicki and Sterman, 1994).

Radzicki and Sterman (1994) stress that a fundamental feature of system dynamics models is that they rest on the theory of bounded rationality (Simon, 1981, Nelson and Winter, 1982). The essence of the theory is summarized in Herbert Simon's principle of bounded rationality (Simon, 1957):

> The capacity of the human mind for formulating and solving complex problems is very small compared to the size of the problem whose solution is required for objectively rational behaviour in the real world or even for a reasonable approximation to such objectively rationality.

The attributes described above make system dynamics modelling well suited to the study of evolutionary dynamics in human systems (Radzicki and Sterman, 1994). The flexibility of the simulation method and emphasis on empirical assessment of the decision rules of the actors means the microstructure of a system can be represented with great fidelity.

The behaviour of a system develops from its structure. That structure consists of the feedback loops, stocks, flows and nonlinearities created by the interaction of the physical and institutional structure of the system which the decision-making processes of the actors involved in the system (Sterman, 2000). The feedback loop is considered as an important element of system dynamics models[2]. It represents the relationship between structure and behaviour of the model. There are two types of feedback loops; positive and negative. Figure A-1 shows an example of these feedback loops.

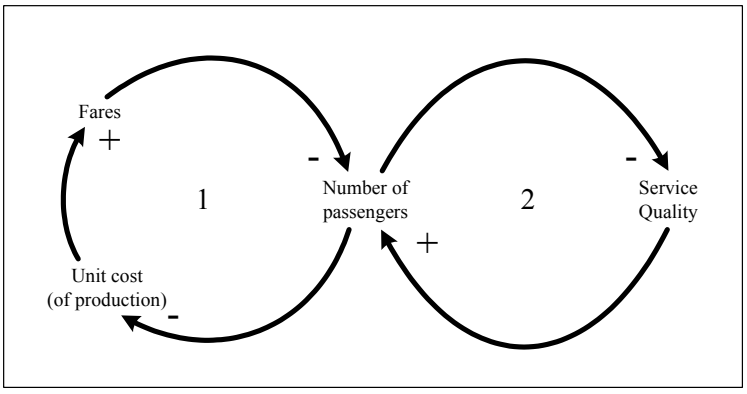


Figure A-1 Example of two feedback loops

[2] Detail explanation of the feedback loops, stocks, and flows can be found in Sterman (2000).

Mayo et al. (1999) give a simple example of these two feedback loops related to public transport service. Figure A-1 above, adapted from Mayo et al. (1999), illustrates how such feedback loops are represented. In the *positive* or *self-reinforcing* loop on the left (1), if fares are cut, the number of passengers increases. A negative-sign arrow means that the change is in a reverse direction. An increase in the number of passengers lowers unit costs. This also presents by a negative-sign arrow. A decrease in unit costs lowers fares. This presents by a positive-sign arrow as the change is in the same direction. For this loops, it is called exponential growth; it arises from positive feedback (Sterman, 2000). The *negative* or *balancing* loop on the right (2) illustrates that as the number of passengers increases, service quality problems increase if the capacity is not adequate enough to meet the increased volume of passengers. These negative loops seek balance, equilibrium, and stasis (Sterman, 2000).

This annex uses the system dynamics model described above as a tool to model the competition and innovation in bus services. The details of the modelling process are described in the following section.

The simulation exercise

Overview

This section seeks to develop the system dynamics model of the competition and innovation of the deregulated system in the bus sector. Figure A-2 shows an overview of the model structure which consists of three parts. These are the demand model, market share model, and operation model (at firm level).

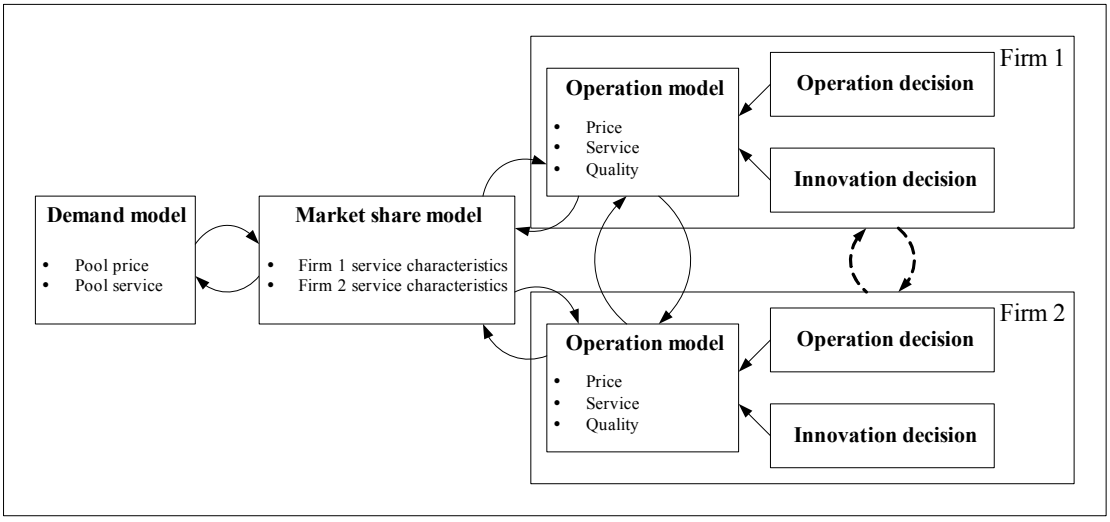


Figure A-2 Model overview for the deregulated system case

Figure A-2 also shows feedback structure of the bus operation model. The demand interacts with the services provided by two operators via the market share model. The operation model is a key to interact with both consumer demand and the competitor. Two decisions are of importance here are the operation decision and the innovation decision. The former presents the act of adjusting the operating component, such as fare or frequency, in order to compete with the competitor. The latter presents the strategic choice that involves the use of new techniques or new production processes.

Then the simulation exercise will be performed to study the interaction between operation and innovation decision of two operators. The demand, market share, and operation model are described in the following sections.

It must be taken into account that the methods and models adopted by Williams and Abdulaal (1993) provide a touchstone for this annex. However, unlike Williams and Abdulaal's work, this annex does not attempt to use the concept of optimisation process to solve to equilibrium. Instead, this annex uses a system dynamics approach, including feedback structure, with a dynamic process to see the pattern of changes in the system. Then the simulation results are analysed using the game theory concept. This will give some fruitful results to understanding the process of competition and innovation in bus sector. However, it must be noted that the innovation included in the model is rather simplified. The detailed qualitative analysis of innovation in public transport can be found elsewhere (Ongkittikul, 2004a). Nonetheless, a better treatment of innovation in a quantitative aspect is required.

Model formulation

The demand model:

This section uses the negative exponential demand model, adapted from Williams and Abdulaal (1993). It is represented by the following equation:

$$D = \overline{D}\left\{\frac{\sum_j w_j^{\phi}\exp\{-\lambda(f_j + d_j)\}}{\sum_j \overline{w}_j^{\phi}\exp\{-\lambda(\bar{f}_j + d_j)\}}\right\}^{\Delta/\lambda} \tag{1}$$

Where D is the total market demand for public transport and $\overline{D}$ is the reference state of the public transport demand. The exponential form is taken from the concept of the composite cost (Williams, 1977) where the parameter Δ determines the dependence of the total market demand for public transport services D on the configuration of fares and frequencies associated with the operators (Williams and Abdulaal, 1993). The term $w_j^{\phi}\exp\{-\lambda(f_j + d_j)\}$ represents the additive generalised cost (or disutility) where f_j is the fare, w_j is the frequency, and d_j is all the *measured* attributes which influence demand other than f_j and w_j. The term w_j^{ϕ} called the frequency dependency is similar to that adopted by Hanson (1990), in which the frequency is taken as a measure of the 'size' of an aggregate alternative. A parameter ϕ determines the frequency cross-elasticity of demand. This formula also links to the market share model, which uses the logit function, as follows:

$$D_j = D \times MS_j \tag{2}$$

$$MS_j = \frac{w_j^{\phi}\exp\{-\lambda(f_j + d_j)\}}{\sum_j w_j^{\phi}\exp\{-\lambda(f_j + d_j)\}} \tag{3}$$

Where D_j is the public transport demand of operator j and MS_j represents the market share of operator j. The parameter ϕ determines the frequency cross-elasticity of demand between the operators and λ determines the fare (and other attributes) cross-elasticity of demand between operators. The relative importance of frequency and

fare in determining the demand of each operator, and the nature of competition, will depend on the values of the parameters ϕ and λ (Williams and Abdulaal, 1993).

The firm operational model:
The linear cost model with operator-dependent fixed and variable cost components is used in this annex as follows:

$$C_j\left(w_j\right) = k_j^* + k_j w_j \tag{4}$$

Where k_j^* represents the fixed cost and k_j represents the variable cost. The variable cost component (k_j) is determined by the frequency of the services (w_j). Further, the service offered by operator O_j is $w_j s_j$ trips per hour, where s_j is the vehicle capacity.

For the equilibrium situation, the fare and frequency can be calculated from information available to the operator. It is assumed that the operator knows the previous demand in order to design the frequency of the next period. Thus the frequency of operator *j* at the *t* period is:

$$w_j^t = \frac{D_j^{t-1}}{s_j} \tag{5}$$

Where D_j^{t-1} is the demand of operator *j*'s service at time period *t-1*. However, this formula will suffer from the fluctuation of the demand and supply, as the price is set as a function of services produced. It is thus wise to average the demand of some periods in the past to overcome the fluctuation problem. This procedure will be discussed later in the simulation exercise section.

For a fare setting, this annex assumes the operators set price from the total cost of production plus the profit margin (pm_j). This formula can be seen as a price mark-up equation which seems plausible in the bus operation (Romilly, 2001). Furthermore, the operator knowledge about demand is similar to the case of frequency, i.e. the operator knows only the previous demand information for designing the fare in the next period. Note that the average of the demand over the past period will be also be used in this formula as in equation (5) but will be described in more detail in the next section. The fare equation is as follows:

$$f_j^t = \frac{D_j^{t-1}}{C_j\left(w_j\right)} \times \frac{1}{1 - pm_j} \tag{6}$$

Finally the revenue can be calculated as follows:

$$\Pi_j = D_j \times f_j - C_j\left(w_j\right) \tag{7}$$

Simulation exercise

Reference model:

The simple model of the bus system is built to illustrate the effects of the competition and innovation. The model has two operators competing in the system. The model utilised in the system dynamics program called 'PowerSim®'.

In this simulation exercise, most of the values are taken from Williams and Abdulaal (1993). The variables and parameters are defined in terms of following units:

$D, \overline{D}$	= passenger trips per hour;
f, d, k^*, k	= pence (100p = £1);
ϕ	= dimensionless;
λ, Δ	= pence^{-1};
w	= hour^{-1}; and
C, Π	= pence per hour.

In the reference model, the variables and parameters are set as follows. ϕ was given the value of 1.0, and $\overline{D}$ was chosen to be 500 trips per hour. The original setting of the cost components were k^* = 1000p and k = 500 p. A value of λ was set to be 0.1 pence^{-1}. In an inelastic market ($\Delta = 0$) under symmetric conditions between two operators (i.e. $d_1 = d_2$; $k_1 = k_2$) the equilibrium fares and frequencies were 20p and 5 per hour, respectively. According to this equilibrium configuration, the profit margin is 30%, which is considerably high. The common profit margin for bus companies is about 15% (White, 2001). Thus this simulation exercise uses 30% and 15% profit margins as high and low levels respectively. Furthermore, the delay of demand information, as described in the previous section, is set to be one period delay while the demand information that used in equation (5) and (6) is set to be an average demand of 5 previous periods, which called the *expected demand*.

The period of simulation is set at a one hour per period. This setting is for the sake of convenience in terms of modelling unit compatibility. With this setting, it is plausible to assume that a period of one hour represents the one-hour of operation of the month during the course of the month. The 'one month' period would be realistic in terms of operation planning. Thus, a simulation run of 12 periods would represent a year of operation.

There are two reference models in this annex: inelastic demand and elastic demand cases. In the inelastic demand case, $\Delta = 0$. In the elastic demand case, $\Delta = 0.04$. This makes the price elasticity around -0.55. The following scenarios will introduce some changes and to see how the system would react to these changes. The first scenario is that one of operators is considering frequency competition. This operator aims to increase services frequency by 50% of its previous demand. It is assumed that another operator (*Firm 2*) does not change its strategy, i.e., in game theory terminology, *Firm 2* plays a dominant strategy. The market share and cumulative revenue of the two operators of this scenario are presented in Figure A-3 and Figure A-4 for inelastic demand and elastic demand cases respectively.

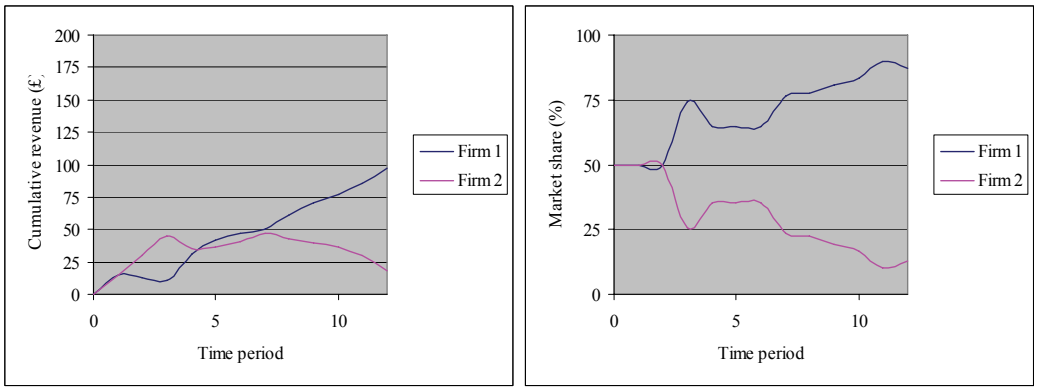


Figure A-3 The cumulative revenue and market share of an inelastic demand case

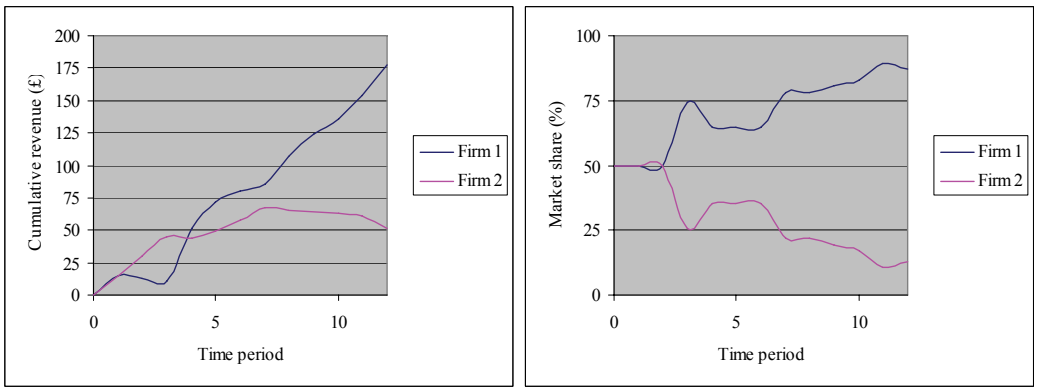


Figure A-4 The cumulative revenue and market share of an elastic demand case

It is obvious that when one firm improves its service, the market share increases. In Figure A-3, the market share of *Firm 1* is around 80% at period 12. Further, revenue of *Firm 1* increases while cumulative revenue of *Firm 2* starts to decline, which means there is a negative revenue change per period. A point to be addressed is that in the first few periods, the cumulative revenue of *Firm 1* was dropped while that of *Firm 2* was increased. An explanation for this is the demand delay. This delay caused mislead the setting of the *Firm 1*'s fare before *Firm 1*'s expected demand is met in later period.

The patterns of the cumulative revenue and market share between inelastic demand and elastic demand cases are similar. For market shares, the results are just slightly different and the pattern is alike, i.e. *Firm 1* is going to dominate the market. For cumulative revenues, the elastic demand gives more revenues for *Firm 1* than the inelastic demand case. As expected, more frequency would induce more passengers.

There are two scenarios that introduced in this section: operation decision scenarios and innovation decision scenarios. Each scenario sets variables for which firms can choose. The results will be analysed using a game theory approach[3].

[3] See Preston (1991) for the literature review of using game theory for analysing bus competition.

Operation decision scenarios:
For operation decision scenarios, each firm has to choose its frequency and profit margin level. Each firm can choose either a normal frequency setting or high frequency setting. The normal frequency is calculated as described in the reference model setting. The high frequency necessitates that the firm increase their *expected demand* by 10%. In terms of the profit margin, each firm has to choose either high (30%) or low (15%) profit margins. The scenarios' results consist of 16 simulation runs.

This annex uses the game theory to analyse the simulation results. The pay-off matrix is constructed using cumulative revenues at the end of period 12. Table A-1 below shows a pay-off matrix for operation decision scenarios with inelastic demand.

Table A-1 Pay-off matrix for operation decision scenarios with inelastic demand

		Firm 2			
	Frequency	*Normal*	*Normal*	*High*	*High*
	Profit margin	*High*	*Low*	*High*	*Low*
Firm 1					
Frequency	Profit margin				
Normal	*High*	180,180	74,147	135,178	39,122
Normal	*Low*	147,74	74,74	119,79	43,62
High	*High*	178,135	79,119	137,137	42,100
High	*Low*	122,39	62,43	100,42	35,35

Note: The elements in this table refer to the cumulative revenue (in pound) at the end of period 12 for firms 1 and 2 respectively.

This annex uses a Nash-equilibrium solution concept[4] to solve the game in each scenario. A Nash-equilibrium is a set of strategies, one for each player, such that no player has incentive to unilaterally change her action. Players are in equilibrium if a change in strategies by any one of them would lead that player to earn less than if she remained with her current strategy.

The Nash-equilibrium outcome of the game presented in Table A-1, when both firms play *normal frequency* and *high profit margin*, is (180,180). This solution is palpable as this is an equilibrium outcome of the setting and both firms have no incentives to deviate from playing (*normal-high*) strategy. We now turn to the results of the elastic demand case.

[4] For the formal definition, see Gibbons (1992), for example.

Table A-2 Pay-off matrix for operation decision scenarios with elastic demand

		Firm 2			
	Frequency	*Normal*	*Normal*	*High*	*High*
	Profit margin	*High*	*Low*	*High*	*Low*
Firm 1					
Frequency	Profit margin				
Normal	*High*	180,180	100,180	146,192	71,173
Normal	*Low*	180,100	117,117	155,113	91,117
High	*High*	192,146	113,155	160,160	82,152
High	*Low*	173,71	117,91	152,82	92,92

Note: The elements in this table refer to the cumulative revenue (in pound) at the end of period 12 for firms 1 and 2 respectively.

The solution for the game presented in Table A-2 is (160,160) which is when both players play *high frequency* and *high profit margin*. The equilibrium outcome in this case is changed from the equilibrium outcome in the inelastic demand case. The reason for this change is that, in the case of elastic demand case, there is an incentive for firms to increase their frequencies due to the fact that the demand will increase as frequency increases. But, in the case of inelastic demand, there is no incentive for both firms to move away from playing *normal-high*. We can see that the highest pay-off for *Firm 1* is when *Firm 1* plays *high-high* and *Firm 2* plays *normal-high*. In fact, *Firm 2*'s normal-high is a reference configuration, so if *Firm 1* moves to play *high frequency* and *Firm 2* does not react, *Firm 1* will be better off. However, it must be noted that, in terms of the Nash-equilibrium, cumulative revenues of both firms are lower than the solution in the case of inelastic demand. In the next section, we will discuss the innovation decision scenarios.

Innovation decision scenarios:
In terms of innovation decision scenarios, each firm has to choose one of the two following strategies; cost advantage and innovation. The cost advantage strategy reduces the variable cost (k_j) by 20%. This can be seen as the labour cost cutting measurement. The innovation strategy is to increase d (additional attribute; see equation (1)) by 5 pence per trip. This strategy requires an extra fixed cost of 700 pence per hours. This strategy can be seen, for example, as an introduction of the travel information or the use of minibus (which can be seen as an increase frequency option). The results of simulation are, again, present in the form of a pay-off matrix. Table A-3 shows a pay-off matrix for innovation decision scenarios with inelastic demand.

The equilibrium outcome of the game, when both firms choose to use cost advantage and innovation strategies, is presented in Table A-3. In this case, the revenue is (70,70). This is a unique Nash equilibrium. This result shows, again, a change from the equilibrium outcome of the reference case.

Table A-3 Pay-off matrix for innovation decision scenarios with inelastic demand

		Firm 2			
	Cost advantage	*Yes*	*Yes*	*No*	*No*
	Innovation	*Yes*	*No*	*Yes*	*No*
Firm 1					
Cost advantage	Innovation				
Yes	*Yes*	70,70	186,13	137,9	218,-48
Yes	*No*	13,186	154,154	79,176	221,93
No	*Yes*	9,137	176,79	96,96	236,11
No	*No*	-48,218	93,221	11,236	180,180

Note: The elements in this table refer to the cumulative revenue (in pound) at the end of period 12 for firms 1 and 2 respectively.

Table A-4 shows the simulation results in the case of elastic demand. Again, it illustrates a unique Nash equilibrium for cost advantage-innovation strategy (196,196).

Table A-4 Pay-off matrix for innovation decision scenarios with elastic demand

		Firm 2			
	Cost advantage	*Yes*	*Yes*	*No*	*No*
	Innovation	*Yes*	*No*	*Yes*	*No*
Firm 1					
Cost advantage	Innovation				
Yes	*Yes*	196,196	322,68	265,108	360,-5
Yes	*No*	68,322	193,193	126,269	249,134
No	*Yes*	108,265	269,126	189,189	327,45
No	*No*	-5,360	134,249	45,327	180,180

Note: The elements in this table refer to the cumulative revenue (in pound) at the end of period 12 for firms 1 and 2 respectively.

The results from these innovation decision scenarios show that if the capacity for improvement is available to firms, it is likely that both firms employ innovation, providing that other firms do so as well. This result can be found in practice where innovation has an effect on the user attributes. One example is the use of minibus. Minibus allows the operator to provide a more frequent service (which reduces the travel time). Thus if one operator uses minibus, the best reply of another operator is also using minibus. However, there is also an exception. If the innovation cannot improve the service's attributes significantly, the best strategy is doing nothing.

Concluding remarks

The result of the operation decision scenarios is in line with Preston (1991) in that firms are more likely to increase frequency and less likely to change price. For the innovation decision scenarios, the result shows that if innovation is available to firms, it is likely that firms will make use of it. Although parameters in the model needs to be calibrated using empirical data, this result gives a useful guideline, and it is a beneficial framework for further developments in this field. It is noted that the model uses here is a simplified bus operation that does not take into account other constraints. For instance, it might be the case that incumbent operator has normal buses in operation, so it is costly to switch to a minibus option.

The analysis of the simulation results gives a new perspective for the analysis of innovation and competition in bus services. This is a promising approach; however, it has to be noted that more developments are needed especially validation with empirical information. The parameters and variables should be calibrated either statistically or expert judgement. Nevertheless, this annex shows the potential of this approach.

Opportunities for simulation model in public transport tendering

Regulatory reform and innovation in public transport services is a complex process. This annex provides a first step to understanding the complexity of the process by proposing a system dynamics model as a tool. The model is based on an evolutionary economics theory where the theory of complex systems and the theory of bounded rationality of decision making are combined.

The dynamic model in this annex provides a notable approach to dealing with the dynamic system of competition and innovation in bus services. A system dynamics model of bus services is constructed. The model consists of three main parts; demand, market share, and operation models. The model then tests two scenarios namely operation and innovation decisions. In the operation scenario, the simulation results show that firms are more likely to increase frequency and less likely to change price. These results show a consistency with previous works, such as Preston (1991). In the innovation decision scenarios, it is likely that firms will make use of innovation, if it is available to firms. This simulation, however, still needs empirical validation in terms of the parameters and variables. Nonetheless, this is a promising approach in which the dynamical process of the system and the complexity of decision-making can be analysed.

Further research is needed in various aspects. As aforementioned, the experiential of validation of the simulation model is needed. Additionally, the interaction between demand and supply at the network level needs to be incorporated. This may require more complicated demand specifications as well as an estimation of the parameters. Nevertheless, this may help to examine the competition between operators at network level. Furthermore, this model can be used in the case of tendering. In this case, the demand function must include the authority decision element.

References

Aa, W. van der & Elfring, T. (2002) Realizing innovation in services. *Scandinavian Journal of Management,* 18**,** 155-171.

Alexandersson, G., Hultén, S. & Fölster, S. (1998) The effects of competition in Swedish local bus services. *Journal of Transport Economics and Policy,* 32**,** 203-219.

Appelman, F., Hendriks, D., Kort, M., Mark, R. van der & Snel, H. (2003) Tussenrapportage - Evaluatie Aanbesteding OV Concessies. Utrech, Berenschot.

Appelman, F., Hendriks, D., Kort, M., Mark, R. van der & Snel, H. (2004) Evaluatie Aanbesteding OV Concessies. Utrech, Berenschot.

Archibugi, D. (1988) In search of a useful measure of technological innovation (to make economists happy without discontenting technologists). *Technological Forecasting and Social Change,* 34**,** 253-277.

Arthur, W.B. (1988) Competing technologies: an overview. In Dosi, G., Freeman, C., Nelson, R.R., Silverberg, G. & Soete, L. (Eds.) *Technical Change and Economic Theory.* London and New York, Pinter Publishers.

Arthur, W.B. (1994) *Increasing Returns and Path Dependence in the Economy,* Ann Arbor, University of Michigan Press.

Atkins (2003) Local Authority Survey. London, Commission for Integrated Transport.

Banister, D. (1985) Deregulating the bus industry in Britain: the proposals. *Transport Reviews,* 5**,** 99-103.

Baulmal, W.J., Panzar, J.C. & Willig, R.D. (1982) *Contestable Markets and the Theory of Industry Structure,* New York, Harcourt Brace Jovanovich.

Bayliss, D. (2002) Review: urban public transport competition. *Public Transport International,* 51**,** 4-9.

Berechman, J. (1993) *Public Transit Economics and Deregulation Policy,* Amsterdam, Elsevier Science.

Borger, B. de, Kerstens, K. & Costa, A. (2002) Public transport performance: what does one learn from frontier studies? *Transport Reviews,* 22**,** 1-38.

Brooks, M. & Button, K.J. (1995) Separating transport track from operations: a typology of international experiences. *International Journal of Transport Economics,* 22**,** 235-260.

Button, K.J. & Costa, A. (1999) Economic efficiency gains from urban public transport regulatory reform: two case studies of changes in Europe. *Annals of Regional Science,* 33**,** 425-438.

Button, K.J. & Keeler, T.E. (1993) The regulation of transport markets. *Economic Journal,* 103**,** 1017-1027.

Cantillon, E. & Pesendorfer, M. (2006) Auctioning bus routes: The London experience. In Cramton, P., Shoham, Y. & Steinberg, R. (Eds.) *Combinatorial Auctions.* MA, MIT Press.

Coombs, R.W. & Miles, I. (2000) Innovation, measurement and services: the new problematique. In Metcalfe, J.S. & Miles, I. (Eds.) *Innovation Systems in the Service Economy: Measurement and Case Study Analysis.* Dortrecht and London, Kluwer Academic.

Coriat, B. & Dosi, G. (1998) The institutional embeddedness of economic change: an appraisal of the 'evolutionary' and 'regulationist' research programs. In Nielsen, K. & Johnson, B. (Eds.) *Institutions and Economic Change: New Perspectives on Markets, Firms and Technology.* Cheltenham, Edward Elgar.

Costa, A. (1997) Public transport efficiency and effectiveness: Metro de Madrid. In Button, K.J., Nijkamp, P. & Priemus, H. (Eds.) *European Transport Networks: Concept, Analysis and Policies.* Cheltenham, Edward Elgar.

CVOV (2003) OV Wegwijzer: op weg naar beter openbaar vervoer. Rotterdam, CVOV.

Damanpour, F. (1991) Organizational innovation: a meta-analysis of effects of determinants and moderators. *The Academy of Management Journal,* 34**,** 555-590.

Demsetz, H. (1968) Why regulate utilities. *Journal of Law and Economics,* 11**,** 55-66.

Department for Transport (2005) Public transport statistics: GB: 2005 edition supplement Department for Transport.

Dosi, G. (1982) Technological paradigms and technological trajectories: a suggested interpretation of determinants and directions of technological change. *Research Policy,* 11**,** 147-162.

Dosi, G. (1988a) The nature of innovation process. In Dosi, G., Freeman, C., Nelson, R.R., Silverberg, G. & Soete, L. (Eds.) *Technical Change and Economic Theory.* London and New York, Pinter Publishers.

Dosi, G. (1988b) Sources, procedures, and microeconomic effects of innovation. *Journal of Economic Literature,* 26**,** 1120-1171.

Dosi, G. (1991) The research on innovation diffusion: an assessment. In Nakicenovic, N. & Grübler, A. (Eds.) *Diffussion of Technologies and Social Behavior.* Berlin, Springer Verlag.

Dosi, G., Levinthal, D.A. & Marengo, L. (2003) Bridging contested terrain: linking incentive-based and learning perspectives on organizational evolution. *Industrial and Corporate Change,* 12**,** 413-436.

Dosi, G. & Marengo, L. (2000) On the tangled discourse between transaction cost economics and competence-based views of the firm. In Foss, N. & Mahnke, V. (Eds.) *Competence, Governance, and Entrepreneurship.* Oxford, Oxford University Press.

ECMT (2005) *Railway Reform and Charges for the Use of Infrastructure,* Paris, OECD.

Economist (2003) Congestion charge: Ken's coup. *The Economist.*

European Commission (2000) *Proposal for a regulation of the European Parliament and of the Council on action by member states concerning public service requirements and the award of public service contracts in passenger transport by rail, road and inland waterway*, COM(2000) 7 final, 2000/0212 (COD), European Commission, Brussels.

European Commission (2001a) Case No COMP/M.2139 - Bombardier/ADtranz, Regulation (EEC) No 4064/89 Merger Procedure. Luxembourg, The Commission of the European Communities.

European Commission (2001b) *European Transport Policy for 2010: Time to Decide: White Paper,* Luxembourg, Office for Official Publications of the European Communities,.

European Commission (2002) *Amended proposal for a regulation of the European Parliament and of the Council on action by member states concerning public service requirements and the award of public service contracts in passenger transport by rail, road and inland waterway*, COM(2002) 107 final, 2000/0212 (COD), European Commission, Brussels.

European Commission (2005) *Proposal for a regulation of the European Parliament and of the Council on public passenger transport services by rail and by road*, COM(2005) 319 final, 2000/0212 (COD), European Commission, Brussels.

Eurostat (2003) *50 Years of Figures on Europe,* Luxembourg, European Communities.

Evangelista, R. & Sirilli, G. (1998) Innovation in the service sector: results from the Italian statistical survey. *Technological Forecasting and Social Change,* 58**,** 251-269.

Feitelson, E. & Salomon, I. (2004) The political economy of transport innovations. In Beuthe, M., Himanen, V., Reggiani, A. & Zamparini, L. (Eds.) *Transport Developments and Innovations in an Evolving World.* Berlin, Springer.

Forrester, J.W. (1961) *Industrial dynamics,* Cambridge, Mass., M.I.T. Press,.

Forrester, J.W. (1992) Policies, Decisions and Information-Sources for Modeling. *European Journal of Operational Research,* 59**,** 42-63.

Freeman, C. (1991) The nature of innovation and the evolution of the productive system. In OECD (Ed.) *Technology and Productivity: the Challenge for Economic Policy.* Paris, OECD.

Freeman, C. (1996) The greening of technology and models of innovation. *Technological Forecasting and Social Change,* 53**,** 27-39.

Frenken, K., Saviotti, P.P. & Trommetter, M. (1999) Variety and niche creation in aircraft, helicopters, motorcycles and microcomputers. *Research Policy,* 28**,** 469-488.

Gallamore, R.E. (1999) Regulation and innovation: lessons from American railroad industry. In Gomez-Ibanez, J., Tye, W. & Winston, C. (Eds.) *Essays in Transportation Economics and Policy: a Handbook in Honor of John R. Meyer.* Washington DC, Brookings Institution Press.

Gallouj, F. (2002) *Innovation in the Service Economy: The New Wealth of Nations,* Cheltenham, Edward Elgar.

Gallouj, F. & Weinstein, O. (1997) Innovation in services. *Research Policy,* 26**,** 537-556.

Geerlings, H. (1999) *Meeting the Challenge of Sustainable Mobility: The Role of Technological Innovations,* Heidelberg, Springer Verlag.

Geerlings, H., Ast, J. van & Ongkittikul, S. (2005) Towards a more fundamental transport policy: an inventory of trends that influence the transport patterns in Western Europe and their implication for policy making. *Journal of the Eastern Asia Society for Transportation Studies,* 6**,** 4050-4065.

Geerlings, H., Klementschitz, R. & Mulley, C. (2006) Development of a methodology for benchmarking public transportation organisations: a practical tool based on an industry sound methodology. *Journal of Cleaner Production,* 14**,** 113-123.

Gibbons, R. (1992) *A Primer in Game Theory,* Harlow, Financial Times/Prentice Hall.

Gifford, J.L. (2003) *Flexible Urban Transportation,* Oxford, Elsevier Science.

Glaister, S. (1986) Bus deregulation, competition and vehicle size. *Journal of Transport Economics and Policy,* 20**,** 217-244.

Griliches, Z. (1957) Hybrid corn: an exploration in the economics of technological change. *Econometrica,* 25**,** 501-522.

Gwilliam, K.M. & Geerlings, H. (1992) Research and Technology Strategy to Help Overcome the Environmental Problems in Relation to Transport: Overall Strategic Review. Brussels/Rotterdam, European Commission/Erasmus University.

Hansen, M. (1990) Airline competition in a hub-dominated environment: An application of noncooperative game theory. *Transportation Research Part B,* 24**,** 27-43.

Helmreich, W. & Leiss, U. (2000) Forecasting and Assessment of New Technologies and Transport Systems and their Impacts on the Environment: FANTASIE: Final Report. Brussels, European Commission.

Hendy, P. (2005) New development: Exemplary provision of bus services - Is London a model for other conurbations? *Public Money & Management,* 25**,** 195-200.

Hensher, D.A. (1998) The imbalance between car and public transport use in urban Australia: why does it exist? *Transport Policy,* 5**,** 193-204.

Hensher, D.A. & Prioni, P. (2002) A service quality index for area-wide contract performance assessment. *Journal of Transport Economics and Policy,* 36**,** 93-113.

Hermans, G. & Stoelinga, A. (2003) Competition in Dutch public transport. *8th Conference on Competition and Ownership in Land Passenger Transport.* Rio de Janeiro, Brazil.

Heyma, A., Red, W., Davison, P., Brand, C., Hernández, H., Blennemann, F., Helmreich, W., Korver, W. & Zwaneveld, P. (2000) Impact Assessment of New Transport Concepts; European Research Project RECONNECT; Deliverable 4. Delft, TNO Inro.

Huntley, P. (2001) Better bus services: partnerships for the future. In Grayling, T. (Ed.) *Any More Fares? Delivering Better Bus Services.* London, Institute for Public Policy Research.

IDEI (1999) Network industries and public service. *European Commission Reports and Studies,* 4.

Kain, P. (1998) The reform of rail transport in Great Britain. *Journal of Transport Economics and Policy,* 32**,** 247-266.

Knowles, R.D. (2004) Impacts of privatising Britain's rail passenger services - franchising, refranchising, and ten year transport plan targets. *Environment and Planning A,* 36**,** 2065-2087.

KNV (2005) Overzicht Openbaar Vervoer Concessies in Nederland. The Hauge, Koninklijk Nederlands Vervoer.

Lancaster, G.A. & Taylor, C.T. (1988) A study of diffusion of innovations in respect of the high speed train. *European Journal of Marketing,* 22**,** 21-47.

Larsen, E.R. & Bunn, D.W. (1999) Deregulation in electricity: understanding strategic and regulatory risk. *Journal of the Operational Research Society,* 50**,** 337-344.

Mackie, P.J. (1999) Quality bus partnerships - implications for market performance. *International Conference on Competition and Ownership in Land Passenger Transport.* Cape Town, South Africa.

Mackie, P.J. (2001) Principles of public policy for bus services. In Grayling, T. (Ed.) *Any More Fares? Delivering Better Bus Services.* London, Institute for Public Policy Research.

Mackie, P.J., Preston, J. & Nash, C.A. (1995) Bus deregulation: ten years on. *Transport Reviews,* 15**,** 229-251.

Mahoney, J.T. (2005) *Economic Foundations of Strategy,* Thousand Oaks, Calif. ; London, Sage.

Mansfield, E. (1968) *Industrial Research and Technological Innovation: An Economic Analysis,* New York, Norton.

MARETOPE Project (2000) Deliverable D1: Reference framework and harmonisation of concepts. MARETOPE Consortium.

MARETOPE Project (2002) Deliverable D2: Legal, organisational and financial framework of local public transport in Europe. MARETOPE Consortium.

Mayo, D.D., Pott, J.D. & Dalton, W.J. (1999) A system dynamics perspective on the risks and benefits of public transport restructure: case study of London Underground. *The 53rd Union Internationale de Transport de Publique International Congress.* Toronto, Canada.

McGuinness, I., Gillingwater, D. & Bryman, A. (1994) Organizational responses to the deregulation of the bus industry in Britain. *Transport Reviews,* 14**,** 341-361.

Miles, I. (2004) Innovation in services. In Fagerberg, J., Mowery, D.C. & Nelson, R.R. (Eds.) *The Oxford Handbook of Innovation.* Oxford, Oxford University Press.

Milz, K. (2002) Concentration and Globalization of the Rail and Public Transport Supply Industry. *UITP Conference.* Lodz, October 2002.

Ministerie van Verkeer en Waterstaat (2003) Farebox Allocation in the Public Transport in the Netherlands. The Hauge, Ministerie van Verkeer en Waterstaat.

Ministerie van Verkeer en Waterstaat (2004) Kabinetsstandpunt Aanbestedingen: Stads- en Streekvervoer. The Hague, Ministerie van Verkeer en Waterstaat.

Mohring, H. (1972) Optimization and scale economies in urban bus transportation. *American Economic Review,* 62**,** 591-604.

Mokhtarian, P.L. & Salomon, I. (1997) Modeling the desire to telecommute: the importance of attitudinal factors in behavioral models. *Transportation Research Part A: Policy and Practice,* 31**,** 35-50.

Monami, E. (2000) European passenger rail reforms: a comparative assessment of the emarging models. *Transport Reviews,* 20**,** 91-112.

Mowery, D.C. & Rosenberg, N. (1979) The influence of market demand upon innovation: a critical review of some recent empirical studies. *Research Policy,* 8**,** 102-153.

Nash, C.A. (1982) *Economics of Public Transport,* London, Longman.

Nash, C.A. & Toner, J.P. (1999) Competition in the railway industry. *OECD Journal of Law and Policy,* 1**,** 197-227.

Nelson, R.R. & Winter, S.G. (1977) In search of useful theory of innovation. *Research Policy,* 6**,** 36-76.

Nelson, R.R. & Winter, S.G. (1982) *An Evolutionary Theory of Economic Change,* Cambridge, Harvard University Press.

NERA (2004) Study of the Financing of and Public Budget Contributions to Railways London, NERA.

Network Rail (2005) *Annual Report and Accounts 2005,* London, Network Rail.

Nooteboom, B. (2000) *Learning and Innovation in Organizations and Economies,* Oxford, Oxford University Press.

North, D.C. (1990a) Institutions. *Journal of Economic Perspectives,* 5**,** 97-112.

North, D.C. (1990b) *Institutions, Institutional Change and Economic Performance,* Cambridge, Cambridge University Press,.

North, D.C. (1994) Economic performance through time. *American Economic Review,* 84**,** 359-368.

OECD (1992) *Oslo Manual - Proposed Guidelines for Collecting and Interpreting Technological Innovation Data,* Paris, OECD.

OECD (1997) *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data: The Oslo Manual,* Paris, OECD.

Ongkittikul, S. (2002) Technological innovations in urban public transport: the 'twin characteristics approach' as a new analytical framework. *Colloquium Vervoerplanologisch Speurwerk.* Amsterdam, The Netherlands.

Ongkittikul, S. (2004a) Regulatory reforms in public transport with respect to innovative capacity. *10th World Conference on Transport Research.* Istanbul.

Ongkittikul, S. (2004b) System Dynamics Model for Innovation and Competition in Public Transport Services. *8th TRAIL Congress.* Rotterdam, The Netherlands.

Ongkittikul, S. & Geerlings, H. (2004) Future International Developments in Rail Rolling Stock, Final Report to ProRail. Rotterdam, Erasmus centre for Sustainability and Management.

Ongkittikul, S. & Geerlings, H. (2005) The innovative capacity of the rail industry: high expectations and ambitions versus limited resources and opportunities. *Journal of the Eastern Asia Society for Transportation Studies,* 6**,** 4129-4143.

Ongkittikul, S. & Geerlings, H. (2006) Opportunities for innovation in public transport: Effects of regulatory reforms on innovative capabilities. *Transport Policy,* 13**,** 283-293.

Oum, T.H., Waters, W.G. & Yu, C. (1999) A survey of productivity and efficiency measurement in rail transport. *Journal of Transport Economics and Policy,* 33**,** 2-42.

Patel, P. & Pavitt, K. (1995) Patterns of technological activity: their measurement and interpretation. In Stoneman, P. (Ed.) *Handbook of the Economics of Innovation and Technological Change.* Oxford, Basil Blackwell.

Preston, J. (1991) Explaining competitive practices in the bus industry: the British experience. *Transportation Planning and Technology,* 15**,** 277-294.

Preston, J. (2001a) Bus service regulation and competition: international comparisons. In Grayling, T. (Ed.) *Any More Fares? Delivering Better Bus Services.* London, Institute for Public Policy Research.

Preston, J. (2001b) An overview of public transport reforms in Great Britain and forecasts for the future. *International Journal of Transport Economics,* 28**,** 23-48.

Preston, J. (2005) Tendering of services. In Button, K.J. & Hensher, D.A. (Eds.) *Handbook of Transport Strategy, Policy, and Institutions.* Oxford, Elsevier.

Preston, J., Whelan, G., Nash, C.A. & Wardman, M. (2000) The franchising of passenger rail services in Britain. *International Review of Applied Economics,* 14**,** 99-112.

Radzicki, M.J. & Sterman, J.D. (1994) Evolutionary economics and system dynamics. In England, R.W. (Ed.) *Evolutionary Concepts in Contemporary Economics.* Ann Arbor, University of Michigan Press.

Roberts, C.C. (2003) Is the current ownership structure of the British bus industry capable of meeting public policy objectives? *8th Conference on Competition and Ownership in Land Passenger Transport.* Rio de Janeiro, Brazil.

Rogers, E.M. (1995) *Diffusion of Innovations,* New York, N.Y., The Free Press.

Romilly, P. (2001) Subsidy and local bus service deregulation in Britain: a re-evaluation. *Journal of Transport Economics and Policy,* 35**,** 161-194.

Rosenberg, N. (1976) *Perspectives on technology,* Cambridge, Cambridge University Press,.

Sahal, D. (1985) Foundations of technometrics. *Technological Forecasting and Social Change,* 27**,** 1-37.

Savas, E.S. (1987) *Privatization : the Key to Better Government,* Chatham, N.J., Chatham House Publishers.

Saviotti, P.P. (1996) *Technological Evolution, Variety and the Economy,* Cheltenham, Elgar.

Saviotti, P.P. (2001) Considerations about a production system with qualitative change. In Foster, J. & Metcalfe, J.S. (Eds.) *Frontiers of Evolutionary Economics: Competition, Self-organization and Innovation Policy.* Cheltenham, Edward Elgar.

Saviotti, P.P. & Metcalfe, J.S. (1984) A theoretical approach to the construction of technological output indicators. *Research Policy,* 13**,** 141-151.

Schaafsma, A. (1997) Competition and innovation have not been improved as a result of the reform of the Netherlands railways. *PTRC European Transport Forum, Proceeding of seminar H***,** 57-76.

Schumpeter, J.A. (1939) *Business Cycles: A Theoretical, Historical and Statistical Analysis to the Capitalist Process,* New York and London, McGraw-Hill.

Shy, O. (1995) *Industrial Organization,* Massachusetts, MIT Press.

Simon, H.A. (1957) *Models of Man, Social and Rational: Mathematical Essays on Rational Human Behavior in a Social Setting,* New York, Wiley.

Simon, H.A. (1981) *The Science of the Artificial,* Cambridge, MIT Press.

Simon, H.A. (1985) Human nature in politics: the dialogue of psychology with political science. *American Political Science Review,* 79**,** 293-304.

Simon, H.A. (1991) Bounded rationality and organizational learning. *Organization Science,* 2**,** 125-134.

Simon, H.A. (1997) *Administrative Behavior: a Study of Decision-making Processes in Administrative Organizations,* New York, The Free Press.

SRA (2003) SRA Announces Agreement for Merseyrail Electrics, Press release, 1 February 2003. London, Strategic Rail Authority.

SRA & ORR (2002) Concordat between the Strategic Rail Authority and the Office of the Rail Regulator.

Steer Davies Gleave (2003a) EU Rail Liberalisation: Extended Impact Assessment, Regulatory Overview for the Netherlands: Technical Note. London.

Steer Davies Gleave (2003b) EU Rail Liberalisation: Extended Impact Assessment, Regulatory Overview for United Kingdom: Technical Note. London.

Sterman, J.D. (2000) *Business Dynamics: Systems Thinking and Modeling for a Complex World,* Boston, Irwin/McGraw-Hill.

Stern, J. & Holder, S. (1999) Regulatory governance: criteria for assessing the performance of regulatory systems. *Utilities Policy,* 8**,** 33-50.

Stoneman, P. (2002) *The Economic of Technological Diffusion,* Oxford, Blackwell.

Stoneman, P. & Toivanen, O. (1997) The diffusion of multiple technologies: An empirical study. *Economics of Innovation and New Technology,* 5**,** 1-17.

Sundbo, J. & Gallouj, F. (1998) Innovation in Services: SI4S Project synthesis Work package 3-4. IFRESI-University of Lille.

Sundbo, J., Johnston, R., Mattsson, J. & Millett, B. (2001) Innovation in service internationalization: the crucial role of the frantrepreneur. *Entrepreneurship and Regional Development,* 13**,** 247-267.

Symeonidis, G. (2002) *The Effects of Competition: Cartel Policy and the Evolution of Strategy and Structure in British Industry,* Cambridge, Massachusetts, MIT Press.

Teece, D.J. & Pisano, G. (1994) The dynamic capabilities of firms: An introduction. *Industrial and Corporate Change,* 3**,** 537-556.

Teece, D.J., Pisano, G. & Shuen, A. (1997) Dynamic capabilities and strategic management. *Strategic Management Journal,* 18**,** 509-533.

Tether, B.S. (2001) Identifying Innovation, Innovators and Innovative Behaviours: A Critical Assessment of the Community Innovation Survey (CIS): CRIC Discussion Paper No. 48. Manchester, Centre for Research on Innovation and Competition, University of Manchester.

Tether, B.S., Hipp, C. & Miles, I. (2001) Standardisation and particularisation in services: evidence from Germany. *Research Policy,* 30**,** 1115-1138.

Tether, B.S., Miles, I., Blind, K., Hipp, C., Lison, N. de & Cainelli, G. (2002) Innovation in the Service Sector: Analysis of data collected under the Community Innovation Survey (CIS-2): CRIC Working paper No. 11. Manchester, Centre for Research on Innovation and Competition, University of Manchester.

Tidd, J., Bessant, J. & Pavitt, K. (2005) *Managing Innovation: Integrating Technological, Market and Organizational Change,* Chichester, John Wiley & Sons.

Tilière, G. de & Hultén, S. (2003) A decade of change in the European rail market: influence on innovation and R&D: toward a new equilibrium in the railway sector. *First Conference on Railroad Industry Structure, Competition, and Investment.* Toulouse.

Toner, J.P. (2001) The London bus tendering regime - principles and practice. *7th Conference on Competition and Ownership in Land Passenger Transport.* Molde, Norway.

Transport for London (2006) *London Travel Report 2005,* London, Mayor of London.

Tyrrall, D.E. (2003) The UK railway industry: a failed experiment in transaction cost economics. *European Business Journal,* 15**,** 38-48.

UITP (2003) *Organisation and Major Players of Short Distance Public Transport: New Developments in the European Union,* Brussels, UITP.

Utterback, J.M. (1994) *Mastering the Dynamics of Innovation,* Boston, Harvard Business School Press.

Utterback, J.M. & Abernathy, W.J. (1975) A dynamic model of process and product innovation. *Omega,* 33**,** 639-656.

Veeneman, W.W. (2002) *Mind the Gap: Bridging Theories and Practice for the Organisation of Metropolitan Public Transport,* Delft, DUP Science.

Velde, D.M. van de (1999) Organisational forms and entrepreneurship in public transport Part 1: classifying organisational forms. *Transport Policy,* 6**,** 147-157.

Velde, D.M. van de (2003) Regulation and competition in the European land transport industry: some recent evolutions. *8th Conference on Competition and Ownership in Land Passenger Transport.* Rio de Janeiro, Brazil.

Velde, D.M. van de (2005) Coordination, integration, and transport regulation. In Button, K.J. & Hensher, D.A. (Eds.) *Handbook of Transport Strategy, Policy, and Institutions.* Oxford, Elsevier.

Velde, D.M. van de & Leijenaar, R. (2001) Towards innovation in public transport tendering in the Netherlands. *7th Conference on Competition and Ownership in Land Passenger Transport.* Molde, Norway.

Velde, D.M. van de & Pruijmboom, E. (2003) First experiences with tendering at the tactical level (service design) in Dutch public transport. *8th Conference on Competition and Ownership in Land Passenger Transport.* Rio de Janeiro, Brazil.

Vroome, H.E. de & Wetzels, R.A.E. (1995) Strategic positioning and contracting: a dynamic approach. *UITP 51st International Congress.* Paris.

White, P.R. (1995) Deregulation of local bus services in Great Britain: an introductory review. *Transport Reviews,* 15**,** 185-209.

White, P.R. (1997) What conclusions can be drawn about bus deregulation in Britain? *Transport Reviews,* 17**,** 1-16.

White, P.R. (2001) Local bus profitability and the role of longer-distance services. In Grayling, T. (Ed.) *Any More Fares? Delivering Better Bus Services.* London, Institute for Public Policy Research.

Williams, H.C.W.L. (1977) On the formation of travel demand models and economic evaluation measures of user benefit. *Environment and Planning A,* 9**,** 285-344.

Williams, H.C.W.L. & Abdulaal, J. (1993) Public transport services under market arrangements, part I: A model of competition between independent operators. *Transportation Research Part B,* 27**,** 369-387.

Williamson, O.E. (1985) *The Economic Institutions of Capitalism : Firms, Markets, Relational Contracting,* London, Free Press;Collier Macmillan,.

Williamson, O.E. (1998) Transaction cost economics: how it works; where it is headed. *De Economist,* 146**,** 23-58.

Williamson, O.E. (2000) The new institutional economics: taking stock, looking ahead. *Journal of Economic Literature,* 38**,** 595-613.

Willman, P., Coen, D., Currie, D. & Siner, M. (2003) The evolution of regulatory relationships; regulatory institutions and firm behaviour in privatized industries. *Industrial and Corporate Change,* 12**,** 69-89.

Wolmar, C. (2001) *Broken Rails: How Privatisation Wrecked Britain's Railways,* London, Aurum.

Zaltman, G., Duncan, R. & Holbek, J. (1973) *Innovations and Organizations,* New York, Wiley.

Zuylen, H.J. van & Weber, K.M. (2002) Strategies for European innovation policy in the transport field. *Technological Forecasting and Social Change,* 69**,** 929-951.

Zwaneveld, P., Heyma, A., Korver, W., Anreiter, W., Fischer, T., Marks, H. & Manthey, A. (1999) Overview of Promising Transport Modes Related to New Propulsion Systems: UTOPIA Deliverable D2. Delft, TNO Inro.

Summary

This thesis studies the effects of regulatory reform on innovative capabilities, mainly technological and organisational innovation and learning, in the public transport organisations. Though there is little research that explicitly examines the relationship between regulatory reform and technological innovation in the public transport sector, we utilise, in this thesis, various theories and studies correlating to the issue as well as empirical evidence (case studies) to support the analyses. In this thesis, the main research question asks:

'What effect does regulatory reform (in the public transport market) have on innovative capability, and which routes of innovation will prevail?'

The thesis is based on two theoretical perspectives: innovation theory and institutional and organisational studies. This thesis provides a broader perspective on innovation; it focuses on both the technological and organisational aspects of innovative activities. In this thesis, the public transport service is exemplified by the 'twin characteristics' approach which defines public transport in terms of three sets of characteristics: technical characteristics, competence, and service characteristics. It then classifies innovation into three subgroups: service innovation, pure technical innovation, and competence development. Within those three groups, the innovative capabilities of the public transport system can be divided into three more categories, namely, innovative capabilities related to 1) infrastructure, 2) vehicle, and 3) service operation. These innovative capabilities can be considered as guidelines for analysing the innovation process in the public transport sector. Furthermore, the thesis defines three levels of innovation to locate where the innovation is positioned in time and space. Level I includes innovation that is new to the industry, such as technological advancements. Level II includes innovation that is new to the country. Level III incorporates those aspects at the micro-level, i.e. an innovation that is new to the area.

The second theoretical perspective, institutional and organisational changes in public transport, states that regulatory reform is a process of change. In order to better understand this concept, the orthodox economic approach allows us to analyse the effects of regulatory reform in public transport. Furthermore, this approach plays a part in providing guidance for the decision-making required in designing regulatory framework. However, once regulatory reform takes place, the effects of the reform are not fully explained purely by the orthodox economic approach.

The thesis describes three concepts that are necessary for the analytical framework. The first concept is the theory of evolutionary economics. This approach studies the process of the economics of technical change. Nelson and Winter (1982) develop the evolutionary theory of a firm where organisational capabilities and behaviours of business firms operating in a market environment are addressed. The second concept, defined by Simon (1997), is the bounded rationality or problem-solving approach. In

sum, it demonstrates that man's rationality is bounded: real-life decisions are too complex to comprehend and therefore firms cannot maximise over the set of all conceivable alternatives. The third concept is transaction cost economics. This notion, proposed by Williamson (1985), argues that firms, markets, and relational contracting are important economic institutions. These economic institutions are also the evolutionary product of a series of organisational innovations. The transaction cost economic theory gives the general framework in which the regulatory reform takes part. The main implication of these three concepts is that, in a long-run, the firms do learn and develop their organisational capabilities in order to compete and survive in the market. Innovation is the result of accumulated knowledge and improved capabilities. The regulatory framework in which firms operate ultimately determines the firms' innovative activities. By combining these concepts, we can analyse the behaviour of a firm in the public transport sector with respect to the innovation in which firms engage.

Organisational changes play an important part in explaining the behaviours of the actors in the public transport sector. In order to respond to the changing environment, organisations must search and acquire knowledge and capabilities. In this process, innovation is used as a strategic tool to achieve an organisation's goal. This relates to two important concepts in analysing development and learning, namely the dynamic capabilities and learning.

Based on these theoretical building blocks, the thesis constructs a model for analysing the effects of regulatory reform on innovation in the public transport sector. Competitive tendering is now a common practice in public transport service. Thus, this thesis focuses on the tendering process as a core process as it is the most determinant factor that affects the public transport organisational behaviours. The main point is the effect of the tendering process on innovation in public transport services. Nevertheless, as a variety of reforms exist, the tendering may differ from case to case, and some areas are also an exception to the tendering.

The tendering process requires all actors to adapt. A firm's dynamic capability is defined by its ability to integrate, build, and reconfigure internal and external competencies in rapidly changing environments. Three elements are addressed: organisational and managerial processes, positions, and paths. In our case, regulatory reform (the tendering process) is a rapidly changing environment. Thus, the dynamic capabilities of the authority depend on its ability to use resources to organise the tendering process in order to achieve their objectives, and control the operation of public transport according to the contracts that are granted. For operators, the dynamic capabilities include the capacity to use and integrate resources to produce a bid that attains the tender, and also the ability to manage the operation of a public transport system that financially benefits according to the initial planning in the tendering process. Innovation is one of the strategic tools that operators use for winning the tender.

An interesting and crucial element in this thesis is the process where the authority and operator meet in the bidding process. In general, the authority provides the program of demand and/or tender document to the potential bidders. The tender document usually indicates the basic requirements and specifications of the services to be tendered; it also indicates the winning criteria of the tender. This is the crucial

element operators must fulfil in order to win the tender. By studying the tender document, operators prepare their offers. At this stage, it should be noted that the innovation is often included in the offer to increase its appeal.

The empirical part will depict the richness of the information of the process thereby the tendering and innovation interact each other. Based on the model constructed in this thesis, two empirical cases were analysed: the bus and railway cases.

The first empirical case presented is a case study on innovation in the tendering process in the bus sector. The thesis analyses the relationship between the tendering process and innovation with empirical evidence from case studies in the Netherlands and in the UK (London). In the Netherlands, three cases were conducted, all in the Provincie Zuid-Holland (PZH) areas. The results from these case studies show that the authorities are moving towards the quality-oriented public transport services. It is clear that quality is now an important issue in the tendering process in the Netherlands. The thesis observes that authorities in our cases incorporate the quality aspects as criteria for awarding the concessions in the tender documents. Authorities tend to anticipate quality improvement through certain kinds of technological innovation, such as low-floor buses, the travel information system, and the smart card. In all, passengers seem to benefit from this improvement, although it is not yet known whether it will sustain in the long-term. On the operator side, the thesis observes that innovation is used as a strategic tool for winning the concession. Where it is possible, operators tend to widen the quality aspects of their public transport services to increase the number of passengers, or to show to the authority that they are willing to innovate. In addition, the thesis observes that both technological and organisational innovations in the tender are easy to imitate. In terms of technological innovation, the duplications of the new, low-floor bus and the travel information system were found. In terms of organisational innovation, operators in the Netherlands have developed the same type of the tender team to handle all tenders in both bus and train concessions.

Furthermore, the thesis examines the innovative capabilities in the London case where the tendering regime for the bus services is also used. The London case illustrates a strong centralised policy. The coherence between the public transport policy and the general transport policy in the area is one of the most successful factors in the recent growth of the public transport rider-ship. Innovative capabilities of the London authority (Transport for London: TfL) are high, and its learning element is moderate but strong. A lesson that we can learn from the London case is that the public authority should consider not only the policy in the public transport sector, but also the transport policy as an integrated system.

In sum, the tendering process leads to service-oriented innovation. The operators adopt their strategies to broaden the quality aspects of the public transport services in order to win more concessions. However, the operators concentrate solely on those aspects that suit their commercial interests (profitability and continuity). This leaves the task of influencing operators to innovate in a manner that benefits society to the authority.

The second case study, the case of innovation in the tendering process in the railway sector, analyses the empirical evidence from two cases: the Groningen and Merseyrail Electrics cases. In principle, there is not much difference between bus and railway in

terms of innovation apart from a few fundamental differences, such as infrastructure and the investment level (the life cycle of the vehicle and infrastructure). However, railway is less flexible; innovation diffusion may be slower than that of the bus, especially in terms of the traffic management system and the infrastructure provision. Clearly, the innovation in the train services needs cooperation from all parties, including the infrastructure company. However, the role of the infrastructure company is not explicitly stressed. A clear strategy must be identified in terms of technological innovation in the railway sector at the government level. The tendering process in the railway sector leads to a situation where the authority, who gives the concession, and the operators, who operate the railway services, focus on the operational aspect. They are not interested in (and not capable to) developing the technology.

A number of conclusions can be drawn from the empirical findings. First, in the railway tendering process, the authority and operators focus on developing their organisational capabilities rather than technical capabilities. The thesis observes that authorities are inexperienced in terms of the railway business, but they can organise the railway tender perfectly. Second, in the railway tendering process, both the authority and operator chose proven technologies rather than new ones because there is less risk involved in terms of technical difficulties and commercial aspects. The authority and operators are now the technical selectors rather than the technical developers, and, as a result, they focus more on the operational aspect. Thirdly, the tendering process in the railway sector has also induced innovation. However, we should look at the tendering process as a part of the regulatory reform process that leads to organisational reconstruction. Thus, reform effectively creates new players into the railway sector. For instance, a regional authority with little experience in the railway business before now organises the tendering process, and manages this task successfully. But we should place more emphasis on the track and train relationship because this relationship is very important for the railway operation. Finally, there is a need to emphasise the issue of long-term planning of innovation in the railway sectors to incorporate the tendering process as a part of transport policy. On a positive note, innovation in the railway sectors concentrates on vehicle investment and service improvement which is the direct result of the tendering regimes. Public transport users benefit from these improvements (new trains, more services, better accessibility). However, competition for the market seems to work on a short-term basis. The tendering process pays little attention to the medium-to-long-term development, i.e. in terms of network, new service development (i.e. new lines), and service integration. Additionally, infrastructure companies should assist in leading the technological strategy because their task automatically combines both track and train development. In particular, the implementation of the new rolling stocks should be done with close consultation with the infrastructure manager.

Finally, the thesis proposes a number of policy recommendations. First, the most important aspect is the monitoring issue. A good monitoring system would assist both authorities and operators in identifying a long-term, integrated strategy for the public transport services in all areas. The authorities would be better able to identify service improvement opportunities, such as a new infrastructure plan or a new bus route or network. They can then make suggestions to the current operator or incorporate their ideas into the new concession. For the operators, monitoring would better demonstrate how well they performed. This would provide valuable information in

future tendering processes in which operators might be involved. Second, the government and regional authority should lead in long-term innovation planning as an integrated approach where the process of innovation is fully recognised. It should incorporate organisational and institutional elements, and infrastructure development including the manufacturing industry and infrastructure providers. A clear vision on innovation in the long run is very important. Third, there is also an area where operator initiatives are more effective than the public sector. Clearly, the service-oriented trend in the tendering process proves that the operator can deliver an innovative service given the right conditions. This should be encouraged, for instance, by creating space in the tender contracts for policy development by the operators. Finally, innovation in the railway sectors revolves more around vehicle investment and service improvement. This is the direct result of the tendering regimes. Though public transport users benefit from these improvements (new trains, more services, better accessibility), the tendering process pays little attention to the medium-to-long-term development, i.e. in terms of network, new service development (i.e. new lines), and service integration. Unfortunately, competition for the market seems to work on a short-term basis. For that reason, there is a need to emphasise more on the issue of long-term planning of innovation in the railway sectors to incorporate the tendering process as a part of transport policy.

Samenvatting

In dit proefschrift is onderzoek gedaan naar het effect van marktwerking, deregulering en privatisering in de openbaar vervoer (OV) sector op het innovatief en lerend vermogen van de betrokken organisaties.
Het is vanzelfsprekend dat de overheden een belangrijke rol spelen in dit proces. Door de introductie van marktwerking en het stimuleren van deregulering en privatisering dragen zij bij aan een situatie waarin de OV-bedrijven genoodzaakt zijn om zich aan te passen aan de veranderende omstandigheden. Beide organisaties, de overheden en de aanbieders, zijn daardoor geïnvolveerd in een continu zoekproces naar de vraag hoe zij hun (eigen) doelen in deze dynamische omgeving het best kunnen realiseren.
Technologische innovatie speelt bij de introductie van marktwerking, deregulering en privatisering een belangrijke rol. In de periode waarin de hervormingen werden gepresenteerd en geëffectueerd, kwamen gelijktijdig nieuwe technologieën beschikbaar, zoals bussen met een lage-vloer instap en elektronische betaalsystemen en dynamische reisinformatie voor passagiers. Er is echter nooit onderzoek gedaan naar de directe relatie tussen hervorming van de aansturing van het OV en het proces van technologische innovatie in deze sector. De hoofdvraag van dit proefschrift luidt dan ook:

Welk effect heeft de veranderende regulering in de openbaar vervoersector op het innovatieve vermogen van openbaar vervoerorganisaties (overheid en bedrijfsleven), en welke rol speelt innovatie in dit proces?

De onderzoeksvraag is vanuit twee theoretische perspectieven wetenschappelijk onderzocht: (a) het perspectief van de innovatietheorie en (b) het perspectief uit de institutionele en organisationele wetenschapstheorie. Gekozen is voor een brede opvatting van het innovatiebegrip. In het onderzoek wordt zowel aandacht besteed aan technologische innovaties in de openbaar vervoer sector als aan organisationele innovaties. Deze aanpak is uitgewerkt in een benadering die in het theoretisch deel van het proefschrift wordt gepresenteerd als de “twin characteristic approach”, waarbij de innovaties in de openbaar vervoer sector worden onderverdeeld in drie hoofdkarakteristieken, te weten: technische kenmerken, organisationele competenties en de geboden dienstverlening die wordt gerealiseerd. Het is op basis van deze indeling mogelijk om innovatie in te delen in drie categorieën: zuiver technologische innovaties, ontwikkelingen gericht op het verberen van de eigen competenties en innovatie gericht op een verbetering van de dienstverlening. Binnen deze indeling kunnen de innovatieve capaciteiten van het openbaar vervoersysteem in drie subcategorieën worden ingedeeld, namelijk innovaties gerelateerd aan de infrastructuur, het transportmiddel en de dienstverlening. Deze categorisering vormt het analysekader waarbinnen het innovatieve vermogen van het innovatieproces in de openbaar vervoersector wordt geanalyseerd. Daarnaast worden in dit proefschrift op basis van tijd en ruimte drie niveaus van innovatie onderscheiden. Het eerste niveau omvat de innovaties die nieuwe ontwikkelingen voor de sector als totaal gevolgen

hebben en daarmee een belangrijke vernieuwing betekenen. Meestal zijn deze innovaties ontwikkeld, getest en geïmplementeerd in andere sectoren voordat ze zijn toegelaten in de OV sector. Het tweede niveau beslaat innovaties die nieuw zijn in een land of regio. Het betreft dan vaak vernieuwing die binnen de sector vanuit een andere regio waar de innovatie al wordt toegepast, wordt overgenomen. Het derde niveau voegt deze aspecten samen op microniveau en betreft innovaties die nieuw zijn voor een specifiek toepassingsgebied in het OV.

De introductie van marktwerking in de OV sector heeft grote institutionele en organisationele gevolgen. Vanuit het theoretisch perspectief wordt in de meeste analyses de neoklassieke economische theorie gehanteerd ter verklaring van vernieuwingen en de daarbij optredende effecten. Deze benadering is ook veelal de leidraad in de besluitvorming als het gaat om de rol van de overheid en de wijze waarop beleid moet worden geëffectueerd. Opvallend is dat wanneer de hervormingen zijn geïmplementeerd, in de praktijk de effecten maar gedeeltelijk vanuit deze benadering kunnen worden verklaard.
Vanwege de onvolledige verklaringskracht van de neoklassieke benadering is in dit onderzoek getracht om een alternatief analytisch kader te ontwerpen dat beter is toegesneden op de beantwoording van de hoofdvraag van deze studie. Daarvoor zijn drie perspectieven gekozen die als bouwstenen dienen voor het te ontwikkelen analysemodel. Het eerste perspectief is de evolutionaire economie. Nelson en Winter (1982) ontwikkelden de evolutionaire theorie van bedrijven waarbij de organisationele karakteristieken en het gedrag van bedrijven worden behandeld. Het tweede perspectief betreft het besef van de beperkte rationaliteit van actoren bij probleemoplossing zoals beschreven door Simon (1997). Dit perspectief laat zien dat actoren een beperkte rationaliteit hebben omdat nooit alle gevolgen van een beslissing kunnen worden overzien. Daarom kunnen bedrijven nooit het optimale alternatief vinden. Het derde perspectief, tenslotte, betreft de economie van transactiekosten. Vanuit dit perspectief, zoals voorgesteld door Williamson (1985), zijn bedrijven, markten en het netwerk waarin zij functioneren belangrijke economische instituties. Deze instituties zijn het evolutionair gegroeide resultaat van organisationele innovatie. De theorie van economische transactiekosten biedt een algemeen raamwerk waarbinnen regulatieve hervormingen plaatsvinden.
De belangrijkste implicatie van het hanteren van deze drie perspectieven voor het analysemodel is dat bedrijven kunnen worden beschouwd als lerende organisaties die hun organisationele capaciteiten continu verder ontwikkelen zodat zij in staat zijn om te overleven op de markt. Zij worden bij het ontwikkelen van innovaties echter begrensd door het raamwerk waarbinnen zij moeten opereren. Door alle eerdergenoemde theoretische concepten te combineren is het mogelijk om het gedrag van een bedrijf, maar ook dat van overheden, te analyseren als een levende en dynamische organisatie, waarbij het bedrijf zich aanpast aan de veranderende omgevingsfactoren.
Het proces van het aanbesteden van concessies is een dergelijk proces dat vraagt om adaptief vermogen van alle actoren die bij dit proces zijn betrokken. De wijze waarop organisaties daarin slagen wordt in belangrijke mate bepaald door het vermogen interne en externe capaciteiten te integreren, uit te bouwen en te herconfigureren in een snel wisselende omgeving. De belangrijkste ontwikkeling waarmee de OV-sector in Nederland momenteel wordt geconfronteerd is het invulling gegeven aan het proces van aanbesteding. Aan de aanbestedende overheden worden hoge eisen gesteld als het gaat om het organiseren van het proces zodat op maximale wijze aan de door haar

gestelde doelen in de vorm van contractueel vastgelegde diensten invulling wordt gegeven. De betekenis die aan innovaties wordt toegekend in proces is vanuit het overheidsperspectief vaak nog diffuus.
Van de OV-bedrijven wordt verondersteld dat zij het vermogen hebben hun capaciteiten dusdanig in te zetten en te integreren, dat zij een goed bod kunnen uitbrengen op de aanbesteding, maar ook dat zij hun continuïteit kunnen waarborgen. Het ligt voor de hand dat een verantwoord financieel aanbod in de offerte een randvoorwaarde is, maar innovatie blijkt ook een van de middelen te zijn die wordt aangewend om een concessie te winnen.

Op basis van bovengenoemde theoretische inzichten wordt in dit proefschrift een nieuw analysemodel gepresenteerd dat ons in staat stelt de ontwikkelingen binnen de openbaarvervoersector beter te kunnen doorgronden. En aangezien het openbaar aanbesteden van concessies tegenwoordig een standaard praktijk is geworden, kan het worden beschouwd als de belangrijkste stimulus voor verandering. Om die reden staat dit proces dan ook centraal in het ontwikkelde analysemodel. Daarbij is nadrukkelijk rekening gehouden met het feit dat er nog steeds veel variatie is in de wijze waarop de aanbesteding plaatsvindt en dat nog niet elke regio onder dit nieuwe regime valt.
Een cruciaal element in het model is dat ervan wordt uitgegaan dat de doelstellingen van de aanbestedende overheden niet automatisch parallel lopen met die van de OV-bedrijven. De interactie tussen deze organisaties is dus zeer belangrijk en vindt plaats op het moment dat tijdens het proces van aanbesteding een offerte moet worden opgesteld of op het moment dat een tussentijdse evaluatie wordt gehouden. Het is het leerproces in deze communicatie over en weer dat in dit proefschrift wordt ontrafeld. Uiteindelijk kan dit betere begrip leiden tot een doelmatiger OV-aanbod.

Het empirische gedeelte van dit onderzoek is gericht op het verzamelen en interpreteren van de beschikbare informatie, die veelomvattend en divers is, om van daaruit het proces van aanbesteding en de rol van innovaties beter te kunnen doorgronden. Twee empirische cases zijn via het in dit proefschrift ontwikkelde model geanalyseerd, te weten de ervaringen met aanbesteding in de bussector en een aanbesteding in het railvervoer. In beide gevallen is een vergelijking gemaakt tussen de ervaringen in Nederland en de ervaringen die in het Verenigd Koninkrijk zijn opgedaan.

In de eerste plaats is gekeken naar de innovatie in het aanbestedingsproces in de bussector. Daarbij is een vergelijking gemaakt tussen de ervaringen in Nederland en de ervaringen in Londen. De Nederlandse casuïstiek die is bestudeerd betreft drie aanbestedingen in de provincie Zuid-Holland. Met deze keuze kon een ontwikkeling over een langere periode worden bestudeerd. Uit de analyse blijkt dat de vervoersautoriteiten zich steeds meer oriënteren op kwaliteit in het openbaar vervoer, nadat aanvankelijk het primaat lag op de kostenkant. Dit komt duidelijk terug in de aanbestedingscriteria waarbij kwaliteit één van de belangrijkste criteria is. Voor de vervoersautoriteiten blijkt kwaliteit vooral te zitten in de technologische innovatie zoals lage-vloer bussen, reisinformatiesystemen en het gebruik van de ov-chipkaart. Op korte termijn lijkt dit de reiziger ten goede te komen, maar de vraag is of, en op welke wijze, dit kwaliteitsniveau in de toekomst kan worden gehandhaafd.
Innovatie blijkt in deze casus voor de OV-bedrijven een belangrijk element te zijn in de bredere strategie om een concessie te winnen. Indien enigszins mogelijk proberen de OV-bedrijven, gebruikmakend van de mogelijkheden die innovatie hen biedt,

variërend van airconditioning in het voertuig tot een koffievoorziening op de overstaphaltes, de kwaliteitsaspecten in hun bod uit te breiden. Daarbij speculeren zij onder meer op de veronderstelling dat een betere service een toename van het aantal passagiers kan betekenen. Hiermee verwachten zij de doelstellingen van winstmaximalisatie en continuïteit effectiever te kunnen realiseren. Tegelijkertijd willen de OV-bedrijven de aanbestedende overheden kunnen tonen dat zij bereid zijn te innoveren. Daarnaast blijkt uit dit onderzoek dat technologische en organisationele innovatie eenvoudig te kopiëren zijn. Voorbeelden van het dupliceren van technologische innovatie zijn de lage-vloerbussen en reisinformatiesystemen. De lage-vloer bus heeft zich in een periode van minder dan 10 jaar ontwikkeld van een "servicegerichte innovatie" tot standaardproduct in de OV-sector.
Op het organisationele vlak valt op dat de OV-bedrijven per bedrijf één team formeren dat in het sterk gedecentraliseerde systeem voor alle regio's waar een aanbesteding gaat plaatsvinden een offerte voorbereidt (hierbij gaat het om ca. 80 concessies voor bus- en (personen)-treinvervoer). Deze teams hebben expertise opgebouwd om zowel concessies voor bus- als treinverbindingen te behandelen.
De casus Londen laat zien dat ook daar de concessie wordt verleend in de vorm van openbare aanbesteding. Maar de organisatie is in tegenstelling tot Nederland, sterk gecentraliseerd. De samenhang tussen het openbaar vervoerbeleid en het algemenere transportbeleid in het gebied is daarbij een van de meest belangrijke succesfactoren en vormt de belangrijkste verklaring voor de recente groei van het aantal passagierskilometers in Londen. Het innovatieve vermogen van de aanbestedende overheid in Londen (Transport for London) is in algemene zin hoog en ook het leervermogen is gemiddeld genomen hoger dan dat in Nederland. De casus Londen laat zien dat de vervoersautoriteiten daar niet alleen over een goed ontwikkeld openbaar vervoersbeleid beschikken, maar dat dit ook is ingebed in het algemene transportbeleid. Door betere afstemming en integratie kan met de aanbesteding een evenwichtig en op alle modaliteiten (zowel van het openbaar als het privaat vervoer) gericht beleid worden gevoerd. Samengevat kan worden gesteld dat het proces van openbare aanbesteding in de bussector leidt tot de introductie van meerdere servicegerichte innovaties in een poging meer concessies te winnen. Zij blijven daarbij echter nadrukkelijk binnen de randvoorwaarden van hun eigen commerciële belang (winstgevendheid en continuïteit). De vervoersautoriteit zou daarom extra aandacht moeten besteden aan het creëren van voorwaarden waardoor het voor de aanbieders aantrekkelijk wordt hun innovatieve vermogen aan te wenden voor innovaties die de samenleving als totaal wenselijk zijn.

Naast het busvervoer is ook het aanbesteden van de concessies in het railvervoer geanalyseerd. Twee specifieke regio's zijn onderzocht: het railvervoer in Groningen/Friesland (NoordNed) en de regio Liverpool waar het railvervoer wordt verzorgd door Merseyrail Electrics. Los van fundamentele verschillen als de koppeling met de railinfrastructuur en de hoogte van het investeringsniveau (hoge kosten aanschaf rollend materieel en lange levenscyclus van het materieel in het railvervoer), bestaan in beginsel weinig verschillen in termen van innovaties tussen bus- en treinvervoer. Toch zijn enkele verschillen te noemenswaardig.
Zo is in tegenstelling tot het busvervoer het railvervoer minder flexibel en kan de verspreiding van innovaties trager zijn dan in het busvervoer, vooral waar het traffic management systemen en het veranderen van infrastructuur betreft. Innovatie in de railsector vereist samenwerking van diverse actoren, zoals de bedrijven die

verantwoordelijk zijn voor aanleg, beheer en capaciteitstoedeling van de infrastructuur.
In het proces van openbare aanbesteding van concessies in de railsector blijken de aanbestedende overheden en de aanbieders vooral gericht te zijn op het operationele aspect rond de uitvoering. Zij lijken geen interesse, of mogelijkheden te hebben om technologische veranderingen tot stand te brengen
Het onderzoek in de railsector leidt tot een aantal bevindingen. In de eerste plaats valt op dat zowel de aanbestedende overheden als de openbaar vervoerbedrijven zich vooral richten op de organisationele aspecten rond het OV en dat zij veel minder zijn gericht op de technische innovatiemogelijkheden. Het is opvallend dat de railvervoersautoriteiten, die toch weinig ervaring hebben met aanbesteding, goed in staat waren deze openbare aanbesteding te organiseren.
Ten tweede kan worden geconstateerd dat beide organisaties bij voorkeur kiezen voor technologieën die al bewezen zijn omdat dit een lager technisch en operationeel risico met zich meebrengt. Dat maakt dat hun rol zich beperkt tot het aansturen van het selectiemechanisme voor bestaande technologie in plaats van de rol van initiator van technologische innovatie. Het proces van openbare aanbesteding heeft overigens wel geleid tot innovatie in de railsector. Eén van de belangrijkste ontwikkelingen in deze context is dat nu meerdere aanbieders toegang hebben tot de railinfrastructuur.
Ten derde kan te worden vastgesteld dat wil het railvervoer ook op de langere termijn competitief kunnen zijn met andere modaliteiten, de nadruk sterker moet komen te liggen bij de lange-termijn planning van innovaties. Het verlenen van concessies gebeurt nog steeds op basis van korte-termijn perspectieven, waarbij de rol van innovaties of de samenhang met het algemene transportbeleid veelal ontbreekt. Het ontwikkelen van het netwerk, de aanleg van nieuwe lijnen of de integratie van diensten (zoals stationontwikkeling langs lijnen) blijft nu veelal buiten beschouwing.
Samengevat kan worden vastgesteld dat de innovaties in de railsector zich vooral richten op investeringen in het materieel en het verbeteren van de dienstverlening. Deze voorkeur is direct te relateren aan het verlenen van concessies via openbare aanbesteding. Dit heeft direct invloed op het comfort en gemak voor de reizigers in de vorm van nieuwe treinen, meer en betere service en betere toegankelijkheid. Voor de introductie van nieuw rollend materieel is het van belang dat er nauw contact is met de infrastructuurbeheerders, omdat veel innovaties zijn gebonden aan de interface tussen het materieel en de (beschikbare)infrastructuur. Overigens valt voor wat betreft de railsector op, vooral omdat de aanbesteding nog in de kinderschoenen staat, dat nog geen leerproces is waar te nemen. De eerste stappen zijn echter gezet, zodat kan worden verwacht dat dit spoedig wel het geval zal zijn.

Tot besluit wordt in het proefschrift een aantal aanbevelingen gedaan. Een eerste aanbeveling betreft de monitoring van geleverde diensten en producten. Daar ontbreekt het nu aan. Een goed monitoringssysteem kan aanbestedende overheden helpen een integrale strategie te ontwikkelen voor de lange termijn als het gaat om het openbaar vervoer in een bepaald gebied. De vervoersautoriteit kan middels monitoring verbeteringen en kansen tot verbetering identificeren, zoals het plannen van een nieuwe busroute of het aanleggen van een nieuwe railverbinding. Deze ideeën kunnen worden doorgegeven aan de aanbieder of worden verwerkt in de nieuwe openbare aanbesteding. Voor de aanbieders zelf zou het monitoren kunnen helpen in het aantonen op welk niveau zij presteren. Dit kan van belang zijn omdat het informatie geeft over de vraag hoe in een bepaalde regio wordt gepresteerd. Zo kan

via benchmarking inzicht kan worden verkregen over de prestaties in vergelijking tot andere bedrijven. Deze informatie kan worden meegenomen in de specificaties van het nieuwe bod dat wordt uitgebracht bij een volgende aanbesteding.
De tweede aanbeveling is dat de nationale en regionale overheden gezamenlijk de verantwoording nemen bij de ontwikkeling van de integrale lange-termijn planning van het innovatiebeleid. Ook infrastructuurontwikkeling en behoeften gerelateerd aan respectievelijke voertuigen en rollend materieel (een visie op innovatie) zouden hier integraal onderdeel van moeten worden. Uit het onderzoek blijkt dat het effectiever is als de overheid daar een strategie voor ontwikkelt dan om dit aan de markt over te laten. Het is aangetoond dat de aanbieder in staat is een gewenst product of dienst te leveren. Dit kan echter worden gestimuleerd door in de concessies ruimte te laten voor een zekere beleidsontwikkeling door de aanbieders.
De laatste aanbeveling heeft betrekking op de ontwikkelingen in de railsector. Geconstateerd kan worden dat introductie van het aanbestedingsproces vooral heeft geleid tot verbetering van het ingezette materieel en de serviceoriëntatie. Zoals genoemd, werd in de aanbesteding geen aandacht besteed aan een visie op ontwikkelingen voor de lange termijn rond het transportbeleid en de lange-termijn integratie met andere OV-diensten die worden aangeboden. In de opwaardering van dit transportbeleid liggen grote kansen op belangrijke verbeteringen.

Curriculum Vitae

Sumet Ongkittikul (1976) was born in Nakhon Nayok, Thailand. He holds a bachelor degree in Civil Engineering and a master degree in Transportation Engineering from King Mongkut's University of Technology Thonburi, Bangkok, Thailand. He also holds a master degree in Transport Economics from the Institute for Transport Studies, University of Leeds, the UK. After he finished his study in Leeds, he then joined the Erasmus Centre for Sustainability and Management (ESM), Erasmus University Rotterdam, for the PhD research in March 2002.

In his PhD's thesis, he looked at the effects of regulatory reform in the public transport sector on innovation. In this study, he developed a theoretical framework based on the evolutionary economics and administrative behaviour theories. This framework then used to analyse the empirical cases. The empirical cases are the bus and railway in the Netherlands and the UK. In the case study, he conducted extensive interviews with public transport stakeholders in the Netherlands e.g. local authorities, operators (bus and railway), manufactures, and railway infrastructure managers, in the Netherlands. He also worked as an intern at Business Unit Mobility and Logistics, TNO Built Environment and Geosciences, as a part of this PhD research. In addition to the PhD research, he also involved in research projects for Ministry of Transport and Public Works, and ProRail.

TRAIL Thesis Series

A series of The Netherlands TRAIL Research School for theses on transport, infrastructure and logistics.

Nat, C.G.J.M., van der, *A Knowledge-based Concept Exploration Model for Submarine Design*, T99/1, March 1999, TRAIL Thesis Series, Delft University Press, The Netherlands

Westrenen, F.C., van, *The Maritime Pilot at Work*: E*valuation and Use of a Time-to-boundary Model of Mental Workload in Human-machine Systems*, T99/2, May 1999, TRAIL Thesis Series, Eburon, The Netherlands

Veenstra, A.W., *Quantitative Analysis of Shipping Markets,* T99/3, April 1999, TRAIL Thesis Series, Delft University Press, The Netherlands

Minderhoud, M.M., *Supported Driving: Impacts on Motorway Traffic Flow*, T99/4, July 1999, TRAIL Thesis Series, Delft University Press, The Netherlands

Hoogendoorn, S.P., *Multiclass Continuum Modelling of Multilane Traffic Flow*, T99/5, September 1999, TRAIL Thesis Series, Delft University Press, The Netherlands

Hoedemaeker, M., *Driving with Intelligent Vehicles: Driving Behaviour with Adaptive Cruise Control and the Acceptance by Individual Drivers*, T99/6, November 1999, TRAIL Thesis Series, Delft University Press, The Netherlands

Marchau, V.A.W.J., *Technology Assessment of Automated Vehicle Guidance - Prospects for Automated Driving Implementation*, T2000/1, January 2000, TRAIL Thesis Series, Delft University Press, The Netherlands

Subiono, *On Classes of Min-max-plus Systems and their Applications*, T2000/2, June 2000, TRAIL Thesis Series, Delft University Press, The Netherlands

Meer, J.R., van, *Operational Control of Internal Transport*, T2000/5, September 2000, TRAIL Thesis Series, Delft University Press, The Netherlands

Bliemer, M.C.J., *Analytical Dynamic Traffic Assignment with Interacting User-Classes: Theoretical Advances and Applications using a Variational Inequality Approach,* T2001/1, January 2001, TRAIL Thesis Series, Delft University Press, The Netherlands

Muilerman, G.J., *Time-based logistics: An analysis of the relevance, causes and impacts,* T2001/2, April 2001, TRAIL Thesis Series, Delft University Press, The Netherlands

Roodbergen, K.J., *Layout and Routing Methods for Warehouses*, T2001/3, May 2001, TRAIL Thesis Series, The Netherlands

Willems, J.K.C.A.S., *Bundeling van infrastructuur, theoretische en praktische waarde van een ruimtelijk inrichtingsconcept*, T2001/4, June 2001, TRAIL Thesis Series, Delft University Press, The Netherlands

Binsbergen, A.J., van, J.G.S.N. Visser, *Innovation Steps towards Efficient Goods Distribution Systems for Urban Areas,* T2001/5, May 2001, TRAIL Thesis Series, Delft University Press, The Netherlands

Rosmuller, N., *Safety analysis of Transport Corridors*, T2001/6, June 2001, TRAIL Thesis Series, Delft University Press, The Netherlands

Schaafsma, A., *Dynamisch Railverkeersmanagement, besturingsconcept voor railverkeer op basis van het Lagenmodel Verkeer en Vervoer*, T2001/7, October 2001, TRAIL Thesis Series, Delft University Press, The Netherlands

Bockstael-Blok, W., *Chains and Networks in Multimodal Passenger Transport. Exploring a design approach*, T2001/8, December 2001, TRAIL Thesis Series, Delft University Press, The Netherlands

Wolters, M.J.J., *The Business of Modularity and the Modularity of Business*, T2002/1, February 2002, TRAIL Thesis Series, The Netherlands

Vis, F.A., *Planning and Control Concepts for Material Handling Systems*, T2002/2, May 2002, TRAIL Thesis Series, The Netherlands

Koppius, O.R., *Information Architecture and Electronic Market Performance,* T2002/3, May 2002, TRAIL Thesis Series, The Netherlands

Veeneman, W.W., *Mind the Gap; Bridging Theories and Practice for the Organisation of Metropolitan Public Transport*, T2002/4, June 2002, TRAIL Thesis Series, Delft University Press, The Netherlands

Nes, R. van, *Design of multimodal transport networks, a hierarchical approach,* T2002/5, September 2002, TRAIL Thesis Series, Delft University Press, The Netherlands

Pol, P.M.J., *A Renaissance of Stations, Railways and Cities, Economic Effects, Development Strategies and Organisational Issues of European High-Speed-Train Stations*, T2002/6, October 2002, TRAIL Thesis Series, Delft University Press, The Netherlands

Runhaar, H., *Freight transport: at any price? Effects of transport costs on book and newspaper supply chains in the Netherlands*, T2002/7, December 2002, TRAIL Thesis Series, Delft University Press, The Netherlands

Spek, S.C., van der, *Connectors. The Way beyond Transferring*, T2003/1, February 2003, TRAIL Thesis Series, Delft University Press, The Netherlands

Lindeijer, D.G., *Controlling Automated Traffic Agents*, T2003/2, February 2003, TRAIL Thesis Series, Eburon, The Netherlands

Riet, O.A.W.T., van de, *Policy Analysis in Multi-Actor Policy Settings. Navigating Between Negotiated Nonsense and Useless Knowledge*, T2003/3, March 2003, TRAIL Thesis Series, Eburon, The Netherlands

Reeven, P.A., van, *Competition in Scheduled Transport*, T2003/4, April 2003, TRAIL Thesis Series, Eburon, The Netherlands
Peeters, L.W.P., *Cyclic Railway Timetable Optimization*, T2003/5, June 2003, TRAIL Thesis Series, The Netherlands

Soto Y Koelemeijer, G., *On the behaviour of classes of min-max-plus systems*, T2003/6, September 2003, TRAIL Thesis Series, The Netherlands

Lindveld, Ch..D.R., *Dynamic O-D matrix estimation: a behavioural approach*, T2003/7, September 2003, TRAIL Thesis Series, Eburon, The Netherlands

Weerdt, de M.M., *Plan Merging in Multi-Agent Systems,* T2003/8, December 2003, TRAIL Thesis Series, The Netherlands

Langen, de P.W, *The Performance of Seaport Clusters*, T2004/1, January 2004, TRAIL Thesis Series, The Netherlands

Hegyi, A., *Model Predictive Control for Integrating Traffic Control Measures*, T2004/2, February 2004, TRAIL Thesis Series, The Netherlands

Lint, van, J.W.C., *Reliable Travel Time Prediction for Freeways*, T2004/3, June 2004, TRAIL Thesis Series, The Netherlands

Tabibi, M., *Design and Control of Automated Truck Traffic at Motorway Ramps*, T2004/4, July 2004, TRAIL Thesis Series, The Netherlands

Verduijn, T. M., *Dynamism in Supply Networks: Actor switching in a turbulent business environment*, T2004/5, September 2004, TRAIL Thesis Series, The Netherlands

Daamen, W., *Modelling Passenger Flows in Public Transport Facilities*, T2004/6, September 2004, TRAIL Thesis Series, The Netherlands

Zoeteman, A., *Railway Design and Maintenance from a Life-Cycle Cost Perspective: A Decision-Support Approach,* T2004/7, November 2004, TRAIL Thesis Series, The Netherlands

Bos, D.M., *Changing Seats: A Behavioural Analysis of P&R Use,* T2004/8, November 2004, TRAIL Thesis Series, The Netherlands

Versteegt, C., *Holonic Control For Large Scale Automated Logistic Systems,* T2004/9, December 2004, TRAIL Thesis Series, The Netherlands

Wees, K.A.P.C. van, *Intelligente voertuigen, veiligheidsregulering en aansprakelijkheid. Een onderzoek naar juridische aspecten van Advanced Driver*

Assistance Systems in het wegverkeer, T2004/10, December 2004, TRAIL Thesis Series, The Netherlands

Tampère, C.M.J., *Human-Kinetic Multiclass Traffic Flow Theory and Modelling: With Application to Advanced Driver Assistance Systems in Congestion,* T2004/11, December 2004, TRAIL Thesis Series, The Netherlands

Rooij, R.M., *The Mobile City. The planning and design of the Network City from a mobility point of view*, T2005/1, February 2005, TRAIL Thesis Series, The Netherlands

Le-Anh, T., *Intelligent Control of Vehicle-Based Internal Transport Systems*, T2005/2, April 2005, TRAIL Thesis Series, The Netherlands

Zuidgeest, M.H.P., *Sustainable Urban Transport Development: a Dynamic Optimization Approach*, T2005/3, April 2005, TRAIL Thesis Series, The Netherlands

Hoogendoorn-Lanser, S., *Modelling Travel Behaviour in Multimodal Networks*, T2005/4, May 2005, TRAIL Thesis Series, The Netherlands

Dekker, S., *Port Investment – Towards an integrated planning of port capacity*, T2005/5, June 2005, TRAIL Thesis Series, The Netherlands

Koolstra, K., *Transport Infrastructure Slot Allocation*, T2005/6, June 2005, TRAIL Thesis Series, The Netherlands

Vromans, M., *Reliability of Railway Systems*, T2005/7, July 2005, TRAIL Thesis Series, The Netherlands

Oosten, W., *Ruimte voor een democratische rechtsstaat. Geschakelde sturing bij ruimtelijke investeringen*, T2005/8, September 2005, TRAIL Thesis Series, Sociotext, The Netherlands

Le-Duc, T., *Design and control of efficient order picking*, T2005/9, September 2005, TRAIL Thesis Series, The Netherlands

Goverde, R., *Punctuality of Railway Operations and Timetable Stability Analysis*, T2005/10, October 2005, TRAIL Thesis Series, The Netherlands

Kager, R.M., *Design and implementation of a method for the synthesis of travel diary data*, T2005/11, October 2005, TRAIL Thesis Series, The Netherlands

Boer, C., *Distributed Simulation in Industry*, T2005/12, October 2005, TRAIL Thesis Series, The Netherlands

Pielage, B.A., *Conceptual Design of Automated Freight Transport Systems*, T2005/14, November 2005, TRAIL Thesis Series, The Netherlands

Groothedde, B., *Collaborative Logistics and Transportation Networks, a modeling approach to network design*, T2005/15, November 2005, TRAIL Thesis Series, The Netherlands

Valk, J.M., *Coordination among Autonomous Planners*, T2005/16, December 2005, TRAIL Thesis Series, The Netherlands

Krogt, R.P.J. van der, *Plan Repair in Single-Agent and Multi-Agent Systems*, T2005/17, December 2005, TRAIL Thesis Series, The Netherlands

Bontekoning, Y.M., *Hub exchange operations in intermodal hub-and-spoke networks. A performance comparison of four types of rail-rail exchange facilities,*T2006/1, February 2006, TRAIL Thesis Series, The Netherlands

Lentink, R., *Algorithmic Decision Support for Shunt Planning,* T2006/2, February 2006, TRAIL Thesis Series, The Netherlands

Ngoduy, D., *Macroscopic Discontinuity Modeling for Multiclass Multilane Traffic Flow Operations,* T2006/3, April 2006, TRAIL Thesis Series, The Netherlands

Vanderschuren, M.J.W.A., *Intelligent Transport Systems for South Africa. Impact assessment through microscopic simulation in the South African context,* T2006/4, August 2006, TRAIL Thesis Series, The Netherlands

Ongkittikul, S., *Innovation and Regulatory Reform in Public Transport,* T2006/5, September 2006, TRAIL Thesis Series, The Netherlands