

INTERNATIONALIZATION OF INFRASTRUCTURES

Edited by Jean-François Auger, Jan Jaap Bouma and Rolf Künneke

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Internationalization of Infrastructures

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Proceedings of the 12th Annual International Conference
on the Economics of Infrastructures

Edited by
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Jan Jaap Bouma
and
Rolf Künneke



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Acronyms

ACER	Agency for the Cooperation of Energy Regulators
AIACR	Association internationale des automobile-clubs reconnus
BAV	Bundesamt für Verkehr
BNA	Bundesnetzagentur
CAPEC	capital costs
CCIF	Comité consultatif international téléphonique
CCIR	Comité consultatif international radiocommunication
CCIT	Comité consultatif international télégraphique
CCITT	Comité consultatif international de téléphonie et de télégraphie
CCNR	Central Commission for Navigation on the Rhine
CCT	Committee on Communications and Transit
CEPT	Conférence européenne des administrations des postes et des télécommunications
CER	Community of European Railway and Infrastructure Companies
CHP	combined heat and power
CIA	comparative institutional analysis
CIM	Convention internationale concernant le transport des marchandises par chemins de fer
CIRM	Comité international radio-maritime
CIT	Comité international des transports par chemin de fer
CIW	Coordination commission integrated water policy
DB	Deutsche Bahn
dft	Department for Transport
DG	distributed generation
DNS	domain name system
DSO	distribution system operator
DÖTV	Deutsch-Österreichischer Telegraphen Verein
EC	European Commission
ECE	Economic Commission for Europe
ECMT	European Conference of Ministers of Transport
EEC	European Economic Community
ERT	European Roundtable of Industrialists
EU	European Union
EUROP	European Freight Wagon Pool

FCC	Federal Communications Commission
FERC	Energy Regulatory Commission
FRC	Federal Radio Commission
HLOS	high-level output specification
IANA	Internet Assigned Numbers Authority
IARU	International Amateur Radio Union
IATA	International Air Traffic Association
IBU	International Broadcasting Union
ICANN	Internet Corporation for Assigned Names and Numbers
ICT	information and communication technology
IEA	International Energy Agency
IFRB	International Frequency Registration Board
IFTTC	International Freight Train Timetable Conferences
IGF	Internet Governance Forum
INU	Inland Navigation Union
IP	internet protocol
ISCC	International Sleeping Car Company
ITC	Inland Transport Committee of the Economic Commission for Europe
ITU	International Telecommunication Union
JNR	Japan National Railway
JPA	Joint Project Agreement
JR	Japanese railway
LIAT	Ligue internationale des associations touristes
LNG	liquefied natural gas
MDG	Millennium Development Goal
NATO	North Atlantic Treaty Organization
NIE	new institutional economics
NMA	Vervoerskamer van de Nederlandse Mededingingsautoriteit
NRA	national regulatory authority
NS	Nederlandse Spoorwegen
NTIA	National Telecommunication and Information Administration
OECC	Organization for European Economic Cooperation
OECD	Organization for Economic Cooperation and Development
OIE	original institutional economics
OPEX	operational costs
OPRAF	Office of Passenger Rail Franchising
ORR	Office of Rail Regulation
PIARC	Permanent International Association of Road Congresses
PTES	Passenger Transport Executives

RFF	Réseau ferré de France
RIV	Regolamento internazionale veicoli
SBB	Schweizerische Bundesbahnen
SCADA	supervisory control and data acquisition
SNCF	Société nationale des chemins de fer français
SOFA	Statement of Funds Available
SRA	Strategic Rail Authority
SUNFED	Special United Nations Fund for Economic Development
TCE	Transaction costs economics
TE	Technische Einheit
TOCS	Train Operating Companies
TSO	transmission system operator
UIC	Union internationale des chemins de fer
UIR	Union Union internationale de radio télégraphique
UN	United Nations
UNECE	United Nation Economic Commission for Europe
UTI	Union télégraphique internationale
WFD	Water Framework Directive
WSIS	World Summit on the Information Society

Internationalization of infrastructures

Jean-François Auger, Jan Jaap Bouma and Rolf Künneke

What are the economic effects of the internationalization of infrastructures? We have addressed that question at the 12th Annual International Conference on the Economics of Infrastructures (Delft, May 2009). At the outset, we knew that technological systems, through the interconnection of components, can run over state boundaries. Hence telecommunication operators are routing calls, worldwide, through cables and satellites. In the same fashion, water basins cover geographic areas that overlap national territories. Moreover, we were interested by the fact that infrastructure services have become increasingly provided by multinational corporations and by international holdings. Some operators broaden their international services by making agreements with foreign operators. Others, with a take-over strategy, make the acquisition of foreign competitors. Finally, we wanted to know how international bodies are governing infrastructure industries. These bodies agree on standards for technical interoperability; they determine the clearing system for tariff compensation; and, in some instances, they regulate the market to facilitate competition. In this introduction, we expose basic definitions and fundamental questions to understand the conference's framework. Thereafter we resume the contributions compiled in these proceedings before reaching general conclusions on the internationalization of infrastructures.

Definitions

At the conference, we have studied the phenomenon of internationalization of infrastructures from the viewpoint of economics. We borrowed the notion of infrastructure from network economics. In this respect, an infrastructure corresponds to a set of technical components, a physical network, that allow a supplier to deliver a service to consumers (Curien 2005). Examples are the provision of services in telecommunication, transport and energy. Corporate and public organizations op-

erate large-scale technical systems that deliver these services. Since the production chain requires the input of several agents, it is coordinated through institutional arrangements. In terms of finance, an infrastructure has strong asset specificity and high sunk costs. Besides, it often requires regulation of the markets, on tariff and network access for example, to guarantee competition.

For the notion of internationalization, we refer to the transaction cost perspective on the multinational firm. Several multinational firms are expanding their activities abroad, because they can reduce the number of transactions by vertically integrating intermediate products and services providers (Buckley and Casson 1976). Hence internationalization refers to the process by which firms increase their production and market activities across national borders. By integrating most of the transactions under hierarchical control, these firms hope to get advantages from increasing economies of scale. It requires that operators lay down infrastructure networks abroad to reach consumers. Alternatively, they can create joint ventures or make strategic alliances with firms that already own infrastructures abroad. Finally, several international activities in infrastructures are supported by flows of capitals coming from international investment banks and financial funds.

In addition to transaction costs, we interpreted the notion of internationalization with institutional economics. An institution, by stipulating the rules, structures economic exchanges (Hodgson 2006). It facilitates the adoption of new behaviors, and, conversely, it constrains behaviors in a range of choices. These rules come from the culture of a society, the system of laws and regulations, the specific rules that agents agree upon. Organizations contribute to the transmission, implementation and enforcements of these rules. So far, the nation state, including its intermediary political levels, was providing most of the formal rules for infrastructures; but, increasingly with time, international bodies took it over. The European Union, for example, has contributed to the advent of international institutions pertaining to infrastructures. To provide a definition, internationalization of infrastructures refers to the increasing network interconnections of infrastructures across borders, and, as a consequence, the creation of international organization to operate them, and the development of international institutions to govern them.

We are aware that, in previous studies, researchers have used similar concepts. Some prefer the notion of transnationalization (Carreras, Giuntini and Merger 1994; Vleuten and Kaijser 2006; Clifton, Comín and Fuentes 2007). By this, they refer to the extension of economic activities beyond national boundaries. This notion encompasses importation and exportation, as well as establishing components of the firm abroad. Indeed, both transnationalization and internationalizations describes the process of increasing economic exchanges across boundaries. The difference, however, is that internationalization also means that it affects several nations, and that some of them constitute groups, with two or more members, to handle the

effects of economic exchanges across borders. Alternatively others use the notion of globalization (Mattelart 1996; Lyth and Trischler 2004; Schot 2007). By that, they refer to economic production and consumption that takes place in networks of exchanges on a world-wide scale. This notion does not apply to all infrastructures, because most of them are subject to strong regional characteristics. Whereas telephonic networks have been globalized, electricity grids remain, at best, continental in scope. In a nutshell, we think that if not all infrastructures have been globalized, they were, more certainly, subject to internationalization.

Questions

To stimulate further discussions, we have raised questions about technology, organization and institution at the conference. First, what are the economic impacts of the increasing network interconnection and interoperability of infrastructures? Technological innovations offer opportunities for far more efficient technical control, management and operation of networks across borders. For instance, operators use information and communication technologies for traffic control systems of airways and railways. Several innovative high-voltage cables run under the seas to connect countries. International standardizing bodies, such as the International Standardizing Organization and the Institute of Electrical and Electronics Engineers, have to decide upon standards to ensure the interoperability of new infrastructure technologies. The absence of standardization can hinder, up to a certain extent, the internationalization of infrastructures. For example, several types of locomotives cannot ride on neighboring countries lines powered with a different electric voltage, unless they have a current converter.

Second, what is the effect of the internationalization of infrastructures on industrial organization? Private infrastructure firms are evolving into multinationals by developing global business strategies. For instance, energy providers initiated international exchange of electric power as a back-up facility in case of failures of national power supplies. Nowadays international trade of electricity gains increasing economic importance, which is accommodated the evolution of international market arrangements and multinational market players. Other sectors become also increasingly internationalized. Airway companies create alliances, merge or establish consortium to extend the world coverage of their routes. Telephonic operators start to offer communication and data services to costumers outside of their national borders. Some industries, despite the liberalization of the markets, took more time to internationalize. For example, railway companies, which remain mostly nationally owned, tend to serve their national market.

Third, how is the internationalization of infrastructures shaped by institutional

arrangements? Institutional arrangements at the international level affect more and more the operations of infrastructure markets. Wireless telephony requires, among others, comparable technical standards and economic clearing systems for the allocation of costs. There is a need, hence, for supranational regulation and governance. The European Union is a well known example, but there are many other supranational regulatory bodies such as the Universal Postal Union and the International Telecommunication Union. The increasing technical and economic interrelations between national infrastructures require political cooperation, under the form of transadministrative and intergovernmental cooperation, to maintain effective services. The increasing importance of supranational regulatory bodies illustrates converging national interests with respect to the operation and management of infrastructures.

Contributions

In these proceedings, we have compiled the contributions following the structure of the conference's programme. Indeed most of the session organizers have invited presenters to contribute on a specific industrial sector. Therefore, we have grouped the contributions into sections that correspond to oil and gas, electricity, telecommunications, water and railways. At both end, however, we have added a section that look back at the history and another one that look forward on the internationalization of infrastructures. We will resume, hereafter, the salient features of the contributions presented at the conference.

In Part I, the authors conduct comparative historical analysis. Christian Heinrich-Franke studies the changing patterns of infrastructure governance in Europe. He proposes an analytical model to identify the factors that shaped international governance structures. The integration of Europe, he notes, has played an important role in the homogenization of governance structures. Frank Schipper explores further the role that European integration has played. He analyzes telegraphy and road transport under the light of the literature on the governance of Europe. He concludes that European infrastructures have been developed in close relationship with global governing institutions. William J. Rankin, in turn, challenges the very notion of infrastructure. He focuses on the debates on international development of the 1950s and early 1960s. According to his thesis, the proponents of international economic development, most of them were working at the United Nations and the World Bank, had contributed to forge the contemporary acceptance of the notion of infrastructure.

In Part II, the authors discuss the internationalization oil and gas. They refer particularly to geopolitics of energy. Aad Correljé and Jacques de Jong raise the

problem of the internationalization of the European natural gas market. Taking into consideration the new patterns of trade, they show that European Union's regulatory framework hinder investments in new pipelines transportation networks. They make recommendations for changes in regulations, for example to stimulate cross-border investments. Wouter Pieterse considers a set of theories that can explain the geopolitics of energy transitions. He reviews economic geography, political geography, political economy and institutional economics. A sound analytical framework, he concludes, would be made of economics geography and of original institutional economics, because both allow a dynamic, evolutionary analysis of energy transitions.

In Part III, the authors are concerned with the internationalization of electricity distribution. They address more specifically the challenges posed by the advent of smart grids, a new technology that assist the operation of electricity grids. Theo W. Fens summarize the situation. He argues that the internationalization of electricity networks concerns not only transmission system operators, but also distribution system operators. Indeed, he pleads for a better technical standardization and the harmonization of governance in the distribution of electricity in Europe. Next, Erik ten Elshof asks what we can learn from an international perspective. He answers that countries can be inspired by what other countries have done so far about smart grids. Asking a different question, Machiel Mulder wonders which challenges smart grids pose to regulation. Regulators may create specific product categories, according to his proposition, to counter regulation that hinders investments in new technologies. Finally, Else Veldman, Danny A.M. Geldtmeijer and J.G. (Han) Slootweg want to see smart grids putted into practice. For this, one needs to adopt a holistic approach to apprehend the technical, market and regulatory aspects of smart grids. At the international level, it implies to engage cooperation over the whole production chain.

In Part IV, the authors raise a number of interesting points about the international governance of telecommunications. Michael R. Fein took the case of the American experience with radio spectrum regulation since the 1920s. He challenges Ronald Coase's argument according to which policy makers failed to adopt an efficient governance structure, that is, a property-right solution. As an alternative, Fein brought forth that the actual regime succeed in preserving the diversity of radio ownership and localism in media coverage. Moving to the internet, Y.J. Park chronicles the possible internationalization of internet governance. So far, the internet remains in the hands of the United States, more precisely in the control of the Internet Corporation for Assigned Names and Numbers. Park makes the observation that, inside the Internet Governance Forum, countries remains divided about when and how the internet will be under the governance of an international

institution.

In Part v, the authors are concerned with issues pertaining to water. They explore the value of water in relation to economic development. First, Dennis Wichelns discusses United Nation's Millennium Development Goals. He describes investments that have to be made to achieve these goals. Besides, he distinguishes the role of public and private parties in the provision of water, by putting the emphasis on the underdeveloped countries. Second, Jacko van Ast and Jan Jaap Bouma talk about institutional innovation to embed public values in water cycles. They refer to the concept of value-based governance, which they back with Elinor Ostrom's works. They compare the theory against the case of the implementation of the European Union's water directives in Belgium. Finally, Nienke van Schie looks at the multifunctional value of water for society. She puts at arms length the neoclassical economic perspective on value. She prefers the institutional approach, because it considers valuation as a collaborative social process of identification and construction.

In Part vi, the authors look at the international dimensions of railways. The contributions put emphasis on the institutional arrangements of this industrial sector. Using a systematic comparative approach, Didier M. van de Velde and Eduard F. Röntgen analyze the institutional configuration of railways in Europe and Japan. They have identified who governs the sector, who manages the fixed stock and who exploit the rolling stock. This sector remains, despite the liberalization of the European market, largely organized by national institutions. They conclude that there is a strong diversity of institutional configuration, each of them has delivered differentiated economic performance. Martijn van der Horst and Larissa van der Lugt claim that the liberalization of railways did not resulted, so far, in an optimal allocation of resources. Their have studied the case of the port of Rotterdam's hinterland chain. Indeed, they observe that additional institutional arrangements were needed to optimize the allocation of resources along the chain.

In Part vii, the authors are developing perspectives on the internationalization of infrastructures. They both stress the importance of aligning technology and institutions at the international level. To begin, Mark A. Jamison discusses the avenues towards a new regulatory regime in globalized infrastructures. He considers the purpose and structure of regulatory institutions in light of the internationalization of infrastructures. He comes to the conclusion that there are no pressing needs to reform regulatory institutions at the international level. Last but not least, Rolf Künneke explores the coherence between technology and institutions in liberalized infrastructures. He summarizes briefly the issues on the operationalization of the concept of coherence for it to become a fully fledged theoretical framework.

Theses

Out of the contributions presented in these proceedings, we draw here some theses on the internationalization of infrastructures. From an historical perspective, we claim that the phenomenon is a process whose deployment takes place over the long-run. It has begun approximately at the mid-nineteenth century with the increase of technical interconnection. In this respect, telecommunication and energy have been most of the time in advance to other sectors. The advent of multinational corporations, at the turn of the twentieth century, has contributed to an increased internationalization at the organizational level. International governing institutions on infrastructures were, however, incepted mostly from the 1920s onwards with a dramatic increase in the period following the Second World War. The European Union has played an important role in this respect. Today, the internationalization of infrastructure continues in various industrial sectors in the context of liberalized services.

About technology, we conclude that standardization of technologies remains paramount to have effective economic exchanges across borders. Interoperability corresponds to the capacity of technical systems to work altogether, despite that they fall under the control and command of different operators. It allows uninterrupted flows of persons, goods, information and energy. Infrastructures require, hence, agreements on standards for its full deployment across borders. It comes particularly to the fore with new technologies at the stage of diffusion. Smart grids, whose diffusion has just begun, will fully deliver their benefits if an international body agrees on basic standards for its conception and operation. The internet has already been standardized. Yet, with the rapid commercialization of new innovations in information and communication technologies, the international community is continuously adopting new standards to allow the continuation of the world-wide interoperability of the internet.

Regarding organizations, we make the observation that firms have the challenge of dealing with the complex transaction costs that arise all along an internationalized supply chain. Firms can have a strategy of integrating vertically a set of or all operations along the supply chain. Otherwise, they have to make contracts, alliances or ventures with firms that control the remaining operations. In the natural gas industry, firms are affected by new patterns of trade that have emerged in Europe. They need further investments in transportation capacity and interconnection to better serve their consumers. In the railway industry, firms are caught with increasing transaction costs occurring all over internationalized hinterland chains. They have to make strategic partnerships for the coordination of operations in the transport of freight, by barge and train, from the ports to the shippers.

On institutions, we claim that there is a growing variety of international institutional arrangements. That can be observed by inventorying the organizations under discussion in these proceedings. Without making a sophisticated typology, we can distinguish classes of organizations: the generic-based such as the United Nations, the World Bank and the European Union; the sector-based are for example the International Telecommunication Union and the International Energy Agency; the region-based are the Pacific and Asian Communication Association and the Caribbean Association of National Telecommunications. All these organizations mediate most of the informal and formal rules that applies to infrastructure operators at the international level.

Several questions can be asked to deepen further our understanding of the internationalization of infrastructures. At which exact pace does this phenomenon change, in particular in relation to the coevolution of technology and institutions? How the power-play in international relations does affect the economics of standards in infrastructures? Are firms deterred to internationalize their activities by the increasing transaction costs along the supply chain? Is there a tendency of institutions that govern infrastructures to go global? Or will most of them likely remain limited by regional scope? A thing seems to be certain, though, regarding the future of infrastructures in an international context. The design of institutions that govern infrastructures will become increasingly complex. We may have to make sure that technology and institutions are coherent, due to the important effects of the internationalization of infrastructures on the economy.

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Part I

History

Changing patterns of infrastructure governance in the transport and communication sectors in Europe

Christian Henrich-Franke

This chapter analyzes and compares over the longue durée the sectoral specifics of international transport and telecommunication governance in the 19th and 20th century in Europe. It demonstrates the increasing complexity of governance structures and the enormous changes in governance, which were caused by wars. In particular, European integration induced an enormous expansion of governance structures, which led to increased heterogeneity in transport, as well as increased homogeneity in telecommunication. These developments will be analyzed and explained by making use of a model, which includes the factors areas of activity, the subject of infrastructure governance, intentions of actors and sectoral specificities.

Since the 19th century, infrastructures in Europe have gone through a process of increasing internationalization. More and more goods, people or information have been travelling across boundaries using infrastructure networks. Organizations which developed different structures of governance were established. Their purpose was the regulation of cross-borders infrastructure networks and services in Europe. Infrastructure organizations like the Central Commission for Navigation on the Rhine (CCNR) are among the oldest international organizations at all.

The aim of this chapter is to analyze and compare over the *longue durée* the sectoral specifics of international transport and telecommunication governance in the 19th and 20th century in Europe. In which way did the governance of infrastructure change over time and why? The overarching aim is to devise a preliminary, multi-factor model which explains the emergence of different governance structures.

In order to achieve these objectives, the chapter will at first identify five types of infrastructure governance. Secondly, a four-factor model will be presented, which is designed to analyze and explain the emergence of the typical governance structures. A third part will portray the emergence and change of governance structures, focusing on the governance structures for rails, inland navigation, wired telecommuni-

cation and radio. In addition, transmodal governance structures, which encompass the entire telecommunication or inland transport sectors, will be considered. The chapter covers the time period up to the 1980s. The impacts of the neoliberal turn of the 1980s on infrastructure governance are not included. In a fourth step, the emergence and change of governance structures will be analyzed. The chapter will conclude with some methodological reflections.

It has to be underlined that this chapter is only concerned with the emergence and change of governance structures. It does not discuss individual decision-making processes within these structures. In accordance with the political scientist Robert Keohane, governance is defined as ‘the process and institutions, both formal and informal, that guide and restrain the collective activities of a group’ (Keohane 2002: 15). Thus governance structures encompass all norms, rules, agreements and organizations which influence the international regulation of transnational infrastructures. Of course, the international system has changed remarkably during the period under consideration. These general developments, however, will not be systematically dealt with at this place.

Types of governance

Here, governance structures are distinguished by their juridical basis and the actors who are involved. Such an approach focuses on the formal elements of governance structure. It marginalizes informal elements, which will be dealt with in a later part of the chapter. Five prototypical structures will be considered here: supranational structures, in which supranational actors play a decisive role; intergovernmental structures, in which governmental actors from the higher ministerial levels are responsible for decision-making; intergovernmental transadministrative structures, in which national administrations’ actors decide on international regulations; non-governmental transadministrative structures, in which national administrations’ representatives negotiate international regulations; nongovernmental structures, in which private actors and companies are the centre of attention .

Elements of analysis

In order to explain the emergence and change of governance structures, this chapter will consider four factor categories.

Areas of activity

When infrastructures are connected and utilized internationally, a multitude

of issues need to be coordinated and regulated. They can be classified into certain areas of activity, the majority of which is associated with the harmonization of different parameters: technical harmonizations (for example, gauges, telegraph cables, radio equipment); operational harmonizations (for example, time tables, road signals, units of weight); administrative harmonizations (for example, clearings, organizational processes, ticket collectors); juridical harmonizations (for example, insurances, consumer protection); the harmonization of tariffs; and the harmonization of infrastructure networks.

Infrastructure policies can be harmonized, too. Policy is defined as an overarching set of basic principles and a catalogue of coherent measures, formulated and implemented by the governing body to direct and limit its actions in pursuit of long-term goals. Obviously, policy is a factor which has to be given precedence over other parameters of harmonization (Aberle 2003: 100).

The last field of activity are common enterprises, for example, if several (national) service providers pool their resources and establish a new (international) organization or company.

Subject of infrastructure governance

Infrastructures can be subdivided into the (material) network facilities and the services provided by using an infrastructure.

Intentions of actors

There are numerous ways to categorize the intentions of the actors who take part in the governance of international infrastructures. Here, a distinction between political, economic and technical objectives will be proposed: political objectives like power can be subdivided further into European and national ones; economic objectives contain the improvement of the economic efficiency of the overall economy and the improvement of the particular sector's efficiency; technical objectives refer to the improvement of infrastructure technology, which is independent from economic purposes.

Sectoral specificities

Infrastructure sectors differ considerably from each other, which makes it difficult to examine the influence of all the particulars on infrastructure governance. Therefore, the focus will be on national regulative authorities and the structure of national service providers.

Rails. The majority of the European countries saw the establishment of big railway companies (often as state-owned monopolists) which took care of both the

material networks and the service. These companies were usually founded at a time when specialized ministries of transport were rare.

Inland navigation (Rhine). A characteristic feature of inland navigation is the strict separation between regulating (state) authorities and a large number of service providers (shipping companies) which founded their first national associations in the second half of the 19th century. The regulation of the Rhine also began at a time when only a small number of countries already had national ministries of transport.

Transmodal transport. National authorities (ministries) were usually constituted with transmodality feature in the early 20th century. Intermodality, competition or coordination between different modes of transport emerged on the (political) agenda at that time.

Wired telecommunication. Telegraphy and telephony usually became the responsibility of (monopolist) administrations which were closely linked to the regulating authorities. Like railway companies, these telegraph administrations were established at a time when specialized ministries of telecommunication were scarce. Oftentimes there was no clear-cut separation between the regulating authority and the telecommunication administration.

Radio. Radio—wireless as it was often called in the beginning—is the only immaterial infrastructure which is discussed here. Its planning is comparatively difficult because national networks can not simply be separated from international ones due to the propagation characteristics of radio frequencies which cross national boundaries. Consequently, participation in international regulation is mandatory. While radio was considered as a variant of wired telecommunication, its national regulation was either incorporated into the existing structures of governance for wired telecommunication or it was at least designed likewise. However, radio was used for a variety of services like broadcasting, aviation, shipping or amateur radio, for all of which organizations were established in order to deal with international matters of each specific service. Like in inland navigation, the separation between the regulating authority and the service providers was a characteristic feature.

Transmodal telecommunication. National administrations and regulating authorities were constituted transmodally right from the start. Nonetheless, intermodality, competition or coordination between the different variants of telecommunication proved to be a topic of minor importance.

Governance structures in history

Railways

From the 1840s onwards, national railway networks were connected internationally. It was, however, not before the 1870s that the railway companies recognized the need of multilateral international regulation. Driven by the prospect of an improvement of their companies' economic efficiency and their international services they began to coordinate operational aspects like the coordination of timetables on regular nongovernmental conferences. In 1872, the International Sleeping Car Company (ISCC) was set up by the Belgian Georges Nackelmackers, offering catering and night services on international trains. Prior to the Great War, the company held a monopoly in Europe.

In contrast to the operational and administrative issues, the technical and juridical ones were an element of governmental cooperation from the very first. Both the International Convention for Transport of Goods by Rail (Convention internationale concernant le transport des marchandises par chemins de fer, CIM), founded in 1890, and the Technical Unity of Railways (Technische Einheit, TE), founded in 1886, were based on intergovernmental agreements. In both cases the railway companies initiated the idea many years before agreements were concluded. They wanted to minimize costs resulting from technically incompatible networks. Originally the railway companies tried to avoid governmental involvement in order to keep the issues under their own control (Kolloch 1958).

The TE mirrors the complex and often conflicting objectives of governments on the international arena. While they tried to protect their national industries on the one hand, they had an economic interest in promoting the most efficiency technology, on the other, in order to decrease transportation costs. The TE fixed minimum standards like the measurements of wagons or loads, which left considerable room for national specification. Railway networks were allowed to develop as separated but interconnectable networks (Puffert 1994).

The CIM laid the basis for international law in rail transportation in 1890. It introduced, for example, the international consignment note and committed the railway companies to the transportation of goods. National jurisdictions in Europe remained nonetheless clearly different. In order to enhance international jurisdiction, the railway companies founded the nongovernmental International Railway Transport Committee (Comité international des transport par chemin de fer, CIT) in 1902. It prepared supplementary provisions which were subsequently incorporated into the governmental agreements (Henrich-Franke 2007: 138).

Before the First World War, a complex but rather complementary mixture of governmental and nongovernmental organizations had emerged, all of which had

separate areas of activities. Many organizations were in the beginning established among a limited number of participants and then extended their membership across Europe. The governance processes were clearly dominated by actors from the railway companies, which tried to keep international cooperation under their own surveillance (Tissot 2003).

To overcome this complexity, the League of Nations gave impetus to the establishment of a new railway organization as a focal point for railway governance. All activities should be transferred to this organization. In the following negotiations, which finally lead, in 1922, to the foundation of the nongovernmental International Union of Railways (Union internationale des chemins de fer, UIC), governments and railway companies were unable to agree on one organization. The authorities pleaded for an intergovernmental structure, while the administrations preferred a nongovernmental one. The railway companies tried to defend their authority to deal independently with railway issues of international scope. In order to secure this aim, they finally agreed to pay the price of confining the new organization's competences to non-binding recommendations. The UIC's scope of activity turned out to be a very restricted one. In face of its limitations the UIC was unable to function as a focal point of European railway governance prior to 1950s. Its only noteworthy success was the establishment of a central clearing office at Brussels in 1925 (Bouley 1985: 228).

The complexity of governance structures even increased in the interwar period. In 1921, the companies had already founded the International Rail Wagon Association (Regolamento internazionale veicoli, RIV), which established rules for the mutual use of freight wagons. This was accompanied by an analogous agreement on passenger cars (Regolamento internazionale carrozze, RIC) in 1923. From 1928 onwards, the timetables were coordinated under the auspices of the International Freight Train Timetable Conferences (IFTTC). All these organizations were nongovernmental and governed by actors from the companies.

In the early 1950s, the UIC was subsequently transformed into a focal point of railway governance, which was the original intention of the League of Nations. This increase in power has to be regarded as a reaction towards the founding of various intergovernmental transmodal organizations, which threatened to cease the railway companies' traditional lead position in European rail governance. They reacted to this challenge by intensifying their relations. Economic reasons were an important factor, too. The railways across Europe started to suffer from deficits. They were in need of improvements of the railway services' economic efficiency, especially in the face of a growing intermodal competition.

The UIC drew up a comprehensive plan of measures concerning technical and operational harmonizations and common undertakings. As a central point a variety

of different non-governmental common enterprises were established like in 1953 the European Freight Wagon Pool (EUROP) or in 1955 the European Company for Financing of Railroad Rolling Stock (Eurofima). With regard to governance structures, the Eurofima was endowed with an interesting mixture of intergovernmental and nongovernmental elements which equipped the governments with a superordinated right of control, while at the same time granting considerable operational freedom to the railway companies. At that time, railway companies were often highly subsidized and had no ability to decide independently on high capital sums (Henrich-Franke 2007: 150–64). In addition, the UIC's committees participated in an advisory capacity in the transmodal organizations' working groups. In 1958, the UIC even initiated the Community of European Railway and Infrastructure Companies (CER), which represents railway companies at the European Union. These activities welded the railway companies together, and made their representatives form a kind of epistemic community, which dissociated from the governmental actors.

All in all, railway governance in the 20th century was characterized by an enormous complexity. Governmental and nongovernmental organizations often co-existed with a competing interest and overlapping areas of activity. Governance structures showed a considerable amount of heterogeneity.

Inland navigation (Rhine)

Rivers like the Rhine have always been used for inland navigation. In modern times, the Congress of Vienna provided a basis for governance on Rhine navigation. The Congress marked an outstanding caesura for infrastructure governance in Europe by setting up the CCNR. This intergovernmental body had the duty to negotiate a regulatory framework for inland navigation, which subsequently was adopted in 1831 as the Convention of Mainz and revised in 1868 as Convention of Mannheim. The CCNR was endowed with enormous powers. It held legislative rights for the further development of the Convention; it kept the enforcement of the Convention under surveillance; and it even exercised a limited amount of supranational jurisdiction. With regard to its areas of activity, the CCNR was remarkable, too. It included all areas that were mentioned here except intermodality. For the first time, infrastructure governance was based on a kind of a common (liberal) policy. Even the matter of tariff was addressed, which culminated in the ban of custom duties in the Convention of Mannheim (Sengpiel 1998).

The motivations for the installation of the CCNR were political as well as economic. The Rhine should be incorporated in an overall political framework for Europe and enhance the efficiency of the European economy. Political objectives,

however, slowly decreased in importance. The members of the CCNR focused more and more on the improvement of the inland navigation's efficiency.

In the 20th century, the CCNR remained the focal point of international regulation on the governmental level. It was, however, complemented in its activities by the transmodal organizations, which tried to deal with inland navigation on a pan-European scale. In the decade following the Second World War, governance structures diversified enormously. Different organizations began to deal simultaneously with the same or comparable issues. This subsequently led to a division of labour. While the United Nation Economic Commission for Europe (UNECE) gave priority on all-European technical and operational harmonizations, the European Conference of Ministers of Transport (ECMT) was mostly kept outside of inland navigation issues except for tariff and infrastructure planning. Both organizations established close relations with the CCNR. Considerable tensions arose between the supranational European Economic Community (EEC) and the CCNR in the 1960 as both disputed on the range of validity of the EEC-treaty on Rhine navigation. Disagreement on this question even turned out as a major factor for the failure of the UNECE transport policy (Henrich-Franke 2009a).

The involvement of national governments, the transport policy of the UNECE and the tremendous economic problems urged the inland navigation business to establish the nongovernmental Inland Navigation Union (INU). The INU's main task was the representation of the companies' interests in the transmodal organizations. It focussed its activities on operational, technical and administrative issues with a gearing to economic improvements. The same objective resulted in a variety of highly specialized common undertakings (pooling agreements), which were aimed at fixing tariffs or distributing loads (Thiemeyer 2009).

All in all, the post Second World War period saw the transformation of the once very homogenous governance structures for inland navigation into much more complex ones. Supranational, intergovernmental and nongovernmental elements and actors coexisted, often competed and even overlapped in their activities.

Transmodal transport

The first intermodal transport organization was the Committee on Communications and Transit (CCT) of the League of Nations. It was established in 1921, because leading politicians considered transport as an important element in the reconstruction of Europe (Schipper 2008). The governance structure was an intergovernmental (transadministrative) one, in which actors from ministries of transport and administrations negotiated independently all kinds of harmonization. Although political objectives were at CCT's very core, high level politicians never took part in its activities. On the contrary, non-governmental organizations and

actors actively participated in the committee's work. For the newly founded specialized national ministries of transport, the CCT offered a good opportunity to get involved into international activities. It must be considered as one of the most important outcomes of the committee that it promoted personal networking among the actors who were involved, even though some governmental representatives were biased against nongovernmental actors. The Committee's activities very soon got a clear intramodal focus, especially in the area of road traffic. Even attempts to formulate overarching agreements like the Statute on Freedom of Transit, which established freedom of transit as a general principle, were limited to railways and inland navigation. Nonetheless, the Committee failed at becoming an integrated element in the overall governance structures. The railway companies, in particular, reacted reservedly and tried to keep international issues within their own sphere.

The first post Second World War decade then witnessed an exponential expansion of transmodal intergovernmental organizations. In 1947 and 1948 respectively, the UNECE and the Organization for European Economic Cooperation (OEEC) established intergovernmental (but transadministrative) Inland Transport Committees. The UNECE can be seen as the CCT's successor. For both organizations, the aims of cooperation were political and economic. The political unification of Europe, the attempts to overcome mutual prejudices and, of course, peace, were best symbolized by transnational transport networks. Both committees facilitated cross-border transportation in Europe by harmonizing different parameters. Within the UNECE, however, the political tension between East and West had a significant impact on the activities and prevented it from dealing with policy matters (Berthelot 2003).

In 1953, the intergovernmental ECMT complemented the existing governance structures. The organization was a result of negotiations in the Council of Europe, which for the first time considered the establishment of supranational structures for transportation. Even a common policy, the pooling of national transportation resources on the European level and the coordination of the different modes of transport were approved. Manifold motivations were put forward to warrant such an organization like the improvement of the transport facilities and economic efficiency. Of course, the political and cultural integration of Europe was an argument, too (Henrich-Franke 2008a). Though all supranational attempts failed, the ECMT established for the first time intergovernmental governance structures on a transmodal level (Brabers 1993). It brought together all Western European Ministers of Transport at regular conferences. The ECMT was the first European organization which covered, in principle, all areas of activity. Very soon, however, the ECMT was transformed into a typical transadministrative governance element, although the ministers held their half-yearly meetings (Ribu 1987).

Just two years later, in 1955, the same arguments which had been raised within the Council of Europe, were again on the table in the negotiations on the EEC. This time, however, they were implemented successfully. Leading politicians insisted on making transportation an important element of the Treaties of Rome, even though large parts of the transport sector were strongly opposed to such an incorporation (Ambrosius 2007). The EEC was contractually obliged to formulate and implement a common policy and it covered, in principle, all areas of activity. Nevertheless, the supranational powers of the EEC Commission were limited to the enforcement of the ban against discriminations. Other decisions depended on the unanimity within the intergovernmental EEC Council, in which national governments, independently acting Ministers of Transport respectively, exercised a veto. The limited geographical extension of the EEC restricted its activities, too. Remarkably, the EEC Council's group for transportation, which carried out the majority of tasks, had an intergovernmental transadministrative character. In this organ the same actors who negotiated transport issues, also met within the other transmodal organizations. The EEC Commission represented a remarkable evolutionary approach to transport governance as it broke with the strict separation of the different modes of transport (Dumoulin 2007). This gave rise to enormous compatibility problems with the existing governance structures in the transport sector. It took the EEC more than three decades to overcome these limitations. In 1985, the EC Court even accused the EC-Council of idleness in formulating a common transport policy (Stevens 2004).

All in all, the political and economic reconstruction of Europe after both World Wars exerted a tremendous influence on the shaping of governance structures in the transport sectors. The emergence of transmodal organizations resulted in a remarkable transformation of governance structures into transadministrative ones. Structures for the individual modes of transport which were, until then, separated now became connected; only the railways remained to some extent outside. National ministries, which had before left many areas of activity like technical, operational and administrative harmonization to nongovernmental actors, extended their activities into these areas. In addition, intergovernmental transadministrative organizations captured neglected areas of activity like policy or tariffs, especially when they were connected to intergovernmental ones. Nonetheless, as national ministries were subdivided along the lines of different modes of transport, so were also the international structures. Only the EEC was, in many respects, an exception to this rule.

Wired communications

Telegraph networks in Europe were internationalized in the late 1840s. The first

international organization was established in 1850 under the label of Deutsch-Österreichischer Telegraphen Verein (DÖTV). In 1855, several countries from South-West Europe emulated the DÖTV and founded the Western European Telegraph Union. Both organizations were complemented by a variety of bilateral or trilateral agreements which were similar to each other with regard to technical, administrative or operational regulations (Wobring 2007). Since telegraphs were merely an unprofitable business throughout the 19th century, technological protectionism did not impede international harmonizations. Tariffs were the only area which showed a different development. Their diversity inspired the French government to call an all-European conference to decide on a European tariffs system at Paris, in May 1865. Leadership in international telecommunication promised political prestige, too.

The Paris conference went beyond a European tariff system and founded the International Telegraph Union (Union télégraphique internationale, UTI) on which nearly all European governments acceded. The governments agreed on common rules on the standardization of technical equipment, adopted uniform operating instructions and laid down a European international tariff as well as accounting rules. In 1875, the UTI already went through a decisive revision. The UTI agreements were divided into a convention, which laid down the organizational structure and fundamental rules for telegraph communications, and the telegraph regulations, which contained the rules. The organization was split up into a plenipotentiary conference (intergovernmental structure) which could decide on the convention and administrative conferences (intergovernmental transadministrative structure) to decide on the regulations. This revision initiated a lasting process of 'transadministering' governance structures in the wired telecommunication sector. Remarkably, the UTI adhered, throughout its existence, to the principle of majority voting (Coddling 1952).

In the following, the national telegraph administrations negotiated the telegraph regulations rather independently at administrative conferences which were called regularly. The governments withdrew completely from the field of telegraph cooperation. UTI was subsequently transformed into an organization of (national) administrations' technical experts who decided on technical, administrative and operational standards. Even tariffs were negotiated. Significantly, the UTI convention was not subject to any revision for 57 years. In 1885, the UTI incorporated the legislation for international telephony.

The increasing internationalization of telephone networks after the Great War raised the need for international standardizations. Therefore representatives from Western European countries decided at a meeting in Paris, in 1924, that the expanding European telephone system necessitated an organ which allowed telephone ex-

perts (from administrations and private companies) of various countries to convene periodically in order to exchange views on technical and operational issues concerning long-distance telephony (Andersson-Skog 1999). The objective was primarily a technical one, because its aim was to foster technological progress. They founded the nongovernmental Consultative Committee for International Telephony (*Comité consultatif international téléphonique*, CCIF) which in the following prepared non-binding recommendations. It was even provided with a permanent secretariat to prepare the annual meetings of the CCIF. The new organization was established as an independent one although a close connection to the UTI was self-evident. It was widely accepted that the committee could carry out valuable preparatory work for the revision of telephone regulations at the UTI's administrative conferences. At the following conference in Paris, in 1925, the representatives from national administrations already added an article to the revised telegraph regulations which put the CCIF in charge of the study of standards regulating technical and operational questions. Any national administration which desired to take part in the CCIF's activities just had to address a declaration to the administration of the country in which the previous Telegraph Conference had been held. Although the representatives at the Paris conference were not endowed with the power to change the UTI's structure, they *de facto* did so. They even set up a similar committee for telegraphy which was called International Telegraph Consultative Committee (*Comité consultatif international télégraphique*, CCIT). The Paris conference clearly indicated the transadministrative character of governance and the self-confidence of the administration's actors who decided independently on international issues (Laborie 2008).

Since the last revision of the convention in 1875, the organization underwent a dramatic process of change. That year, the UTI had the character of a group of (European) states' governmental representatives who met periodically at administrative conferences to discuss matters of international telegraphy. Prior to its merger with the International Radiotelegraph Union (*Union internationale de radio télégraphique*, UIR) in 1932 the UTI had been transformed into a complex (global) organization for administrations capable of continuous and effective work. Complex, but very homogeneous, transadministrative governance structures had evolved, incorporating governmental, administrative and private actors.

Radio

Radio technology achieved a state of practical application in the 1890s. At that time it was mostly a matter of maritime purposes. The first approach to international cooperation was put forward by the German government, which, on the suggestion of the private company Allgemeine Elektrizitäts-Gesellschaft (AEG), decided to call

a preliminary conference, in 1903, to discuss the issue of international regulations. The German move was triggered off by the (private) Marconi Company's attempts to expand its monopoly on radiocommunications across the globe. Political objectives were the decisive motivations. The German government feared a loss of control over the monopolized national communication facilities (also due to military purposes) and it had an interest in protecting its industry as well. Technological protectionism and the avoidance of interferences were reasons, too.

A first intergovernmental conference on regulations, which was attended by the most important maritime powers of the world, was convened in Berlin, in 1906. The conference adopted a convention which included—as did the telegraph convention—fundamental rules for radio communications. The radio regulations, annexed to the convention, contained detailed rules on technical, operational and administrative standards as well as juridical matters. Complex governance structures, however, were not established. Instead, the UIR was founded according to the model of UIT. The UIR was instructed to carry out the periodic revision of the convention and the radio regulations on either plenipotentiary or administrative conferences. The bureau of the UIT was designated to act as central administrative office. Like in the telegraph sector, the national radio administrations and the industry negotiated the radio regulations rather independently in the aftermath at regular administrative conferences. Governments subsequently slackened control over international radiocommunications, partly because radio was a technically difficult matter which required a lot of expertise. At the next radio conference at London, in 1912, private companies were already permitted to participate in advisory capacity without the right to vote. From the beginning, radio was governed within transadministrative structures (Coddington 1952).

In the aftermath, the number of radio users and services increased. Apart from maritime services, radio was also used by broadcasters, aviation and radio amateurs. Regulations for the new services had to be established and, of course, the interest groups of these services had to be incorporated into the UIR's governance structures. Therefore, the Washington administrative conference extended the UIR's activities to the allocation of frequencies in 1927 (Wormbs 2008). This step entailed an enormous enlargement of the Union's activities with regard to quality. Since then, the UIR distributed rights to exclusively use specific parts of the spectrum. In addition to that the Washington conference established the International Radio Consultative Committee (Comité consultatif international des radiocommunications, CCIR) which was similar to those for telegraphy and telephony; but it was based on an intergovernmental agreement. Organizations like the International Air Traffic Association (IATA), International Broadcasting Union (IBU), the International Amateur Radio Union (IARU) or the International Maritime Radio Committee (Comité international radio-maritime, CIRM) were allowed participation in

the UIR's structures, to provide technical and operational advice. The CCIR was an important factor for the emergence of transnational personal networks (epistemic communities) which allowed negotiations in informal settings (Henrich-Franke 2008b).

A diversification of governance structures is noticeable in the sense of a separation of the governing of networks and the governing of services. Many radio service organizations negotiated regulations for their particular radio service outside the UIR. Remarkably, the nongovernmental IBU even allocated individual frequencies within the broadcasting bands (Wormbs 2008).

The emergence of the governance structures for international radio followed the same pattern as those for wired telecommunication. Prior to the merger with the UTI, the UIR had developed complex but very homogenous governance structures which incorporated governmental, administrative and private actors.

Transmodal telecommunication

The first transmodal organization in the telecommunication sector came into being with the merger of the UTI and the UIR into the International Telecommunication Union (ITU) at the Madrid telegraph and radiocommunication conference in 1932. Two organizations with a similar structure were joined together in order to eliminate a duplication of work. The liaison was merely a juridical issue. Wired and wireless telecommunication operated henceforward under the provisions of a shared convention although the day-to-day work continued to be strictly divided. The consultative committees, the administrative conferences and the regulations remained separate.

The structure established in 1932 was not changed in its essential features until 1992. During that time, ITU's structure just went through two minor modifications in order to meet changing requirements, if one disregards the abolition of colonial voting. Firstly, the ITU established an International Frequency Registration Board (IFRB) in 1951, to coordinate the increasingly complicated task of managing the radio spectrum. This organ should regulate the use of frequencies in order to eliminate harmful interference. Its structure was supranational, although its competences were restricted to recommendations. In case of an unauthorized use of a frequency, the IFRB was unable to sentence a member and to prohibit transmissions. Attempts in that context to establish a global telecommunication policy, including a supranational IFRB with the competence to enforce justice, failed because of tensions between the Eastern and the Western bloc (Henrich-Franke 2009b). Secondly, the two consultative committees for wired telecommunication merged into the International Telegraph and Telephone Consultative Committee (Comité consultatif international de téléphonie et de télégraphie, CCITT) in 1956, in order

to respond more effectively to the requirements generated by the development of wired telecommunication.

With regard to the geographical scope of its activities, the ITU had changed considerably. What began in the 1860s as a predominantly European organization was in the 1950s transformed into a global one. The harmonization and coordination of intra-European telecommunication infrastructures was just one aspect among others (Coddling 1982).

European integration also affected the telecommunication sector. The Frenchman Edouard Bonnefous, the very same politician who launched the idea of a supranational integration of the transport sector, also proposed the foundation of a supranational European postal and telecommunication organization in 1955. The idea was backed with the same arguments which were offered for the integration of the transport sector in 1950. In addition, the proposed organization should supplement the ITU and deal with intra-European affairs (Laborie 2008). Finally, in June 1959, the nongovernmental transadministrative European Conference of Postal and Telecommunication Administrations (*Conférence européenne des administrations des postes et des télécommunications*, CEPT) was founded after a conflictual four-year debate. Membership was restricted to PTT-administrations. This organization was not linked to other projects of European integration but rather incorporated into the existing transadministrative governance structures as a kind of sub-organization of the ITU (Franke 2004). The CEPT continued the traditional transadministrative way of telecommunication governance in Europe. The organization got a flexible internal structure and could, in principle, extend its activities to all areas by setting up specialized working groups. As a consequence of its non-governmental transadministrative structure the CEPT was only authorized to make non-binding recommendations. Nonetheless, the CEPT decided on regulations for international telecommunication in Europe (Neutsch 2007).

Eventually, the CEPT expanded its activities into many areas. On the one hand intra-European issues were no longer introduced within ITU while on the other hand CEPT was used as a forum for the preparation of universal ITU conferences on a European base. From the 1980s onwards the CEPT even formulated common positions—supported by all members—for ITU administrative conferences (Henrich-Franke 2006).

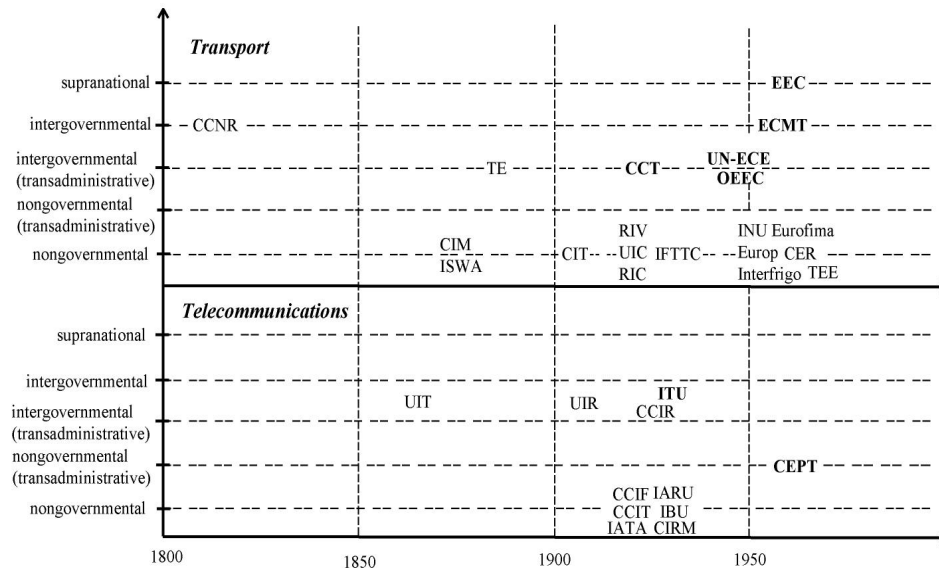
The processes and decisions, which were taken within these structures, increased enormously in the second half of the 20th century when European countries entered the era of information societies. The radio sector, in particular, witnessed a considerable increase in the number of conferences. Since the beginning of the 1970s, the ITU hosted a large radio conference with hundreds of participants almost every year. These conferences were preceded by years of preparatory work. Since the responsibility for these activities lay in the hands of a rather limited number of actors,

the links within the epistemic communities became ever closer. Informal transadministrative structures emerged, complementing the more formal governance elements (Henrich-Franke 2006).

All in all, the governance structures of the telecommunication sector were remarkably homogenous. Since 1932 all structures were transmodal, although they remained strictly divided along the lines of different modes of telecommunication. The revision of the convention was the only occasion where the telecommunication sector as a whole was governed transmodally. The characteristic features of the governance of telecommunication were its transadministrative character and the high share of informality. Many issues were solved outside the official decision-making procedures among the actors concerned.

Comparison and analysis

Throughout the 19th and the 20th century, governance structures in the transport and communication sectors became increasingly complex. Structures which were first established among a limited number of participants were subsequently expanded across Europe. More and more organizations concerned themselves with a growing number of areas of activity. In the beginning, administrations or private companies were the ones who mainly reacted to technical, administrative or operational needs by establishing nongovernmental organizations. In the 20th century, however, governments or European politicians took the lead. In all infrastructure sectors, changes in the governance were the consequences of wars. Peace negotiations and the reestablishment of the international system triggered off the foundation of new organizations and organs responsible for infrastructure issues. Infrastructures were discovered as symbols for unification of Europe. European integration induced an enormous expansion of governance structures which led to increased heterogeneity in the transport sectors as well as increased homogeneity in the telecommunication sectors. While the governance structures in the transport sectors underwent considerable change as time went on, they remained rather constant in the telecommunication sector. In that sectors, the CEPT was integrated as a complementary element into the overall governance structures. In the transport sector, however, the UNECE, the ECMT and all other organizations generated a duplication of work. New intergovernmental organizations competed with each other as well as with nongovernmental organizations. Only in areas like infrastructure planning, the harmonization of tariffs, jurisdiction (rights) or common policies, where governmental authority was required, the competition in the transport sector remained at a comparatively low level.



The 20th century witnessed a tendency towards the creation of intergovernmental governance structures which were gradually transformed into transadministrative ones (see Figure 2.1). Thus, new intergovernmental governance structures became elements of traditional transadministrative negotiation routines. The EEC Commission as the only actor who resisted such transformations remained an alien element within the governance structures over a long period. Remarkably, the foundation of transmodal intergovernmental organizations was accompanied by the establishment of nongovernmental ones. Private actors tried to gain influence over the decision-making process. This was observable especially in infrastructure sectors with a high number of service providers like radio or inland navigation.

It was a general phenomenon that transadministrative governance structures generated a high level of informal elements of governance where matters were solved among experts outside any official decision-making procedures. The de facto transformation of intergovernmental governance structures into intergovernmental transadministrative ones depended, for the most part, on the importance of expert knowledge for the regulation of infrastructures. Very often a comparatively limited number of actors governed particular infrastructures. The more governance processes were treated within these transadministrative structures, the more informal the structures were. This was most obvious in the radio sector where expert knowledge was an extraordinarily important factor. Controversial issues often were solved in a smooth way outside of the official decision-making procedures. Dur-

ing the negotiations on the international level, the (national) spheres of influence were mutually respected by the administrators. Therefore, initiatives to overcome the separation and protection of national infrastructure networks were rare. This turned out to be an important factor for the failure of the EC common transport policy until 1985. From a perspective of democratic legitimacy, the administrations' freedom to decide independently must be regarded as an important issue.

In the following, the influence of the four factor categories on the emergence and change of different governance structures will be analyzed.

Areas of activity

Different areas of activity clearly correlated with particular governance structures (see Table 2.1). Technical, operational or administrative harmonizations and common undertakings turned out to be issues that were mainly governed through

Table 2.1: Areas of activity of transmodal transport and railway organizations

Nongovernmental		Intergovernmental			Supra-national	Transport
		Transadministrative				
		CTT	UNECE	ECMT	EEC	
—		X	X	X	X	Technical
—		X	X	X	X	Administrative
—		X	X	X	X	Operational
—		X	X	X	X	Rights
—		—	—	—	X	Tariffs
—		X	X	X	X	Infrastructure
—		—	—	X	X	Policy
—		—	—	—	X	Common undertakings

Nongovernmental						Intergovernmental		Supra-national	Railway
RIV RIC	UIC	CIT	Int.fri.	Europe	Euro- fima	TU	CIM		
—	X	—	X	X	X	X	—	—	Technical
X	X	—	X	X	—	—	—	—	Administrative
X	X	—	X	X	—	—	—	—	Operational
—	—	X	—	—	—	—	X	—	Rights
—	—	—	—	—	—	—	—	—	Tariffs
—	—	—	—	—	—	—	—	—	Infrastructure
—	—	—	—	—	—	—	—	—	Policy
—	—	—	X	X	X	—	—	—	Common Undertakings

nongovernmental or transadministrative structures. These activities often were outside of governmental interest. Governments only intervened in decision-making processes in order to protect national industries. The administrations and the (big) railway companies got themselves straight on this. They avoided any decision which could jeopardize the national industries. Tariffs, network planning and policy proved to be areas of activity which required intergovernmental structures as governmental competences were a prerequisite to negotiate these issues.

If one considers the historical dimension, it becomes apparent that, in most of the cases, the international governance of infrastructures started with questions of technical and operational harmonization or common undertakings. In a second step there was an expansion to juridical and administrative harmonizations. Finally, tariffs, infrastructure planning and policy were included. This pattern was observable even in the transmodal organizations, which in principle could deal with all areas.

Subjects of infrastructure governance

The planning and construction of (material) networks was usually reserved to governmental authorities. Consequently, there was a tendency to deal with these issues on an international basis within intergovernmental organizations. De facto, however, they were subsequently negotiated within transadministrative settings. Services, on the contrary, were a matter usually governed within nongovernmental or transadministrative structures.

In the *longue durée*, the absence of a clear-cut separation of service providers and governmental regulating authorities proved to be a particularity of the infrastructure sectors. Service providers often had a monopoly position and were in many respects subject to direct or indirect governmental control. Consequently, transadministrative governance structure dominated the international governance of infrastructures.

Intentions of actors

With regard to the intentions for the foundation of an international infrastructure organization, a correlation between political objectives and the creation of intergovernmental or supranational organizations comes to the fore. Technical objectives or the intention to improve a particular sector's efficiency usually leads to the creation of transadministrative or nongovernmental structures. In this context, expertise turned out to be a decisive factor. If organizations were founded on a supranational or intergovernmental basis, experts were included in governance processes from the beginning. Even private actors were regularly included in an ad-

visory capacity. Remarkably, the EEC Commission received an advisory committee consisting of experts.

In the historical dimension, it is getting apparent that political objectives (European) and overall economic objectives mainly arose as a consequence of war. Such objectives were responsible for remarkable extensions of governance structures especially in the transport sector. Noticeably, such objectives vanished in the course of time, whereas the objective to raise the particular sector's efficiency or technical objectives remained constantly on the table.

Sectoral specificities

Railways. The early foundation of big railway companies (network and service) resulted in a clear separation between nongovernmental and intergovernmental governance structures. From the beginning, railway companies tried to keep the international cooperation under their own control. Railway companies pooled their resources whenever they felt an economic need to do so. The authorities were included only if it could not be avoided. The relative absence of competition between railway companies encouraged the subsequent emergence of an epistemic community. In the post Second World War period, this community was welded together even closer because of intermodal competition and the emergence of transmodal organizations, within which national ministries of transport began to deal with all areas of railway issues. Railway companies dissociated themselves from these organizations and competed with them. Thus, governance structures became even more heterogeneous.

Inland navigation (Rhine). The strict separation between governing authorities and service providers did not impede an intense cooperation between them. The shipping companies even represented national authorities in intergovernmental organizations regularly. Especially in the CCNR different actor groups cooperated intensively. The foundation of transmodal organizations in the 1940s and 1950s resulted in the establishment of nongovernmental interest groups by the inland navigation business. Governance structures became more heterogeneous and governance processes more conflict-laden.

Transmodal transport. The strict internal division of national ministries according to the modes of transport also shaped international governance structures. Different ministerial units dealt with international issues independently from each other and thus contributed to the division to the organs of the transmodal organizations. Consequently, these organizations hardly ever occupied themselves with issues of intermodality. In that respect, the EEC was a remarkable evolutionary approach to transport governance as it broke with the strict separation. This, however, gave rise to enormous compatibility problems with national ministries' structures.

Wired telecommunication. The absence of a clear-cut separation between service providers and regulating authorities and the early establishment of the administrations resulted in very homogeneous transadministrative governance structures. Probably this can also be attributed to the fact that telecommunication was an unprofitable business in the 19th century which was in need of (governmental) subsidies. The homogenous structures supported the emergence of an epistemic community among the actors. As well as in the railway sector, the absence of international competition between national services was an important factor for the establishment of transadministrative governance structures and of epistemic communities which exercised impartial control over infrastructure governance.

Radio. The (formal) governance structures for radio were to a large extent copied from and closely connected to wired telecommunication although the service providers were more numerous and diverse. Remarkably, the same transadministrative character emerged in the form of a comparable epistemic community among the relevant actors. In fact, the epistemic community in the radio sector was more closely knit, not least because the decision-making processes were more numerous, especially from the 1970s onwards. Physical characteristics were an important factor, too. Participation in the international regulation was indispensable, even for the governance of national networks. The informality of transadministrative governance structures permitted a flexible treatment of the complex issues that were part of the radio regulations. At the same time, governance structures were open for the participation of service providers. Like in inland navigation, the officially strict separation between authorities and service providers was transformed into (trans-administrative) governance structures which were de facto heavily integrated. The large number of service providers was flexibly included into decision-making procedures.

Transmodal telecommunication. International governance structures mirrored the national ones. Although transmodal organizations were founded comparatively early, issues of intermodality, competition or coordination between the different variants of telecommunication proved to be of minor importance.

Conclusion

Many factors shaped governance structures for infrastructure services in Europe in the 19th and 20th century. Areas of activity, subjects of infrastructure governance, intentions of actors and sectoral specificities were just four among a large number of possible factors. The inclusion of other factors like the profitability of an infrastructure service, technical specifics or overall policies promise to give a much more deeper insight into the reasons for the emergence of particular governance

structures.

Any generalization from the results of this chapter is subject to restrictions. Causal connections were hardly observable. Instead, the individual factors had a tendency to result in specific outcomes. Moreover, it has to be kept in mind that the factors were separated for analytical purposes. Countless interdependencies between these factors occurred, which have not been sufficiently examined. The difference between de jure and de facto governance structures and processes often makes it impossible to distinguish different types of governance. It seems that more research on their causes needs to be done. Reality appears to be a lot more complex than the limited results of the model that is presented here. Nonetheless, such a model proved to be fruitful analytical tool for highlighting factors which played a role in the emergence and change of governance structures. The inclusion of further infrastructure sectors like pipelines, aviation or road transportation promises to complement the results, too. Also an in-depth comparison of wired telecommunication and railway governance or a focussing on epistemic communities would be interesting tasks for future research.

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European integration and infrastructures since the 19th century

Frank Schipper

The European sub-continent has historically had relatively large densities of infrastructures, national borders and cross-border flows. This may in part explain the relatively high incidence of transnational infrastructure regimes that have been put in place to regulate infrastructure-supported flows. The chapter discusses the relation of such European transnational infrastructure regimes with those of a more global character. It illustrates this subject matter tentatively for telegraphy; and somewhat more in-depth for road traffic signs. It concludes that European and global transnational infrastructure regimes should not be conceptualized as mutually exclusive, but as fundamentally intertwined levels.

In 1984, just before the Single European Act would tremendously boost the internal market of the European Communities, the European Roundtable of Industrialists (ERT) published the report *Missing links* (ERT 1984). In it the business lobby complained about the lack of adequate land-based transport infrastructures and proposed several grand projects to overcome this deficit. The report proved a decisive input for the European Union (EU) Trans-European Networks program. Policy documents emanating from the European Commission echo the points that the business representatives had raised—not in the least place because the latter’s call for continental infrastructures largely coincided with the former’s own agenda and interests.

Similar claims have been heard time and again in the course of the 20th century—and before. They not only condemned a supposed lack of physical infrastructures, but also the lack of an appropriate set of rules to allow infrastructures to work across borders. The truth of the matter is that Europe has for long been a place dense in infrastructures and cross-border interaction. As a result the ensemble of countries sharing the space of the subcontinent has been confronted early with manifold problems arising in the wake of the internationalization of infrastructures. It is not likely to be a coincidence that the Central Commission for Naviga-

tion on the Rhine, often cited as the first modern intergovernmental organization (Lyons 1963), was established in Europe to deal with traffic and other uses of one of the world's busiest rivers at the time. A proliferation of similar international organizations would follow, and Europe formed the key playground for most of them.

Here, the aim is to explore the emergence of specifically European variants of infrastructure governance over time. A European bias is not simply a new guise to conceal deep-seated Eurocentrism. There are some characteristics prevalent in the European peninsula that may in part explain the emergence of a broad set of transnational policies. Among them is the fact that Western Europe has long been 'an overcrowded region in terms of both population and the number of distinct states' (Wallace 2000a). In the 20th century, the latter element was further exacerbated in the wake of the First World War, when a dozen or so new states were created from the defunct empires in Central-Eastern Europe (Bugge 2002). The new borders cut right through existing infrastructures and the associated currents of trade. The situation raised myriad questions on ownership and how best to allow the continuation of flows while respecting the new geopolitical situation at the same time, particularly in the railway sector (Anastasiadou 2009).

Europe therefore constitutes a fruitful site to study the internationalisation of infrastructures. In order to understand the process of internationalisation, we need not only to map the physical connections that have been made, but also to carefully measure the interactions they have supported over time. This chapter tentatively discusses the relation between infrastructure development, the dynamics of the transnational flows they support, and the transnational infrastructure regimes that regulated them. It seeks to understand at what level such regimes occur, considering in particular the interaction between global and European levels. The second section draws its inspiration from literature on European governance in its discussion of transnational infrastructure regimes. The two subsequent sections serve to illustrate the themes developed in the second section. The third section does so tentatively for telegraphy, the fourth section discusses road traffic signs in greater detail. The final section tries to capture the central lessons to be drawn from the contrast between these two cases.

Transnational infrastructure regimes and European governance

As a theme, the internationalization of infrastructures requires a world carved-up in modern nation-states. Infrastructures could only cross national borders as soon as the latter had been put firmly in place—irrespective whether this happened prior to or after the construction of the infrastructure itself. Several infrastructures are considerably older than the modern state. This is most obviously the case for 'natu-

ral' infrastructures; but it also holds for certain man-made infrastructures. We may think of maritime connections, rivers, and road-like infrastructures as examples illustrating the point. At the same time, the formation of the modern state has gone hand in hand with the creation of infrastructures reinforcing it and extending its control over territory. Eugen Weber has demonstrated this most eloquently for the case of France in his well-known *Peasants into Frenchmen* (Weber 1976).

Infrastructures and national borders contradict each other to a certain extent. Infrastructures carry a connective promise, while national borders symbolize the neat separation between different polities. Important scholarly work has helped to play down such a black-white conceptualization of infrastructures and borders. Infrastructures do not only connect, but also exclude and restrict in defining where it is possible to go (Edwards 2003). Be that as it may, as a general rule of thumb infrastructures do aim to enable connections through space. From such a perspective, infrastructure-supported flows may be characterized as the materialization of the connective promise embedded in the infrastructure itself.

In similar ways the field of border studies has moved our understanding of borders from clear-cut division lines to zonal entities, enlarging the geographical scope of the region in which borders exert their influence, that connect as much as they divide (Baud and van Schendel 1997). Interestingly, border studies have rarely taken up the study of infrastructures, despite the fact that these material devices at least in part make a connective view on borders possible. Infrastructures have not only been instrumental in creating connectivity across borders, but also contributed to a feeling of the compression of space.

That shrinking feeling

Francis Delaisi, an astute French economist and enthusiastic Europeanist during the years of the Interwar Period, had a keen eye for the effects of infrastructure on modern everyday life. In 1925, he published *Les contradictions du monde moderne*, spelling out his thoughts on modern life and the ways in which technologies had changed its outlook. Infrastructures in particular, Delaisi claimed, were increasingly turning the world into a global village devoid of significant hurdles to long-distance connections. He wrote:

the universe has internationalised profoundly. The immense network of railway lines and passenger ships, crossing the continents and seas, reaches into the deep interior of the most faraway countries [...] the telegraphs and the submarine cables allow to receive information from everywhere and to transmit orders everywhere. (Delaisi 1925)¹

1. Our translation from French: 'l'univers est profondément internationalisé. L'immense réseau des lignes de chemins de fer et de paquebots, traversant les continents et les mers, pénètre au

But while the global village had already become a reality thanks to the connective qualities of infrastructures, politico-administrative structures had up to that point in time been unable to keep pace and adapt themselves accordingly to the new situation. The fundamental contradiction of modern life materialized in the mismatch between far-reaching infrastructure technologies and antiquated institutions ill-equipped to steer them properly. The technical revolution of the 19th century, Delaisi continued, had not yet had its effect on the institutions and ideas of the (early) 20th century.

Such remarks did not form isolated observations, but resonated with more widely shared feelings of increased global interconnectedness that demanded new sets and types of rules accompanying transnational infrastructures and the flows they supported. They informed the convictions and writings of (liberal) internationalist thinkers from the late 19th century onwards (Zaidi 2008) and made headway in engineering circles in the Interwar Period as well (Schot and Lagendijk 2008). Leonard Woolf's 1916 pamphlet *International Government* is typical for the kind of reasoning that dominated these circles:

Our civilization rests ultimately upon the Post, the Telegraph, the Telephone, the Railway, the Steamship, the Motor Car, and the Aeroplane. If you cut the communications of Europe we should fall back plumb the 20th century to the 10th. But these communications are international; they cease to exist unless they are made independent of the frontiers of States. They are the greatest of all international interests, and they cannot perform their functions without international administration. (Woolf 1916: 184)

Liberal internationalist thinkers had an impact on the discussions taking place after the First World War about the would-be League of Nations. As minister of foreign affairs of South Africa, general Jan Smuts represented the British Empire at the Paris Peace Conference in the Committee deliberating the creation of the League, chaired by American president Woodrow Wilson. Unsatisfied with the public debate on the League, Smuts wrote an essay sketching the contours of the future League. Smuts' became one of the most influential inputs in the process of setting-up the League (MacMillan 2001). He underlined it should not only become a beacon against war, but also facilitate cooperation on manifold day-to-day issues that might be the object of international agreement. In his opinion,

Questions of industry, trade, finance, labour, *transit and communications*, and many others, are bursting through the national bounds and are clamouring for international

fond des plus lointains pays [...] les télégraphes et les câbles sous-marins permettent de recevoir de partout les informations et de transmettre partout les ordres.'

solution. Water-tight compartments and partition walls between the nations and the continents have been knocked through, and the new situation calls for world-government. (Smuts 1918)²

Many agreed with Smuts. While keeping the peace worldwide remained the primary *raison d'être* for the League, its creators gave the Geneva organization a second main task alongside its first: to provide a forum for cooperation to tackle problems transcending national borders in any policy-field in which these spelled trouble. In the words of Susan Pedersen, 'if one notes [the League's] efforts to regulate cross-border traffics or problems of all kinds, it emerges. . . as a harbinger of global governance' (Pedersen 2007).

But while the League may have succeeded in realizing its universal ambitions in some policy areas, it did not do so in others. The evidence suggests that the work on communications and transit became an almost exclusively European affair (Schipper, Lagendijk and Anastasiadou forthcoming). The same strands of thought that had achieved wide popularity among liberal internationalists also made inroads into the burgeoning European movement of the Interwar Period. Delaisi himself became an important figure in those circles, becoming one of the key economic thinkers in the Paneuropa Union led by Count Richard Coudenhove-Kalergi. (Transport) infrastructures were crucial to Delaisi for bridging the gap between 'the two Europes', being the subcontinent's industrialized core on the one hand and its agricultural periphery on the other (Delaisi 1929). Coudenhove-Kalergi himself claimed that 'Europa ist eine Funktion der Technik' (Coudenhove-Kalergi 1932). He was deeply troubled that large states like the Soviet Union and the United States could take full advantage of infrastructure technologies, while Europe remained as divided as ever to its own peril.

The discussion on how to mobilize infrastructures in the service of European ideals moved along two aspects. First, there was the material aspect concerning how to give Europe the physical infrastructures it needed. The Interwar Period was a period rich in grandiose, large-scale European infrastructure schemes that were never realized (Vleuten and Kaijser 2006). Sceptics questioned the demand for such infrastructure connections. They argued that even if the overly expensive plans would see the light of day, they would face multiple hurdles blocking their use across national borders. A second aspect of the debate therefore concerned the governance of cross-border infrastructure use, not only of the future would-be Eu-

2. Our emphasis in the quote. 'Transit' referred to the passage of flows on the territory of a state that was neither its origin nor its destination. 'Communications' did not only refer to telecommunications, but also included all forms of transport and electricity. The use of the term 'communications' in this sense continued in the Interwar Period. The specialised agency of the League of Nations dealing with these matters was known as the Organization for Communications and Transit.

ropean infrastructures, but also of those already present. It raised the issue what kind of regulatory structures should be drawn up in order to allow the use of infrastructures across the border.

European transnational infrastructure regimes

The problematic sketched above hints at the potential mismatch between the full action radius of a particular infrastructure and the range covered by the set of rules regulating its use across borders. In his book *Political Machines*, Andrew Barry draws attention to just such a mismatch between the spatial reach of technology, or 'technological zone', and the rules and regulations that have not quite reached the same extent. The space of government, Barry argues, does not only refer to geographic or territorial space, but should also be considered in relation to the zones formed through the circulation of technological practices and devices. The focus of the book is on the governance of technology in the EU. Barry discusses various attempts to bring technological capabilities and the geographic reach of accompanying rules and regulations in line with each other at a European level.

We may refer to such sets of rules as 'transnational infrastructure regimes'. The most encompassing type of regime would be a global one, but, as *Political Machines* reminds us, there are also less encompassing levels on which transnational infrastructure regimes can take shape, including European transnational infrastructure regimes. Under such a heading we may put any regime that is labelled as such by the actors involved in shaping it, irrespective of its geographic extension. There may be different reasons to restrict such regimes to the European realm. There might be a densification in infrastructure use that can be characterized as European rather than global. The sets of rules may be drawn up in the context of processes of European integration. Or it may simply be easier to agree among a sub-set of countries having had lots of experience on designing mutually agreeable rules and regulations.

Alec Stone Sweet and Wayne Sandholtz have made the relation between 'flows' and 'supranational governance' in the EU the linchpin of their theory on the emergence of supranational governance in the process of European integration (Stone Sweet and Sandholtz 1998). Basically their theoretical framework seeks to understand how supranational governance emerges over time. There are two drivers of the process: first, a group of 'transactors' who, in one way or another, benefit from transnational flows; and, second, a set of actors disadvantaged by national rules. Both will strive for rules and regulations that liberalize and facilitate cross-border flows. As flows grow in strength, they will achieve the leverage necessary to achieve this result—supranational governance of cross-border flows becomes a fact and results in further increases of flows. Then a new cycle begins, and the transactors will lobby for additional policy measures to facilitate flows. And so on and so forth. In-

frastructures and the flows they support are perhaps the most straightforward case in which the framework set up by Sandholtz and Stone Sweet can be brought to fruition. Indeed Donald J. Puchala, an authoritative voice in the field of European studies, claimed their edited volume is at its best where it discusses infrastructures (Puchala 1999), namely in the chapters on telecommunications (Sandholtz 1998) and aviation (O'Reilly and Stone Sweet 1998).

Stone Sweet and Sandholtz more or less exclusively focus on the EU. Yet, not all regulatory regimes seem to be completely steered by the EU only. As Helen Wallace has observed, 'the EU is only one, even if by far the most invasive, arena for building European policy regimes' (Wallace 2000b). A. R. Zito shows, for example, that in the specialised field of air pollution, the United Nations Economic Commission for Europe has played a primordial role in the set-up of a European regulatory regime in this field that involved the EU as well (Zito 2001). The need to explore alternative institutional settings seems a fortiori true in the case of infrastructure governance, a field that has a long history and has witnessed the dedicated interference of a whole parade of institutional actors over time (Vleuten et al. 2007). Several of these actors had a global rather than a European character. Therefore investigating the connection with what Stone has identified as 'global public policy networks' seems quite appropriate (Stone 2004).

Moreover, Stone Sweet and Sandholtz explicitly refer to work of Deutsch, who gives ample emphasis to the long-term dynamics in the formation of communities. Thus they make incursions into the historical realm. Nevertheless, the infrastructure related chapters on telecommunications and aviation fall short of taking a truly long-term perspective, both restricting themselves to the 1980s and thereafter. It begs the question what the impact has been of earlier flow increases (or decreases, which Sandholtz and Sweet do not address to any large extent) on the transnational infrastructure regimes.

To summarize the argument so far, there was a widely held conviction that material infrastructures and their associated flows were overtaking political structures, still dominated by the formation of the modern nation-state. The latter needed a substantial make-over to be able to facilitate infrastructures to realize their transnational potential. The response to this challenge was of a global nature in some circles, but of a macro-regional, European character in others. It pops the question: how may we think about the relationship between the global and the European? One view is to consider the European as an intermediary level or step between national and global arrangements. Barry observes, for example, that while technological zones clearly transcend national borders, they are nevertheless not global in their extension either.

The next two sections attempt to illustrate the interaction between European

and global transnational infrastructure regimes. The next section does so tentatively for the case of electric telegraphy. Telegraphy being a technology often linked to globalization, it is interesting to explore the European ramifications of its transnational infrastructure regime. The subsequent section contrasts the telegraph story with a small segment of the transnational infrastructure regime for road infrastructures. Its focus on the case of road traffic signs is revealing for the interactions between global and European levels it displays.

Electric telegraphy

Telegraphy has often been described as a technology in the service of ‘networking the world’. A key characteristic of the available historiography on the development of the telegraph is therefore its connection to the process of globalization and global interconnectivity (Geyer and Bright 1995; Lyth and Trischler 2004; Schot 2007). Accounts putting the telegraph network of the 19th century on a par with the world wide web of the internet today further underline the encompassing universal character of the technology (Standage 1998; van der Woud 2006).³ It is important to note that a similar perspective also permeated contemporary accounts dating back to the heyday of telegraphy. They too generally underlined the global scope of telegraphy (Lenschau 1903; Heringa 1914).

This does not deny the important role of telegraphy in processes of state and nation-building. Eugen Weber demonstrates the considerable impact of the technology for France. In the period 1851–1855 all prefect seats were linked to Paris by electric telegraph. He illustrates the tremendous growth in the use of telegraphy by indicating that in the Tarn the number of telegrams jumped from 663 in 1859 to 140,000 in 1897 (Weber 1976).⁴ The effects were rather more dramatic in states characterized by a large degree of internal diversity and huge marginal hinterlands. Todd Diacon beautifully captures the process by recounting the epic story of the construction of a telegraph line through the Amazon Basin (1906–1930) as part and parcel of the long-term effort to incorporate indigenous people into the Brazilian nation. The construction of wires connecting Brazil’s coastal core and the vast rainforests of its interior thus became an attempt to ‘string together a nation’, hinting at the huge difference telegraphy could make in this respect (Diacon 2004).

Additionally, telegraphy was used to enhance the geopolitical position of nation-states (Hugill 1999). This element returns explicitly in the literature on teleg-

3. Van der Woud also includes steamships and railways in his term *wereldwijd web* (world wide web).

4. Worldwide the number of telegrams grew from less than 30 million in 1870 to over 300 million by 1900 (Mattelart 2000).

raphy in relation to 'new imperialism'. Daniel Headrick devotes ample attention to how the telegraph made the colonial enterprise cheaper and enabled more direct forms of control (Headrick 1988). In a similar vein, Niall Ferguson answers the question, 'How did the Victorians do it?' ('it' referring in particular to domination of the Indian sub-continent by only a couple of thousands of Britons) in a threefold way: the steamship, the railway and, last but not least, the telegraph. In addition to enabling more direct forms of control, the telegraph heightened interest back home in what was happening in the colonies. Ferguson suggests queen Victoria herself only developed an interest in foreign affairs outside Europe once her residence was equipped with a 'Queen's telegraph office' (Ferguson 2003). It has brought Armand Mattelart to characterizing the British empire as the 'empire of cable' (Mattelart 1996).

The gist of this literature is to highlight the strategic importance of (submarine) telegraph cables, British dominance, and mutual mistrust on the international scene eventually leading (at least in part) to a costly duplication of telegraph lines, later attenuated by the emergence of wireless communications after the turn of the century (Headrick 1988; van Laak 2004). British dominance in the earlier 19th century gave way to Anglo-American dominance from the 1890s onwards, though we should not underestimate the capacity of smaller states to bend dependence upon their territories for landing cables to their relative advantage (Hugill 1999; Silva et al. 2006). The history of the telegraph is thus reduced to a sequence of obligatory passage points, the historical moments marking the spectacular development of telegraphy in the 19th century. They include the Dover–Calais connection in 1851 (after an unfruitful try in 1850), the first Transatlantic cables in 1858 (which ceased to function after a couple of months), and a second Transatlantic attempt in 1866 resulting in a more functional exemplar.⁵ Such a perspective turns the Pacific Ocean into a kind of final frontier, conquered by the cable in 1902 (Lenschau 1903; Heringa 1914).

But was electric telegraphy truly global? The available statistics suggest rather that the bulk of the traffic crossing national borders remained quite close to home. Data for international flows going to and from the Netherlands illustrate this clearly. Over 90 percent remained within the European continent (see Table 3.1). The data from the Netherlands supports the argument that we should develop different ways of thinking about telegraphy to grasp its not-so-global meanings. Based on the data, it seems particularly fruitful to study its European ramifications. Recently scholars have started to dig into this subject matter from a European angle (Labo-

5. Despite the disfunction of the 1858 cable, it was nevertheless considered the 'cable that sprouted globalization', and 1858 was taken as benchmark for festivities in 2008 to celebrate 150 years of Transatlantic telecommunications (Schrijver 2008). It remains to be seen what will happen in 2016 in this respect.

Table 3.1: International telegram outflows from The Netherlands, 1913

Continent	Country	Telegram	Share (%)
Europe		1,528,911	91.85
	Belgium		15.00
	France		7.00
	Germany		35.00
	United Kingdom		27.00
	Other countries		16.00
Americas		193,237	5.49
Asia		7,326	0.22
Africa		86,629	2.40
Australia		1,248	0.04
Total		1,817,351	100.00

Source: Heringa 1914.

rie 2006; Wobring 2007). The International Telegraphy Union (ITU, 1865)⁶ established an explicit European regime as separate from an extra-European regime at a conference in Berlin in 1885 for the purpose of rate application (Coddington 1952). Henceforward the statistics the ITU published annually display this differentiation. As Cris Shore has remarked in the context of the EU,

[Euro-statistics] are not only powerful political instruments for creating a knowable, quantifiable and hence more tangible and governable. . 'European space': rather, they are also powerful moulders of consciousness that the meta-classifications within which identities and subjectivities are formed. (Shore 1999: 31)

Electric telegraphy thus demonstrates that the 'invention of Euro-statistics' was not restricted to institutions as explicitly European as the EU, nor that it was restricted to the period after the Second World War. It also happened at the headquarters of the ITU in Geneva, where the difference between the European and the non-European world was accentuated in statistical yearbooks in which they were a seemingly unnecessary element. It is not the intention of this paper to contribute to the 'progressive story of European integration' inevitably leading to that process to take place (Gilbert 2008). The point here is not to demonstrate that European integration also took place in telegraphy in the 19th century or to provide the current EU with roots in that epoch. Instead, the point is to broaden our understand-

6. The ITU was renamed International Telecommunications Union in 1932.

ing of what European integration means when we look at it through the lens of technology in a long-term perspective (Misa and Schot 2005). Electric telegraphy is a promising case to study in that respect.

Roads

Where the invention of the electric telegraph (and other types of telegraphy, for that matter) can be clearly tied to particular dates in the not-too-distant past, it is generally thought that roads have prehistoric roots and thus antedate history itself (Lay 1992). This paper discusses only a tiny part of the long history of roads emerging in modern times as part of the transnational road regime: road traffic signs. It does so because this particular case is able to illustrate how parts of transnational infrastructure regimes may transfer between local, national, European and global levels.

Road traffic signs today display a staggering variety of shapes, colours and symbols (Colors Magazine 2004). Tim Edensor has linked this variety to national identities, identifying traffic signs and driving practices as part of national motor-scapes or roadscares that have organically grown in respective nation-states, while between nations important differences in roadscares have remained. As soon as we cross a national border, we all of a sudden become aware of international differences, and of the naturalness of our own roadscape (Edensor 2004). Edensor's characterisation is not entirely adequate for two reasons. First, by overly zooming in on national differences he downplays the essentially local origins of traffic signs in an initial stage. Municipal authorities introduced signs to solve specific urban traffic problems experienced in their respective towns and cities. Edensor suggests a degree of national homogeneity that was not always supported by the sheer variety in local solutions and thus within-nation divergence. Second, municipal authorities did not pick their solutions in splendid isolation either. Some municipal authorities were very well-connected nationally and internationally. Through their contacts they could share experiences and get inspired by choices made elsewhere (Saunier 2002). As a result of that, traffic signs look more similar today across the globe than they have perhaps ever done, despite the differences that remain.

At an early stage of the development of motorized traffic, themes relating to road safety became the object of international negotiations through the dedicated work of international organizations representing the interests of motorists from the late 19th century onwards. Among the first was the Ligue internationale des associations touristes (LIAT), an alliance of touring associations founded in Brussels in 1898. In 1900, Paris hosted the first Congrès international d'automobilisme, coinciding with the World Exhibition in the French capital (Flonneau 2005). In

the wake of these events the city became the seat of the Association internationale des automobile-clubs reconnus (AIACR, 1904), and the Permanent International Association of Road Congresses (PIARC, 1908).

The international standardization of traffic signs for motorized vehicles was taken up in this institutional setting. In 1900, the touring clubs decided on three standardized designs for road warning signs, and added a fourth in 1902. National clubs and companies like Michelin initially produced the signs and put them along the road. Typically clubs put their names on the signs they sponsored to advertise themselves. (Merki 1998, 2002). The four signs served as input for the first international conference dedicated to motorized traffic and involving government representatives in Paris, 1909. The Convention resulting from the conference re-confirmed the four road signs in its Annex D. The outcome defied the changed opinion of the touring clubs, adopted at a 1908 conference in Stockholm, that a single danger sign was preferable, but the AIACR and the Touring club italiano successfully opposed this position (Mom 2007). The groundwork for the standardization of road traffic signs had been laid.

After the end of the First World War, the League of Nations started to absorb the work done previously. Its specialized Advisory and Technical Committee for Communications and Transit (CCT) considered organizing a conference to revise the 1909 Convention on Motor Traffic in 1924. To draft the revision it appointed a Committee of Enquiry for Road Traffic chaired by Dr. A. Stiévenard, inspector of the Belgian Railways (CCT 1924).⁷ The discussion on revision included deliberation on the benefits and drawbacks of the 1909 system and the alternative that was by then used across Scandinavia of a single sign for all dangerous traffic situations. The four signs of the 1909 Convention warned road users for uneven roads, sharp turns, level crossings and dangerous crossroads. The Swedish government had informed other signatories of the 1909 Convention of its intention to establish a red triangle as a unique danger sign (see Figure 3.1). O. Bilfeldt informed the session that the automobile clubs of Denmark, Finland and Norway had also embraced the red triangle. E. Mellini coldly received the proposal, remarking it had taken Italy ten years to introduce the 1909 signals. Any change implied considerable costs for replacement and take a similarly long time to implement. The Committee decided to retain the four signs, adding to them a fifth featuring a locomotive to indicate unguarded level crossings, which were increasing in number due to the abolition of gates across Europe (Road Committee 1924: 12).⁸

7. The other members were F. Amunátegui (Chile), O. Bilfeldt (Denmark), E. Chaix (Automobile-club de France and AIACR), E. Delaquis (Switzerland), P.C. Franklin (United Kingdom), E. Mellini (Italy), F. Pflug (Germany), J. Romein (Secretariat) and J.F. Schönfeld (Netherlands).

8. The original article had already stipulated that 'Governments of the Contracting States may agree in common to modify this system of notices.' As advantageous additions to the four-sign

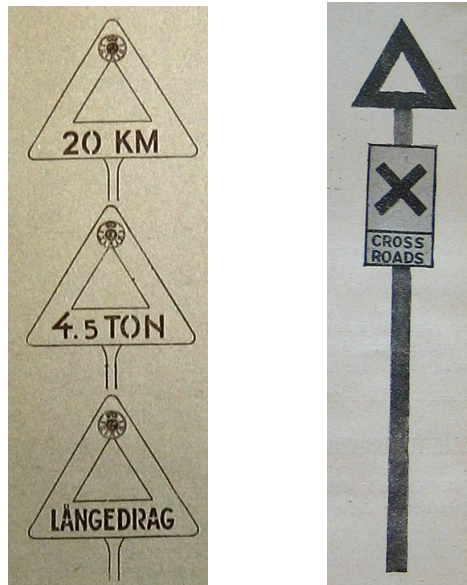


Figure 3.1: The Scandinavian red triangle (K.A.K. n.d., left; Vandone 1921, right). The signs on the left displays three variants of the unique red triangle used in Scandinavian countries, indicating a 20km speed limit, a 4.5 ton weight limit and a town name. The small symbol in the top of the triangle was the emblem of the Swedish Royal Automobile Club. The sign to the right shows the same triangle as it was used in Great Britain; the international sign for a (dangerous) crossroads was attached to the pole underneath the general danger triangle.

The discussion returned in March 1925. The representative of the International Federation of Professional Motor-car Drivers, A. Förstner, absent at the first session, indicated the 1924 International Drivers Conference had proclaimed that the signs adopted in the 1909 Convention to be excellent. To accommodate the different opinions Pflug proposed to add the Scandinavian triangle to the list of international signs, to be used for dangers not covered by the other signs. On behalf of the Nordic countries, Bilfeldt wholeheartedly supported the proposal and the amendment was adopted (Road Committee 1925: 8). Undeterred by this discussion, the Scandinavian states proposed the use of the red triangle as a unique danger

system it suggested a sign to indicate a customs house and one ordering a halt, see article 8, 1909 Convention.

sign again at a meeting of the Conseil central du tourisme international in October 1925, where they walked out when their fellow participants refused to accept the proposal (Road Committee 1926).⁹ Eventually the proposals for revision with regard to traffic signs were adopted at a conference in Paris in 1926 to revise the 1909 Convention, increasing the number of international standardized signs to six.

Road signs reappeared when the Road Committee took up its work after the Paris conference. A guiding principle in its work on traffic signs was to prevent introducing too many, as this would distract the attention of drivers and thus create new dangers (Road Committee 1927b: 3–4). The discussion concentrated on shapes and colours. National practices with regard to colours varied considerably (see Table 3.2). With regard to shapes, the triangle indicated dangerous traffic situations, conform the stipulations of the 1926 Convention on Motor Traffic. For speed limits the Committee recommended the use of rectangular plates. All other signs should have a circle of 60cm in diameter (Road Committee 1927a: 3–5).

Table 3.2: Road signal practice in various European states, 1927

Country	Colour signs	Background colour	Rationale
France, Italy	White	Dark blue	Visibility, durability
Germany	Black	White, red edges	Most conspicuous
Switzerland	Black	White	—

Source: Road Committee 1927a: 4.

In addition the Committee debated the use of signals by drivers and by officials directing traffic, and mechanical devices replacing them, namely headlights and traffic lights. Concerns about safety were especially acute in urban settings, but with regard to local circumstances the Road Committee was ambivalent. On the one hand local caprice should not create too much confusion for road users, on the other hand it was necessary to adapt traffic regulations to local circumstances. The discussion on road signs illustrates the former position clearly. The Committee wanted to ensure a minimum degree of coherence in urban traffic signs. First, road safety would be best served if road signs were intelligible for foreign visitors. Second, although there were costs involved in harmonizing signs, the sooner it was done, the lower they would be, for the simple reasons that when more signs had been put up at a later stage more had to be replaced. To increase the chances of

9. The Conseil central du tourisme international had been founded in 1925 as a cooperative body between the automobile and touring clubs (ait 1998).

success of the meeting on which the Road Committee discussed the signs, Dr. De Schulthess, representative of the International Union of Towns, joined the Committee's deliberations at its fifth session (Road Committee 1927b: 1).

The discussion on speed limits illustrates the latter position concerning the need to adapt to the local traffic situation. In an emotional letter on behalf of the Society for the Protection of the Public against Dangerous Driving and his own Vienna-based Association for the Promotion of the Safety of Traffic,¹⁰ Dr. S. Stimmer described a drastic cutback of the maximum allowable speed as the most pressing need for unifying European traffic rules (Stimmer 1927). In his view, the absence of a general limit to reckless speeds was the disturbing cause for the horrifying regularity of severe accidents. Smelling trouble, Committee member Crespi wrote Romein that as far as the automobile-clubs were concerned introducing such measures limited human progress. Crespi squarely denied automobile traffic caused more death on the road than other non-motorized traffic. Improved braking systems further diminished the need for a speed limit (Crespi 1927).

The Committee unanimously expressed the conviction that local authorities should always remain completely free to adopt the speed limits they deemed appropriate given specific local circumstances. With regard to a general European speed limit the Committee was split. Some believed introducing an absolute speed limit in addition to local restrictions would be a good thing at the national, not the European level. Others objected that speed was but one of several factors contributing to the occurrence of accidents. The Road Committee could therefore only agree on the requirement that drivers should remain in control of their vehicles at all times, and on standardizing the road signs indicating local restrictions to speed (see Figure 3.2) (Road Committee 1927b: 10–11).

The next stage in terms of the standardization of traffic signs came in 1931 at the European Conference on Road Transport, where traffic signs were one of the major topics that were being discussed. Preparation of the theme had been entrusted to a committee chaired by the respected M.A. Stiévenard. The discussion of the committee went smoothly, suggesting there was broad agreement on the aims to be achieved. The major driving force was that not agreeing on internationally standardized signs might lead to chaos in road signs among countries. At the same time participating countries guarded against adopting too many signs, so as not to confuse drivers. Ultimately, though, the individual states retained a certain degree of liberty to introduce new signs as they deemed fit (LoN 1931a: 86, 103, 106).

The resulting convention divided signs in three categories, each with an exclusive shape. Triangular signs indicated dangerous situations, obligation signs were

10. Gesellschaft zum Schutze der Bevölkerung gegen die Ausschreitungen des Automobilmus and Verein zur Förderung der Verkehrssicherheit respectively.

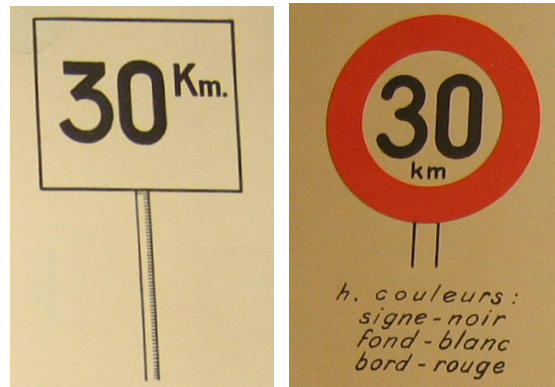


Figure 3.2: Road sign prohibiting speeds over 30km (LoN 1930: 11; LoN 1931a, between 114 and 115). The picture to the left represents the rectangular sign as initially proposed, the picture to the right the sign as eventually adopted at the 1931 conference, replacing the rectangular shape of the speed limit sign with a round shape (LoN 1931: 88).

circular, and rectangular signs gave indications. In terms of color use, the convention stipulated the color red should predominate in signs indicating any kind of prohibition. The AIACR had an important role in drafting the convention presented at the conference. The final version the Conference adopted hardly differed from what the AIACR had proposed (Perón 1931). Signs did not become uniform all across Europe; but a short glance at the many available alternatives shows the tremendous scope of the reduction of existing differences (LoN 1931a: 9).

The 1931 Conference formed the high mark of attempts to standardize road signs at an international level during the Interwar Period. Several states that had not signed the Convention on Road Signs did apply its signs. By the late 1930s, this was the case for Belgium, Czechoslovakia, Denmark, Germany and Yugoslavia (see Figure 3.3). The conference had firmly fortified the existing framework for the discussion and adoption of internationally agreed signs. During the next years, the collection of signs expanded with new ones, such as those prohibiting overtaking or the use of sound signals (CCT 1935).

The set of road traffic signs emerging out of the work of the League of Nations thus acquired a distinctly European character. This was not only the case for road traffic signs, but for the League of Nations' dealings with road transport in general, and to a very large extent for all of its work concerning communications and tran-

of them was a European Agreement supplementing the 1949 Convention on Road Traffic and the 1949 Protocol on Road Signs and Signals (Anonymous 1958).

The European Agreement supplementing the 1949 Protocol made its facultative signs obligatory and added some extra ones. The results of the implementation of the latter were hailed as a great help to the international tourist (Merlin 1956). In the early 1960s, the ITC started to draft a new European Agreement as an accessory to the 1949 Convention and Protocol (ECE 1964). However, in May 1965 the ECE noted, 'a European agreement of this nature could only supplement these texts, whereas some of their provisions require revision' (ECE 1965). With a request to ECOSOC to convene a revision conference no later than 1967, the ECE catapulted the issue to the global level, a suggestion ECOSOC readily took over. The ITC prepared the basic document for submission to the conference (ECE 1966).

The revision process reached its apogee with a month-long conference in Vienna lasting from 7 October to 8 November 1968. Two legal instruments were signed in the Austrian capital. The Vienna Convention on Road Traffic replaced the 1949 Convention. Among other things it stipulated the mutual recognition of the legality of vehicles of other signatory states as long as they displayed a registration number in the front and on the rear, and carried the standardized sign indicating its country of origin. The Vienna Convention on Road Signs and Signals replaced the 1949 Protocol. The ink of the Vienna Conventions was barely dry or the ITC started to discuss a European Agreement supplementing them. On 1 May 1971, it concluded the European Agreement supplementing the 1968 Convention on Road Traffic, and the European Agreement supplementing the Convention on Road Signs and Signals (ECE 1969).

An interesting pattern thus becomes visible. Some regulations already in force for international road traffic in Europe moved to the global level in the post-war period; but agreement on a worldwide basis came at the price of watering them down. European countries did not always deem this outcome satisfactory enough (Vonk 1950). As a solution they opted for adding European Agreements to worldwide instruments. Thus the European situation remained slightly different from the global one.

Conclusion

Infrastructures need dedicated work to allow them to function across borders. In this chapter, the set of rules and regulations affecting how infrastructures function across borders is labelled 'transnational infrastructure regime'. The chapter seeks to understand at what level such regimes materialize, focussing in particular on European and global levels. The material presented in this chapter seeks to demonstrate

that shaping transnational infrastructure regimes happens at these levels simultaneously, and specific policy measures may move from one level to another. We should not think of global and European levels as mutually exclusive in this respect.

The telegraphy case shows that a technology with strong global connotations has also been appropriated in specifically European ways, making it legitimate to distinguish a European level in addition to the global one on which the regime for this technology is also located. It shows that in order to understand certain infrastructures governed by transnational infrastructure regimes with a clear global scope, it may also be necessary to research its European equivalent to understand them more fully. In other words, we need to move from the global to the European in this particular case.

The case of road traffic signs indicates that a reverse direction is possible as well. The transnational regime relating to this particular part of the complex whole of (road) transport rules and regulations moved from the European level up. Rules concerning road traffic signs had a proto-European character around the turn of the century and at the 1909 Paris Conference. This organically grown situation was strengthened during the Interwar Period to reach its European apex in 1931. At a conference for which participation was explicitly restricted to European member states of the League of Nations an explicitly European set of signs was adopted—and gradually spread over the continent. This European outcome moved to the global level at the road transport conferences in 1949 and 1968.

The contrast between these two cases suggests we should not view infrastructure technologies simply as either contributing to networking the world or to networking Europe. Both levels work at the same time, and their strength varies over time. It is for the historian to investigate the related fluctuations in time and cross-fertilization taking place.

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Infrastructure and the international governance of economic development, 1950–1965

William J. Rankin

Only in the context of international debate about economic development after Second World War did the term infrastructure become a label for the technical-political systems required for growth and modernity. This chapter traces the intellectual and institutional roots of the category of infrastructure in the development debates of the 1950s: its affinity with the earlier idea of social overhead capital and its mobilization in the conflict between the United Nations and the World Bank surrounding the financing of development investment. I argue that debates about development aid shifted attention from an economic definition of infrastructure towards one framed more in terms of general prerequisites. Analyzing this expansive category of infrastructure, which remains largely in place today, gives insight into the territoriality of the post-colonial world and challenges exclusively physical or engineering-based ideas of infrastructure.

What does it mean to write the history of infrastructure? One approach is to write the separate histories of all those infrastructures that have come to have such importance for modern society, starting with canals and waterworks and ending with fiber optics and the immaterial cyberinfrastructures of the internet. This approach, however, takes for granted the idea that infrastructure is a coherent and stable historical object, that infrastructure is a neutral way of describing certain engineering works, regardless of historical period. What if we took the very idea of an infrastructure as a historical problem, and asked not how the infrastructures of the past were organized, but how things like roads, telecommunications, and power came to be seen as similar kinds of things, parts of the coherent bundle we now call infrastructure? As part of a reflection on the internationalization of infrastructures, I think this question is especially relevant, since analyzing the intellectual history of infrastructure shows it to be closely related to new kinds of international collaboration, in particular the practice of economic development aid after Second World War.

A central point here is to see infrastructure as a quasi-philosophical concept.

Even though it often seems merely a simple label for certain large-scale systems of transportation and communication, I want to focus less on which things are labeled as infrastructure than on how the category is defined and understood. Infrastructure involves a separation of human activity into two categories: the supportive and the supported. The boundaries of infrastructure are thus defined in terms of a vertical, gravitational metaphor: infrastructure is fundamental, basic, foundational, and it is as necessary for its superstructure as a solid foundation is for a building. Karl Marx used a similar metaphor for describing society in general, where an economic base determines the nature of the cultural-political superstructure.¹ The modern category of infrastructure, however, is more complex than this, as it blurs the distinction between physical and metaphorical support. The support provided by railroads and hydroelectric plants is undoubtedly metaphorical, yet immaterial infrastructures (such as standards) seem in turn to refer, metaphorically, to the physicality of steel and concrete.

Note how different this is from the horizontal metaphor found in networks: even though an electric grid can be seen both as a network and as infrastructure, as a network it is defined by connections and pathways through which something circulates, while as infrastructure it is defined by its supportive relationship to other economic activities (Dupuy 1988; Curien 1993; Offner 1999). Although network effects can lead to the same conditions of natural monopoly found in many infrastructures, they are philosophically quite different. Economically, too, they are defined by different considerations of cost, price, scale, and relationship to the state.

Infrastructure is also quite different from other categories which happen to label many of the same things—categories such as public works, public utilities, or natural monopoly. Without too much simplification, one could distinguish these categories by their associated economic variable. Public works, for example, is largely a question of labor—labor deployed by the state, especially in times of crisis. Public utilities are a question of price: a way of justifying price regulation to ensure that socially sensitive services are not interrupted by cyclical economic fluctuations. Natural monopolies, in turn, are a function of the supply–demand curve (Robinson 1928; Porter 1995; Mosca 2006). In contrast, the category of infrastructure has its roots in a debate about cost, where the business logic of overhead accounting came to be applied to entire national economies.

The question of cost is also what separates the modern concept of infrastructure from earlier uses of the word. The word infrastructure, as others have pointed out, can be traced back to French railroad engineering in the late nineteenth century,

1. Marx used the terms *Basis* and *Überbau* in the foreword to his 1859 *Zur Kritik der Politischen Ökonomie*. Beginning in the late nineteenth century, *Basis* was sometimes translated (somewhat incorrectly) into French as *infrastructure*.

and infrastructure was an important category in French, in a variety of domains, long before it began to be used in other languages after 1950 (Laak 1999).² But nowhere in these earlier uses of infrastructure can one find the idea that large-scale engineering systems, especially those of transportation and communication, together constitute a supportive base for other kinds of economic activity. It is only in the 1950s discussion about international financing for economic development that infrastructure becomes recognizable as a concept relating engineering to larger socioeconomic concerns.³

I have two goals in this chapter. First is to sketch how the concept of infrastructure emerged from intellectual and institutional debates about development. I argue that infrastructure should be understood as the reification of the concept of social overhead capital used by development economists, and that this reification took place as a result of a struggle over the financing of international aid, with the United Nations (UN) and the World Bank as the major players. Second, I want to argue that we should take the link between infrastructure and early development economics quite seriously, to see infrastructure codifying and reproducing certain ideas about the role of the state, territorial sovereignty, and socioeconomic modernization. In short, I want to suggest that infrastructure be understood as an inherently international category. Or better still, as a post-national one—one signaling the increasing misalignment between bounded geographical units, cultural groups and economic markets.

Early development economics and social overhead capital

The category of infrastructure only began to be used in development economics near the end of the 1950s; its immediate predecessor—and in many respects its direct synonym—was the notion of social overhead capital, which came into wide use in the early part of the decade (Greenwald 1965). Social overhead capital, as the phrase implies, refers to capital that is not attributable to any one productive activ-

2. Dirk van Laak focuses on railroad engineering. In addition to railroading, where it was in use by the late 1860s, the word was also used in geology, archeology, aviation, and maritime engineering to mean literal substructure. It was used metaphorically in many areas, including philosophy (especially in discussions of Marxism), political science, and psychology.

3. Based on searches of full-text newspapers, periodicals, and books. The closest relatives to modern ideas of infrastructure in French are found in general discussions of the foundations of society and government (from the late 1930s) and in the coordination of various engineering systems for aviation (from the late 1920s). The term infrastructure was also used by the Western European Union and North Atlantic Treaty Organization (NATO) (in French and English) to refer to their coordinated heavy-construction programs in western Europe, from roughly 1949. In the popular press, however, this was seen as NATO-jargon, and in English-language discussions of development the word was treated again as a neologism in the late 1950s.

ity (hence overhead), and is shared between many individual enterprises (hence social). It initially referred mostly to systems of transportation, communication, and power, but by the mid-1950s it was being used to label many other systems that fit the same logic, including education, government services, and even the rule of law. The idea of social overheads can be traced back at least to the 1920s, but in development economics it took on a new importance through its relation to capital, especially in the work of the World Bank and the modernization theory of writers like Walt Rostow.

The first important point about social overhead capital is that it did not originate from within academic development economics. Early development theory is often portrayed as infrastructure-centric; if there is a single theory that stands for the economic thought on development in the 1950s, it is the ‘big push’, where a huge infusion of lumpy infrastructure capital is seen as necessary for overcoming the vicious circle of low productivity, low savings rate and low investment thought to exist in underdeveloped countries. This theory is most closely associated with the work of Paul Rosenstein-Rodan, especially his 1943 article on industrialization in eastern Europe, but the contemporary work of Eugene Staley or Kurt Mandelbaum is seen as espousing a similar view (Arndt 1973; Meier 2005). Reading this work from the early 1940s, however, it is difficult to find any great interest in what was later called infrastructure. All these authors call attention to basic services like roads or power; but it would be more apt to characterize this early work as a call for overall central planning, rather than the kind of infrastructure-type investment typical of development work in the 1950s. Mandelbaum’s interest in basic services, for example, is essentially a call for Keynesian deficit spending, while Rosenstein-Rodan is in fact quite critical of the idea of basic industries altogether. The conclusion of his 1943 paper is instead that the entirety of east and southeast Europe should be treated as one large corporation—what he called the Eastern European Industrial Trust—and subjected to total planning. In his paper, infrastructure industries like transportation or power were treated very similarly to productive or service industries; the goal was overall balance of all sectors (Rosenstein-Rodan 1943; Mandelbaum 1947: 5).

Evidence suggests that the idea of social overhead capital emerged instead as a kind of working theory among the staff of the World Bank. As Albert Hirschman—one of the most prominent critics of early development thought—put it, social overhead capital ‘can be operationally defined as comprising those activities for the financing of which the [World Bank] shows a pronounced preference, just as the behavioral sciences have been said to comprise all those endeavors which manage to obtain financial support from the Ford Foundation’—and indeed many of the earliest articles to use the phrase in the 1950s were written by World Bank staff

(Adler 1952; Hirschman 1958: 83). Famous for its resistance to academic economics in its early years, the appeal of the Bank's idea of social overhead capital was not its logic—which, Hirschman argued, was 'far from compelling'—but rather its usefulness as a heuristic for justifying how Bank funds were being used. This post-hoc theorization is not surprising, since during its first decade the Bank's greatest concern was the viability of its bond issues and its credibility with the private banking establishment in the United States. As an institution staffed almost entirely by Americans, and headquartered in Washington, DC, it was also careful to avoid any projects that suggested state ownership of industry. Thus almost by necessity, its early development work was focused on discrete projects that seemed somehow 'public,' but could be evaluated using the typical tools used by bankers—projects like railroads, power plants, or irrigation (Mason and Asher 1973).

Despite the Bank's own statements about the importance of private enterprise over state-controlled industrialization, however, its emphasis on social overhead capital suggests that its political-economic assumptions were not terribly different from those of the more radical planners. Indeed, the Bank's counterposing of 'national overhead' to 'directly productive activities' indicates a predilection for seeing the state as a business rather similar to Rosenstein-Rodan's call for a single Eastern-European trust. The difference was not the nature of the state, but simply the role of government: if the solution to industrializing 'backward' areas was to treat entire countries or regions as one large business, the World Bank positioned itself (and its recipient governments) as top management; private enterprise would be responsible for day-to-day operations. Social overhead capital was thus a way of marrying the central-planning focus of economists like Rosenstein-Rodan with a post-Keynesian division between public and private.

The reason I stress this affinity between social overhead capital and anti-liberal concepts of the state is not to suggest that it signalled a great departure from contemporary notions of public and private; but to highlight the fact that thinking in terms of social overhead is not a neutral political-economic stance. Prior to the early 1950s, the most thorough treatment of the larger economic implications of overhead was John Maurice Clark's 1923 book, *Studies in the Economics of Overhead Costs*; his chapter on the 'Costs of Government as Overhead Outlays' makes this point quite clear. As Clark put it, to 'think . . . of the nation as a business house' means to 'disregard the traditional boundaries between the private and public economies' (Clark 1923: 451–2). Instead of seeing a separation of political and economic spheres, one would be compelled to 'regard government as a productive economic agency of a vital sort, a partner of industry, provider of some of the most vital factors of production' (Clark 1923: 453–4). This is more than a call for regulation, deficit spending, or government provision of public works; it is a realignment

of public and private around questions of cost, where public refers to those costs for which social return exceeds private return.⁴ Perhaps most interesting here is that in the dozen or so examples that Clark gives of social overheads, only one—roads—has anything to do with construction or large-scale engineering.

What separated the World Bank from earlier writers like Clark was the idea that social overhead was not just a kind of cost, but a kind of capital. Indeed, the reputation of the 1950s as the decade of infrastructure largely stems from the Bank's ongoing focus on large-scale construction works at the expense of agriculture or social programs. In general discussions of development, however, writers began to slide between 'social overhead capital' and 'social overhead' as if they were the same thing, and by the mid-1950s the cost-accounting logic of overhead came to problematize the Bank's own emphasis on physical construction. Just as Clark had included traffic regulations, census statistics, and pure-food inspections in his list of government overheads, writers on development began to see things like agricultural research and primary education as potential sites of investment—as types of capital. In a 1953 review of the World Bank's development plan for Mexico, for example, social overhead was taken to include not just transport and power, but also education. Similarly, an analysis of the Japanese legacy in Formosa, also from 1953, included maps and geological surveys as social overhead among a longer list of physical engineering works (Ginsburg 1953; Mosk 1953). Overhead, in other words, soon exceeded the bounds set for it by the World Bank.

The clearest installation of the idea of social overhead capital into development theory is found in the work of Walt Rostow, the most prominent of the modernization theorists of the 1950s and 1960s (Gilman 2003). In his 1956 article on 'The take-off into self-sustained growth,' which introduced the staged theory of development later made famous by his 1960 book, a certain amount social overhead capital—in transport, power, education, etc.—is seen as necessary for moving from the stage of preconditions to the stage of take-off. It is in Rostow, much more than Rosenstein-Rodan or even the Bank, that we find the idea that large overhead outlays—what he calls 'lumpy overhead capital construction of long gestation period'—must precede development, and that 'it is the inescapable responsibility of the state to make sure the stock of social overhead capital required for take-off is built' (Rostow 1956: 30, 40; Rostow 1960: 30). Rostow's main move is to transform what for Clark was largely a question in steady-state economics into a dynamic theory, with overhead being given temporal priority. Regardless of its merits as a theory of growth, the result of this is to make the overhead-productive distinction appear as

4. Social cost-benefit analysis was hardly new—it was, for example, the basis of Dupuit's 1844 analysis of public works. Mill justifies the overall role of the government in similar terms. Manuela Mosca (2006) gives other nineteenth-century examples. What distinguishes Clark and the idea of social overhead is its business logic.

one of scale and gestation period (that is, as quantitative properties of certain kinds of built works, railroads being Rostow's paradigmatic example) rather than as one of social cost–benefit analysis—despite the fact that he himself sees education as overhead capital.⁵

As an integral part of the debate on economic development, the idea of social overhead capital thus solidified two positions that are important for understanding the category of infrastructure. First, it encapsulated a particular theory of the state. The purview of the overhead state is not defined as a middle position between interventionism and laissez-faire—both of which imply a separation of political and economic—but in terms of economic factors alone. What this means, however, is that the political division between public and private becomes secondary to (and potentially misaligned with) the economic division between overhead and productive. (Privatized infrastructure is relatively common; private public works are a logical impossibility.) Second, in the practice of the World Bank or the writing of social scientists like Rostow, we see the cost logic of overhead intermingling with considerations of the scale, fixity, or physicality of capital. The temporal concern with prerequisites heightens this tension. What this means is that there were soon multiple ways of defining the boundary between overhead and directly productive costs: via ideas of public, social cost–benefit analysis, temporal priority, or the physical features of certain engineering works. Despite the basic business metaphor, social overhead capital was never strictly an economic proposition. Its ambiguities were reasonably apparent in the discussion of social overhead capital; with infrastructure, they are much less so.

Development institutions and the politics of infrastructure

At the same time that development economists began to suggest that social overhead was the key to economic growth, a much wider-ranging debate was taking place at the international level about the kinds of institutions best suited to administer aid. Just a few years after the 1946 creation of the World Bank at Bretton Woods, there were proposals from high-level committees in the UN and the United States for creating new organizations that could provide types of aid that the World Bank could not. These debates were largely triggered by President Harry Truman's 1949 Point Four speech about the need to spread science and technology to the underdeveloped world, but they lasted through the entirety of the 1950s, and it was only with the creation of the International Finance Corporation and the International Development Authority as part of the World Bank system, and the creation

5. Albert Hirschman (1958) makes a similar observation; he is especially critical of the idea that social overhead capital must necessarily precede other kinds of investment.

of the two predecessor organizations of the UN Development Programme, that the constellation of international development institutions that we know today was solidified.⁶

It was out of this debate that infrastructure emerged as the wide-ranging category I described in my introduction. The debate radicalized the ambiguities of social overhead capital, making infrastructure seem both more physical and more like a catch-all category of prerequisites. In particular, it was the subtle politics that took place between the UN and the World Bank about concessionary loans that reified social overhead capital into infrastructure, detaching it from a discussion within economics and replacing the business metaphor of overhead with a more straightforward metaphor of physical support.

The 1955 UN report that first introduced the French word *infrastructure* into the English-speaking development discourse was concerned with the viability of proposals to create a fund for financing economic development as part of the UN system. This proposed fund—known as Special United Nations Fund for Economic Development (SUNFED)—was designed to fill a gap in the existing landscape of economic development institutions. Dividing international aid into bilateral and multilateral, and likewise into market-rate loans and concessionary aid, there were institutions filling three of the four possible slots. The World Bank was a source of multilateral loans at market rates, and several countries had agencies for providing bilateral aid of all kinds.⁷ What was missing was a multilateral institution that could provide aid for worthwhile projects that could not satisfy the World Bank's criteria for a viable loan; this was the empty slot that SUNFED was designed to fill. One persistent source of controversy, however, concerned the appropriate form for concessionary aid: whether aid should take the form of 'soft' loans (loans made at below-market rates, or with extended grace periods and payback schedules) or should only be given as outright grants-in-aid. In the early 1950s, the Bank was vehemently opposed to soft loans, while many developing countries and UN officials preferred them as a way of avoiding the aura of charity that might accompany grants-in-aid (Caustin 1954; Mason and Asher 1973: 382–9).⁸

The use of the word infrastructure in the 1955 SUNFED report can be seen as

6. Naturally, organizations with more limited memberships were also important, notably the Organization for Economic Co-operation and Development Assistance Committee and the various regional development banks; non-governmental organizations have likewise become increasingly influential.

7. Notably the United States Export-Import Bank for market-rate loans, the various grants-in-aid programs of the US State Department and Mutual Security Agency, and the various funds and banks of the United Kingdom, France, and other colonial powers.

8. Another important point of controversy was about apportioning voting rights between donor and recipient countries, and the inclusion of communist countries (the Eastern Bloc did not participate in the World Bank or the International Monetary Fund).

an attempt to deflect this disagreement. Earlier proposals for SUNFED-like organizations had largely defined the role of the proposed fund in terms of financing. The problem, as they identified it, was that worthy projects which were non-self-liquidating or whose rate of return could not support a market-rate loan were being left unfunded. Defined in this way, there was no way to avoid a confrontation with the World Bank (UN 1951: 84–6; UN 1953: 6). The 1955 report, however, defined the role of SUNFED not in terms of a lack of financing, but in terms of a lack of results—namely, the lack of an ‘economic-social “infrastructure”’ in underdeveloped countries. The report explained:

It would be . . . wrong to consider that the Fund’s essential mission would be to finance non-self-liquidating investments and not potentially self-liquidating investments. From the general economic point of view, all infrastructure investments, whether social or economic . . . are directly or indirectly self-liquidating, since they all contribute to the short-term or long-term development of the country. (Sheyven 1955: 3–4)

What was missing from the array of existing funding agencies, in other words, wasn’t a particular kind of concessionary financing—grants, soft loans, or some combination of the two. What was missing was a fund ‘that would make possible the financing of infrastructure investment,’ regardless of the particular means employed (Sheyven 1955: iii).

There is no reason to think that the authors of the report were trying to use infrastructure in a new way.⁹ Indeed, their understanding of infrastructure is quite similar to what we find in reports of the French colonial development program, where infrastructure referred specifically to a set of material objects (railroads, highways, ports, etc.) that together created a base for other economic activity (Commissariat général 1949: 9). But given the overall shift in the late 1950s towards thinking about development in terms of human beings—not just the increasingly expansive definitions of social overhead capital, but the influence of the UN Technical Assistance program or Theodore Schultz’s work on human capital as well—discussions of infrastructure very soon came to blur the boundary between material objects and social services in a similar way to Rostow. In a newspaper editorial about SUNFED, for example, a UN official included health and education as the first items in a list of the ‘economic and social infrastructure investments’ to be supplied by the proposed fund (Seynes 1956).

SUNFED never did get created, but its failure actually pushed the idea that infrastructure was a category of general prerequisites, rather than simply a synonym

9. The section on infrastructure was written by Raymond Scheyven, a conservative Belgian banker-politician, and Jan Tinbergen, a Dutch economist.

for equipment or public works. In 1957, the United States brokered a compromise which created a UN fund for more targeted types of technical assistance; it was known as the Special Fund; but it had no mandate for capital investment (Bhuraskar 2007). This move had two immediate consequences. First, it prompted UN economists to frame the work of the new Special Fund in terms of non-material types of infrastructure. Especially important was Hans Singer's idea of 'preinvestment infrastructure'—'the human, technological, and data infrastructure' that could be created by the various UN programs of training and research (Singer 1964: 21). Similarly, since many development pundits were unsatisfied with the Special Fund as a solution to the problem of concessionary finance, the continued calls for a new kind of institution also made use of a combined human–physical idea of infrastructure. The development administrator Robert Jackson framed the need for an International Development Authority in terms of both physical infrastructure and human infrastructure, while Barbara Ward called attention to India's need for an 'infrastructure of transport, power, education, and so forth' (Jackson 1958: 55; Ward 1961: 130). Singer was explicit in linking these expansive ideas of infrastructure to the popular success of Rostow's take-off theory, arguing that both Rostow's 1960 book and the creation of the Special Fund were symptomatic of an increased emphasis on prerequisites, both human and physical, and a shift towards seeing the condition of underdevelopment as a temporal problem where different kinds of infrastructure were necessary at different stages (Singer 1960: 69).

By the beginning of the 1960s, the concept of infrastructure was ubiquitous in discussions of economic development—much more so than social overhead capital had ever been. It was used in newspapers and popular journalism, in scholarly writing, and in the official development plans created by individual countries or the World Bank.¹⁰ For economists, social overhead capital and infrastructure were essentially the same thing; they both inhabited the fuzzy middle ground between a static description of certain social costs and a dynamic understanding of the lumpiness and time-lag of certain large construction projects.¹¹ In non-specialist writing, however, infrastructure became simply a synonym for prerequisite, a way to label all those things lacking in the underdeveloped world—that is, everything separating the state of underdevelopment from that of modernity. Infrastructure thus came in many flavors: the UN constantly referred to 'economic and social infrastructure,' while social scientists discussed organizational, institutional, and sociological infrastructure (Myrdal 1960; Myint 1962; Krueger et al. 1989). Overall, the transition

10. By 1960, the word had been in use in English for a decade to describe the NATO construction program; it began to be more widely used after the UN General Assembly issued a resolution in late 1957 stressing the importance of economic and social infrastructure. The World Bank began using it in its country-analysis reports around 1962.

11. This is how it is used in World Bank reports, for example.

from social overhead capital to infrastructure—that is, the semantic shift brought about through the politics of international aid—subordinated economic analysis and ideas of the state, making infrastructure seem more like a neutral description of various prerequisites to growth. Detached from the logic of cost–benefit analysis, infrastructure came to embrace a much wider range of meaning than social overhead capital, but at the same time it was even more closely associated with fixed, physical objects. The result was that intangible infrastructure (such as education) seemed to refer metaphorically to tangible infrastructures; use of the identical metaphor when describing railroads became unnoticed.

The irony here is that these essential ambiguities of definition and physicality—which still persist today—were the product of debates about economic development during a time when many economists and policy-makers were growing increasingly frustrated with the World Bank's exclusive emphasis on the financing of self-liquidating heavy-construction projects. In other words, the reification of social overhead capital into infrastructure was in fact a reaction against projects which we now see as quintessential examples of large-scale infrastructure. Infrastructure became a way of talking about the necessities of modernity without recourse to economics; but it could not do so without being tied to the early strategies of the Bank.

Infrastructure territoriality and materiality

The close alliance of the concept of infrastructure with changing attitudes towards economic development suggests two broader lessons. First is the relation between infrastructure and internationalism, or more broadly, the relation between infrastructure and new forms of post-colonial territoriality. I want to suggest that the close link between the modern category of infrastructure and international debates about development should not be taken as a coincidence. Instead, I would say that infrastructure only makes sense as part of the new international system created in the middle of the twentieth century.

At first glance, infrastructure seems like a relatively neutral geopolitical idea, or even one that reinforces territorialities of national consolidation. The idea of social overhead capital, after all, took the country as its natural unit; it reinforced the tendency to think of growth in terms of national economies, with clean divisions between domestic and foreign. The world system it implied was very much in keeping with the territoriality of the nineteenth century: the analogy between countries and businesses gave a clear division between a national inside of total control and an international outside of total anarchy.

The administration of international aid, however, worked at cross-purposes to

this simple analogy. One of the central problems of development practice after Second World War involved new types of coordination: not only were there many international organizations whose efforts needed to be coordinated amongst themselves; but various development initiatives had to be coordinated at the country level as well. This gave rise to a new conflict between the geographical sovereignty of territorial states and the functional sovereignty of international organizations, with the bureaucratic expansionism and self-preservation instincts of both elite-led governments and technocratic international agencies furthering the tension. These new administrative alignments also provoked new geographies of planning, especially international river-basin development, regional training institutes, and continental mapping programs (Sharp 1952, 1961). The world system of postwar development coordination tended to regard territorial states more as administrative units for subdividing global initiatives than as self-contained political-economic agents.

Infrastructure was much more closely aligned with this latter system than the national units implied by social overhead accounting. The goal of the SUNFED proposal was to make an international organization that would have functional sovereignty over the financing of infrastructure, much like the World Health Organization had functional sovereignty over epidemics and vaccination. While not as radical as SUNFED would have been, the various international development agencies that were put in place by the early 1960s mostly accomplished this goal: the creation of the International Development Authority as part of the World Bank and the creation of the Special Fund as the counterpart to the UN Technical Assistance program gave both the Bank and the UN the dual task of keeping their programs geographically balanced yet targeted enough to reward countries that best took advantage of aid. Infrastructure was a universalist concept with a particular territoriality: it could be used at any geographic scale, and could align with either administrative or economic geographies.

The second major lesson here concerns the materiality of infrastructure and the difficulty of defining it solely in terms of physical construction. Infrastructure seems like a concept with a core and a periphery: things like railroads and power plants are definitely infrastructure, while education and health sometimes make the cut and abstract notions of property rights and entrepreneurialism seem to stretch the concept to its limits. But this is not how infrastructure is actually deployed administratively. Government planning documents routinely include categories like social infrastructure; the recent Bush administration even defined national morale as a critical infrastructure of the United States (Moteff, Copeland and Fischer 2003). Rather than being defined through economic or engineering considerations, with heavy construction being somehow more infrastructural than other infrastructures,

the governmentality of infrastructure often reduces to no more than a justification of prerequisites, a normative (and at times seemingly arbitrary) judgment of what is necessary to achieve certain goals.

Being mindful of the history of infrastructure as a category—its roots in international development, its problematization of territoriality and materiality—does not mean that the category should be banished, or even that some other category should be used instead. Rather, I want to suggest that we pay closer attention to how the category is actually used by governments and international organizations, and resist the inclination to see intangible or non-economic infrastructures as conceptually novel, or to see their infrastructural status as any more metaphorical than that of large engineering systems. As a category created in the context of international debates about development—especially theories of staged growth through specific prerequisites—we should ask whether the normative judgments implied by infrastructure still align with our own ideas about economic development and sociopolitical modernity.

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Part II

Oil and gas

Infrastructures for natural gas The challenges of internationalization

Aad Correljé and Jacques de Jong

The European natural gas infrastructure is facing the challenge of adapting itself to an increasingly international pattern of supply and demand, while the coordination of transactions is getting more and more complex. New patterns of trade are evolving, reflecting the consequences of the gradual development of an intra-European gas market. Developments on the demand and supply side, suggest a need for significant investments in pipelines, supplying gas from far away, but also in the midstream infrastructure interconnecting countries and connecting facilities like liquefied natural gas terminals and underground storage facilities to the existing networks. A (potential) lack of transmission capacity into and between the several consuming regions will dampen competition, causing higher gas prices and reducing the security of supply. This chapter aims contributing to an informed discussion about regulatory approaches that go beyond the notion of just a imposing liberalized market.

Whilst gas demand in Europe increases, its indigenous production is in decline. More and more gas will have to be imported from remote sources, mostly using long distance pipelines but also via liquefied natural gas (LNG). At the same time, a pan-European market for natural gas is expected to develop, which leads to new movements of gas in addition to the traditional flows from production direct to markets. Liberalization of the gas market has brought its own dynamics and requirements for infrastructure. Finally, the issue of security of supply has moved up on the policy agenda, promoting diversification and new infrastructure. Accommodation of these developments requires a significant expansion of the current European Union (EU) (interstate) transmission network for natural gas in the coming decade.

Yet, investments in transmission capacity materialize only slowly and are lacking support from, and coordination between, regulators and transmission system operators (TSOs). In its *Gas Market Outlook* (2008), the International Energy Agency (IEA) concludes that ‘in marked contrast to North American pipeline investment, investments in internal connections and new supply projects in Europe continue to

lag'. The result is that today, it is hardly possible to book cross border capacity for next year on any frontier in Europe.

Insufficient transmission infrastructure in the EU hinders potential suppliers to compete for market share. It may also frustrate investments in gas production and upstream transmission outside the EU, gas storages and LNG terminals. It therefore hampers the development of an integrated EU-gas market and negatively affects security of supply, while the ultimate goal of the liberalization has been to create a EU-gas market with free trade and competition throughout the EU, to the benefit of EU's citizens.

This chapter addresses the main impediments to the development of the EU gas transmission network and notably its cross-border transit dimensions, inside and around the EU, focusing on the situations where market players have expressed an interest and willingness to pay. It will also offer recommendations on regulatory and coordination issues to overcome these problems.

Investments in cross border transmission

Investments in pipelines have significant economies of scale. TSOs organize open seasons, under which interested potential users are invited to make long term reservations of capacity, to attract as many customers as possible to create an optimal scale. These open seasons also help to treat potential users in a non-discriminatory manner. Open seasons in Europe attract significant market interest. While there are willing investors and shippers prepared to give long term capacity commitments, particularly cross-border investments have difficulties to materialize. Stakeholders can relate to the way gas transmission is regulated, and to the complicated and slow decision-making processes the main obstacles.

New transmission infrastructure is capital intensive. Once a pipeline is built, its costs are sunk. Consequently, the dominant risk of an investment in gas transmission is the market risk, that is, the risk that insufficient capacity will be contracted and/or the risk of tariffs that are too low and that do not allow for an adequate return on investment. According to elementary economics, this risk should be borne by the investor who decides to build the pipeline, who in turn will seek ways to manage and contain part of these risks by means of assurances from future users. By means of long-term capacity contracts, investors are able to reduce their market risk. This principle of shared risks has been the cornerstone of the successful and rapid development of the gas industry in Europe in the last decades. However, this was before tariffs became the domain of regulation. Nowadays, tariffs are regulated, and uncertainty over future regulatory actions poses a serious additional risk for investors (and for users). Indeed, regulators set new tariffs every 3 to 5 years. This

regulatory risk has become an important part of the investor's risk.

Transmission companies apply market-based investment criteria

Unbundling has separated the transmission operations from the supply activities. In the past, investments in transmission were carried out by integrated companies and were made to support of commodity transactions along the gas value chain on the basis of integrated business economics.

Nowadays, unbundled transmission companies have to act as standalone entities. Consequently, investments in transmission should be based on their own merits and will be executed only if rewards and risks of the specific investment are balanced. The shareholders in Europe, generally private, require that the reward-risk balance and revenues are market based. Regulated returns based on assumptions made by national regulatory authorities (NRAs) about investment risks may not be sufficient to attract investments, if these investors judge the risks to be higher than assumed by the NRA.

Also, transmission companies have less market insights than the integrated company of the past. Transmission companies know very well the past and current gas flows, but what about the future? This stresses the importance of allowing shippers and TSOs to enter into long-term capacity commitments, as the former parties will have a better market insight due to their involvement in the commodity and transport market.

Investments and regulation

Since NRAs set transmission tariff methodologies and have responsibilities for tariff-adjustments, they have a dominant impact on the economics of a pipeline project, and regulation may easily become a determining and even prohibitive factor in two situations: first, when NRAs give insufficient support to an investment at the outset; and second, when the risk of future changes in rules and regulations, imposed during the economic life of the investment, is considered to be a substantial market risk.

Current (regulated) tariffs are often not sufficient to cover the costs of an investment. Consequently, a positive investment decision will not be taken, unless the NRA makes it economically viable by allowing increases of some (particular the transit) or all of the current transmission tariffs. This is however a complicated decision for a NRA, because usually, only some shippers/stakeholders will benefit from the investment, while other shippers and/or stakeholders, even those who are negatively affected by the investment, have to pay (part of) it. Lengthy regula-

tory decision processes with the risk of court appeal by harmed shippers and other stakeholders are the result.

A second issue is the handling of market risk. In the EU, NRAs usually apply a system of revenue regulation for transmission companies. According to this method, the revenues for a TSO are fixed in relation to its regulatory asset base and operational costs. This revenue capping causes however a shift of the market risks from the investor to the users. After all, with fixed revenue, less contracted capacity in certain pipelines will automatically result in higher tariffs in other pipelines. Hence the equation

$$c_s \times t = r$$

where c_s is sold capacity, t tariff and r revenue. So, managing the market risk is no longer a matter between the investor and the user(s) of new infrastructure. The risk is put on all shippers. Thus, in the end, it becomes the responsibility of the NRA to make a judgment about a new investment, for which he has neither the responsibility nor the skills.

These problems are even more complex when the investment concerns cross border or transit capacity. Different national regulatory regimes, combined with national focuses by the NRA, make decisions about cross-border arrangements difficult, also because they may easily lead to conflicts between different national interests. Why should local shippers and consumers suffer the imposition of higher tariffs and thus pay (part of) the investment bill to enable international shippers and producers to transit gas to other countries? And why should NRA (applying revenue cap regulation) put the burden of market risk of such transit investments on the shoulders of local shippers and consumers?

Emphasis on asset sweating creates the wrong mindset

So far, the liberalization process has paid little attention to investments in new infrastructures. Asset sweating was the main paradigm, and NRA have concentrated on cost efficiency and lowering tariffs and promoting trade and competition in the market place. Developing capacity allocation mechanisms, but more so applying entry–exit systems for transmission tariffs were resulting regulatory approaches. Certainly, entry–exit systems, with virtual hubs, helped the development of trading and are of primary importance for the market. Yet, they also cause cross subsidies between short distance and long distance cross border transports, thus (unintentionally) leading to cross subsidies between national and cross border transmission.

Controllable costs of gas transmission are relatively a minor portion of the over-

all cost for consumers. It is also questionable whether higher capacity utilization rates should be seen as a measure of the success of liberalization, as it ignores the reality of an evolving EU gas market. Developments associated with market liberalization and competition and the provision of choice to consumers, producers and shippers, which could benefit the performance of the market, should lead to a decrease in the usage of gas transmission capacities. Combined with the reduction in current supplies from depleting sources within the EU, which is likely to lead to redundancy in old supply systems, these developments would actually suggest that lower pipeline utilization should be seen as the measure of a successful transition of the EU market into a competitive market with short-term transactions. This line of thinking is supported by the experience in the United States (US), where utilization has decreased and which is seen as the most liquid and competitive gas market in the world.

Is there any lessons from the United States?

Investments in (interstate) infrastructure in the US are abundant. The US gas market is seen as the most liquid and competitive gas market in the world. Although the situation in the US differs from the one in the EU, it is worthwhile to compare both markets. While in the EU, NRA concentrate on cost efficiency, the federal US Energy Regulatory Commission (FERC) has as objective the 'promotion of the development of a strong and reliable energy infrastructure'. In the US, regulated returns and tariffs are such that they make investments attractive for transmission companies. On the other hand, in the US, the investors who share it with shippers by means of long-term capacity contracts take the market risk. Voluntarily, shippers and transmission companies may enter in non-regulated contracts with the objective to lower the costs along the gas chain and sharing the benefits with the transmission investor. Long-term transmission contracts are seen by FERC as sufficient proof that investments are in the interest of the consumers. This allows FERC to play a supportive role in the licensing processes and supports voluntary dedicated long term contracts between pipeline companies and shippers.

Where from here?

The lack of investments in new gas infrastructures cannot be attributed to the market; it is an issue of regulatory design. The successes of the various open seasons processes demonstrate clearly the willingness of market participants to enable investments in new transmission capacity. However, the economics of these invest-

ments tend to be flawed by an inappropriate regulatory framework, imprisoned by its revenue and tariff setting practices, risk allocation and regulatory decision making processes. This is also demonstrated by the experience in the US where, under comparable circumstances, significant investments in the regulated transmission industry are taking place.

In order to overcome the present regulatory risks and flaws in the regulatory system, we have the following four recommendations. First, the risks and rewards for new cross border investments in transmission infrastructures should be for the market participants. Tariffs for new cross-border pipelines should be sufficient to make investments in new transit capacity economically attractive and take into account the duration of the capacity booked. Applying tariff adjustments at the time of new investments, based on LRIC, that is, reflecting actual capital expenditures (including economies of scale), and translating these costs into perpetual (that is, fixed, possibly indexed) tariffs in entry–exit-systems should be sufficient and rewarding for these investments.

Second, applying the non-discrimination principle in entry–exit tariff methodologies in a way that would be in the interests of the wider community of EU consumers, would allow to make distinctions in exit tariffs between international and regional users, facilitating effective cross-border flows in the EU gas market, including options for TSO transit-competition.

Third, (standardized) long-term transmission capacity contracts with fixed (indexed) tariffs should be allowed as a sound basis for investments in transmission capacity. Often these will underpin long term commodity contracts, which should be considered as essential instruments in enhancing long-term supply security for the EU. In order to allow the necessary flexibility for market parties throughout the value chain non-standardized, customized transmission contracts should be offered by TSOs as well, under appropriate regulatory conditions in line with competition law.

Fourth, the Agency for the Cooperation of Energy Regulators (ACER) as the new body for the cooperation between NRA, should clearly get a straightforward mission to promote the development and of a strong and reliable energy infrastructure in the EU energy market. Amending its mandate in that sense, ACER should also get the necessary powers to intervene in cross-border issues in the wider interest of EU consumers.

These recommendations would imply a conversion of the current regulatory system to a set of rules that ‘promotes the development of a strong and reliable energy infrastructure’.¹ This should lead to an environment where investments in

1. This is one of the main stated objectives of the US Federal Regulation and Oversight of Energy.

cross border transmission infrastructure, sought by shippers, are facilitated. None of these recommendations is totally without problems; but these are not insuperable and small relative to the expected benefits, which would enhance the trading of gas in the EU, promote competition and add to the security of supply. Consumers would be the winners. We believe that these recommendations as to their content could be applied in the context of the exemption regime under article 36 of the new EU Gas Directive. Especially when cross-border projects are involved, the application of the article 36 requires a coordinated and mutually consistent approach by the NRAs involved. Additional interpretive guidelines from ACER to support NRAs and EU Commission decision-making would however be very helpful. As to the role and mandate of ACER, the present regulation, as it is already seen as a first step in the direction of a more effective regulatory system for intra-EU infrastructures, should however be amended and exploratory discussions and considerations could start already right now.

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Note

This chapter is based on *Crossing Borders in European Gas Networks: The Missing Links*, research report (Den Haag: Clingendael International Energy Programme, 2009).

Theoretical considerations on the geopolitics of energy transitions

Wouter Pieterse

Energy transitions can have large geopolitical consequences and, vice versa, geopolitics influence transitions. In the current literature on the transition to a hydrogen economy, it has only little attention. This chapter will describe an analytical framework that can be used to describe the evolution of energy systems in the context of geopolitics. Our analytical framework uses economic geography, political geography and political economy as building blocks linked by the institutional economic approach. The purpose is to find patterns in habits and institutions that explain the geopolitical process accompanied by energy transitions. This will help understanding future energy transitions and in their geopolitical context.

It is claimed that an energy transition is needed due to three world scale problems concerning energy demand, energy supply and the environment. The spatial characteristics of the energy supply chain will change dramatically with the possibility of major geopolitical consequences. The goal of this chapter is to create an analytical framework that explains energy transitions in a geopolitical context. The chapter will also assess institutional economic theory on its relevance for studying geopolitics. Transition are often described in scenarios, roadmaps, etc. Although geopolitics is often mentioned, especially to underscore geopolitical benefits, it is never studied in greater detail. The framework described in this chapter will tested with the case of the emergence of the oil industry. It will ultimately serve to analyze the case of the hydrogen industry.

On the supply side of the energy supply chain, it is claimed that the world is running out of fossil energy sources (Dorian et al. 2006; IEA 2007). The fast growing world population and the soaring economies of China, India, and Brazil result in an accelerating energy demand. Consequently, energy consuming countries are competing for the scarcely accessible resources, colliding and cooperating with other international entities. There are different approaches for coping with these problems. A transition to a alternative energy system can be one of them.

At the same time air quality in especially cities is worsening and global warming has become a major issue (Dorian et al. 2006). The Kyoto deadline is enforcing governments to reduce greenhouse gas emissions. New international initiatives are taken and the pressure on countries to commit to environmental goals is increasing. There is a call for more efficiency and alternative energy solutions that support further economic growth and reduce pollution.

Alternative energy carriers like hydrogen might be able to solve parts of these problems. It implies that an energy transition is needed. There is extensive literature available that describe transitions from a policy perspective and governments use transition theories for management purposes. Transition management focuses on national policies, lacking attention to the international component. However many scenarios often refer to the geopolitical advantages of hydrogen; they never seem to support this with arguments based on research.

The spatial factor plays a major role, as the activities in the energy system are located in different nation states and regions. In general, resources are not located where they are consumed. Therefore, nations have always tried to influence the spatial structure of the supply chain according to their particular goals relating to security of supply and demand, allocation of economic rents and the environment. The geopolitical influence on the spatial structure of the energy system in development is seldom addressed, so approaches are not readily available. I will remedy the situation in this chapter.

To be able to study the geopolitical influence, an analytical framework is needed. The meaning of geopolitics will become clearer and a better understanding is created on energy transitions from a geopolitical point of view. An energy transition will have geographic as well as geopolitical consequences. These consequences will partly reveal themselves in the institutional arrangements, introducing different actors and types of arrangements. By finding patterns and factors in past energy transitions, we can assess the possible geopolitical impact of a future transition towards hydrogen.

First, the framework will be built up by introducing and explaining key concepts such as transition. Then the term geopolitics, after being unpacked, will be reconstructed in a framework. Geopolitics combines different approaches namely economic geography, political geography and political economy. In addition, we will elaborate on institutional economics, which will provide the link between these approaches. New institutional economics and original institutional economics are assessed on their usefulness to create an analytical framework.

Transitions

‘[T]ransitions are processes of sociotechnical evolution in which economic, institutional and technical structures develop interactively and change drastically in the long run’ (Bruggink 2005). There are two approaches to transition. First, according to transition theory these three aspects interact in three levels of transitions; namely the landscape, sociotechnical regime and technological niches (Geels and Verbong 2000; Geels 2005; Rotmans et al. 2000; Rotmans 2003; Verbong and Geels 2007). Transition theory has its roots in evolutionary economics; but it takes a policy perspective on evolutions to new (large) sociotechnical systems. Concepts as path dependence and lock-in play a large role, and need to be dealt with by the policy makers to breach the current system. Second, transition management, a more normative version stemming from transition theory, guides the policy maker through the transition. It suggests certain policy actions for the different phases of transitions. The phases, four in total, are based on the product life cycle, using the characteristic s-curve.

The multi-level perspective described by Frank van Geels (2002) is widely accepted as transition theory. The level of the sociotechnical regime is dynamically stable, changing incrementally through small innovations. Many forces, as vested interests of organizations, keep the collection of sociotechnical regimes stable. At the level of technological niches different technologies are developed which call for a radical change in the regime but is not able to change it (yet) and therefore coexist. These niches are too small to have a decisive influence; but slowly many different appliances are found diffusing into the regime. Finally, the sociotechnical landscape level ‘refers to aspects of the wider exogenous environment that affect sociotechnical developments . . . They are beyond the direct influence of the actor and cannot be changed at will’ (Geels 2005). These levels interact and might create a transition.

In transition management, as described by Jan Rotmans et al. (2000) the four phases, identified by transition theory, need different policy approaches. In the first phase, the transition is predeveloped; government needs to broaden the field of possibilities, spur the participative discussions, and perform strategic niche management. In the second phase, the transition takes off and the actors need to be mobilized. In the third phase, the innovation and therewith the transition is speeding up; government should choose, adjust and support continuation of the developments. In the fourth and final phase, the system stabilizes, and the government should consolidate the new regime.

The main purpose of transition theory is to describe past transitions. In transition management, however, the theory is used for policy recommendations on a

national level and scenario building for future transitions. In the case the of energy, the international component is very important and constrains the influence on transitions.

Many scenarios for the transition to a hydrogen economy follow more or less the patterns described in transition management. As a consequence, they use their concepts for recommendations for national governments. In many of these scenarios, geopolitics is addressed without further elaboration, as if geopolitics is given, and the goals and their meaning for society are clear. The geopolitical situation is difficult to influence by a single actor and cannot be changed at will. The framework used does not help to solve geopolitical issues, because it is partly situated at the difficult to influence landscape level. Moreover, management of a transition is not the goal of this research. Hence, transition theory and management does not help to solve the geopolitical questions related to energy transitions.

Unpacking geopolitics

‘Geopolitics . . . observes and speculates upon the influence of geographical necessities upon political events and changes in the political forms of states’ (Hagan 1942). While economic and political geography describe the economic and political status of different geographic regions and its development and interaction, political economy addresses governance structures, geopolitics deals with the possible strategies to gain access to limited geographical necessities or to improve the actors’ geographic conditions.

The economics of the geographic location of activities in the supply chain is influenced by political geography and political economy. Different states have different institutional, economic and political regimes that influence the routes and physical aspect as capacity of the infrastructure, including transit rights and costs. Why activities take place at specific locations can thus not be answered by using economic reasoning alone. It involves political processes and institutions (Odell 1963; Manners 1964).

Geopolitics is seen as an applied study. The geographic configuration is its starting point. Economic geography, political geography and political economy can provide the basis on which geopolitics is researched, but need to be linked. We believe institutional economic theory can provide this link. In the next sections, the four perspectives are described with the purpose to find commonalities and patterns that can be combined in an all embracing approach.

Economic geography

In addition to the usual costs of production and consumption, the specific spa-

tial patterns in energy systems give rise to variations of costs related to location, distance, transport and storage. The supply chain can be a useful tool to identify the different segments and position them economically and geographically. The supply chain separates the energy system in several segments. It enables the explanation of different elements of the energy system on their spatial aspects. The supply chain crosses borders and includes the geographic factors location, distance, transport and storage (Manners 1964; Odell 1963). It can historically be observed that shifts in the costs of transport and storage have been crucial drivers, alongside the basic costs of production and use, in the evolution of energy use (Odell 1963; Manners 1964).

Gerald Manners has the following practical approach to economic geography: 'In the study of the geography of energy three sets of questions merit particular attention. The first concerns the energy industries themselves. . . . The second set of questions relates to the transport of energy. . . . The third set of questions concerns the consumption of energy' (Manners 1964). Where and why do activities take place? What are there patterns? Do they change over time? Is this seasonable? What are there implications? These questions can be approached in three ways. We can examine each resource in turn; study a variety of different energy economies; or find factors which influence the geography of energy and examine them in greater depth, 'avoiding repetition, including different energy sources, and giving the study depth' (Manners 1964). Peter Odell (1963) uses a similar approach.

Political geography

Whereas geopolitics studies the significance of geographic territory, its resources and the strategies which follow from it, political geography 'constitutes the spatial analysis of political phenomena' (Ferrari 2005). Political geography describes both the spatial outcomes of political processes and the ways in which political processes themselves are affected by spatial structures.

Four levels of political geography can be distinguished: the local, state, regional, and international level. The political regimes in countries determine in part the perception on energy issues and the way, when and with whom to resolve them. Political change can change preferences, interdependencies and relative position of countries or regions. Thus the way to resolve energy issues as shown in several publications (Odell 1963, 1970 and 1998; Correljé 1994). Moreover, changing borders can change the resource base and boundaries of the energy system. It follows that changes in political geography can have a major impact on the functioning of the energy infrastructure as a whole. Although political geographic changes can be very revolutionary, the institutional arrangements do not change radically (Odell 1998).

Political economy

Political economy studies political and economic aspects without the spatial implications. It focuses on the interaction of nation states on institutional, political and economic aspects. Nations compete and bargain in different forms from conflict to cooperation shaping the political economy of energy. Political economic problems are dealt with through institutional arrangements which are historically embedded (Rutherford 1996; Hodgson 1998; Williamson 2000). The type of arrangements used differs per country or region depending on the political economic regime and its history. Although the nation state is starting point of this approach, the process of globalization and the rise of non-governmental organizations (NGO) demise their role, which can be dealt with by using a multi-level governance approach (Finger et al. 2006).

NGO become increasingly powerful. Nations are increasingly interdependent and depend on the NGO for their supplies of energy. Issues cannot be resolved by individual nations. This process of globalization therefore needs a shift in thinking from nation states to more general spatial aspects. From this perspective, political economic issues occur at different spatial levels; local, national, regional and international. This results in the multi-level governance approach with institutions as unit of analysis for the study political economic processes.

The geography is an important element in the way the political economy takes form. The perception and the power of specific geographic areas on geopolitical issues differ with the position in the supply chain, which is to a large extent determined by its geography. The sort of power and arrangements nations might use depend on their resource base, territory, the activities in the supply chain they are involved in and the way they deal with (inter)national issues traditionally. But due to globalization, ties with NGO become increasingly important.

Although many theories have been developed and used to describe the (international) political economy, no one has a satisfying explanation for the processes involved in energy systems, which are context specific. For example, John Clark (1990) and Ethan Kapstein (1990) describe the history and economics of oil. They explain the evolution of energy demand and supply patterns by using different theories and approaches. These approaches are, however, dominated by business economics, cartel theory, vertical and horizontal integration theories, etc. They pay little attention to the government point of view and the evolution of institutions. Why and how institutions come to being? They do not address this question. However, the institutional aspects are dominantly present, it is from a static rational institutionalist view lacking explanations on the political background of the processes.

Institutional economics

A distinction can be made between original institutional economics (OIE) and new institutional economics (NIE) (Rutherford 1996). On the one hand, OIE has a biology based evolutionary background. It implies that history matters and habits influence the development of institutions. On the other hand, NIE has an efficiency approach, closely related to neoclassical economics. Both approaches attempt to describe and explain the governance structures of firms and governments. This section will describe NIE and OIE approaches and assess them on their probable value to the research of geopolitical issues.

New institutional economics

Transaction costs economics (TCE), the most well known and accepted approaches of institutional economic, argues that the existence of the firm can be explained for reasons of reducing transaction costs. Transaction costs are 'the costs involved in coordinating economic transactions' (Groenewegen 1996). The key is to use a governance structure that reduces transaction costs to the optimum, so that the production function is as efficient as possible. When 'firms coordinate transactions at a lower costs than contracts; firms supersede the price mechanism' (Groenewegen 1996). It follows, that 'TCE makes a fundamental distinction between governance structure like firms on the one hand and contracts on the other' (Groenewegen 1996). Central to the argument are the property rights, and some, like Ronald Coase and Douglas North, place large emphasis on this issue. Getting the property rights right will lead to economic prosperity. There are several problems related to this perspective.

The first problem concerns equilibrium thinking. In TCE actors are rational, and the focus is on the efficiency of the production function through efficient coordination (Groenewegen 1996; Rutherford 1996; Hodgson 1998). Equilibrium thinking, taking that ex-ante the most efficient governance structure can be determined, suggests that one optimal cost minimizing structure exists. However many different governance structures exist for the same kind of activities which seem to work efficient (Aoki 2007). This issue is not recognized nor explained by TCE.

A second problem with TCE is that it doesn't provide a satisfactory explanation for government policy and structure, since no standard government structure exists and since the efficiency question is often of lesser importance. On the one hand, lowering transaction costs can be a policy instrument for national governments, since companies might choose the country with the lowest transaction costs to settle their activities. On the other hand, the coordination of transactions in the international supply chain can be, and mostly is, very complex. They involve multiple

states, firms, either national or public, and international organizations of all kinds with different goals and methods of dealing with these transactions. Coordination is a sociopolitical process which differs with the actors involved. Political goals and preferences play a major role. Furthermore, many different problems related to very different issues are linked and solved within the same process (Odell 1963), increasing complexity of the transactions let alone minimizing the costs.

A third problem is with the property rights. Although property rights need to be arranged, doing this properly depends on many factors related to culture, or cognitive frameworks of the geographic area under study. Rationality of property rights can therefore be questioned, and, as Douglas North points out in his 1990 book, same arrangements do not have the same result at the end. No corruption, a similar idea about what property is as in the American culture in which NIE is developed, and a well working judicial system are precondition for efficient property rights. These are already difficult to influence issues and which are not addressed by NIE.

A fourth problem is that coherence between the technical system and the coordinating regime is needed for the system to work as it should (Finger et al. 2005). As mentioned above, the supply chain contains links and nodes and therefore can be described as infrastructure or a technical system. According to Mathias Finger, John Groenewegen and Rolf Künneke, 'the technical functioning of infrastructures needs to be supported by suitable institutional regimes in order to perform satisfactory, be it economic, societal, and even in technical terms' (Finger et al. 2005). Performance indicators they propose are: static efficiency, dynamic efficiency or innovation possibilities, and system efficiency. Technical system integrity is determined by its resilience or robustness especially of their critical elements or functions.

So, next to sociopolitical and an economic viewpoint, a technical viewpoint of governance of international supply chain exist and needs to be considered. The technical system and the transactions involved become increasingly complex at the higher political levels. Different countries govern different parts of the infrastructure and have different rules and norms on how it functions. Additional coordination is therefore needed for transactions which cross borders, and especially for transactions which are critical for the technical functioning of the system. This can become troublesome due to different opinions on criticality. In addition, many critical functions do not take place in the country it is critical for. The question which arises is what kind of regime or governance structure is related with what type of international technical system. So far, NIE does not provide an answer.

Original institutional economics

Original institutional economics (OIE) started with the writings of Thorstein Veblen and, later, John R. Commons. It follows an evolutionary approach borrowed from Darwinian biology. Darwinians explain the development of organisms with general and specific theories. Institutionalists, who adopt this practice, argue that there are multiple levels and types of analysis which must be linked together. 'A crucial point here is that the concepts of habits and of institution help to provide the link between the specific and the general' (Hodgson 1998). As a result, OIE enables the linking of micro processes to macro processes on a more general level using institutions and habits as unit of analysis.

The OIE approach is dynamic as well as holistic instead of static and deterministic as in NIE (Groenewegen 1996; Rutherford 1996; Hodgson 1998; Wilber and Harrison 1978). OIE enables the use of different theories to explain the existence and the development of institutions and technology. According to Geoffrey Hodgson (1998), this theory 'does not attempt to build an all-embracing, general theory. Instead, complex phenomena are approached with a limited number of common concepts and specific theoretical tools' (Hodgson 1998).

Different institutional arrangements are made for similar situations due to different understanding of the problems and interests embedded in habits and institutions (Campbell 1997). The different understandings find their cause in cultural differences, or historically given interpretive frames and meaning systems without disregarding the constraints given by existing institutions, power balances and state actions limiting institutional solutions. The core concepts used are habits and institutions in which the (economic) phenomena are embedded and, more importantly, developed.

Habits and institutions are vague terms. How they change is difficult to determine. Change is driven by problems and interests constrained by institutions leading to lock in and path dependence. From a rational perspective the main interest is to create an efficient production function and reduce transaction costs by efficient coordination for profit maximization. It is recognized however that (rational) interests are not sufficiently able to explain why inefficient institutions and multiple equilibrium exist. Mechanisms of change need to be found.

To cope with the above problem the concept of ideas is introduced as an instrument to complete the models of NIE and OIE (Berman 2001; Blyth 1997; Campbell 2004). Historical institutionalists had similar problems explaining institutional change and also introduced ideas in their analysis. Both, however, do not explain how ideas work or what they mean; but they focus on what and how they influence institutional change (Blyth 1997). John Campbell (2004) attempts to operationalize the concept of ideas to explain institutional change from a OIE perspective.

Ideas helps to understand habits, identify them and describe how they change.

Ideas, embedded in the cognitive frames of society, constrain institutional change on the background; but they can also be on the foreground as concepts and theories (Campbell 2004). A distinction can be made between two categories of ideas (see Table 6.1). First, ‘ideas underlining taking for granted assumptions residing in the background’; and as ‘concepts and theories located at the foreground.’ ‘Second, ideas can be either cognitive or normative’ (Campbell 2004). By combining the two categories, four types of ideas can be identified which affect policy making for both government as well as non-governmental organizations: programs, paradigms, frames and public sentiments. ‘[P]aradigms and public sentiments are second-order concepts insofar as they constitute the underlying ideas upon which the first-order concepts, that is, programs and frames, rest, respectively. As such, paradigms and public sentiments are constraints that limit the range of options’ (Campbell 2004). The role of interests becomes a subgroup within the concept of ideas (Campbell 1998, 2004).

Table 6.1: Types of ideas according to Campbell

	Concepts and theories in the foreground of the debate	Underlying assumption in the background of the debate
Cognitive (Outcome oriented)	Programs (elite prescriptions that enable to chart a course of action)	Paradigms (elite assumptions that constrain the range of useful programs)
Normative (Non-outcome oriented)	Frames (symbols and concepts to legitimise programs)	Public sentiments (public assumptions that constrain the range of legitimate programs)

Source: Campbell 2004.

Ideas can be exogenous at first, might solve a problem, and will or will not be accepted within the present system and change beliefs, habits, technology, etc. If an idea is accepted, it might lead to paradigm shifts within a region, country or industrial sector. From this perspective, an idea becomes a roadmap (Berman 2001; M. M. Blyth 1997; Campbell 2004), which fits well with the concept of programs and frames.

Ideas can also be embedded within existing paradigms, belief systems, and pre-

scribe how some action should be or not be conducted. 'In sum, to understand ideational change it is necessary to focus on the reasons why ideas are discredited, new ideas are advocated by important carriers, and some ideas and not others achieve public resonance' (Berman 2001). In addition, the study of how ideas are endogenously created or externally brought in is also important to understand the underlying mechanisms.

The concept of idea, as Campbell describes it, fits in this framework for five reasons. First, historical institutionalists 'focuses on how ideas become embedded in social norms, patterns of discourse, and collective identities, intangible institutions characterized by intersubjective understandings or shared belief systems' (Berman 2001). Hence it recognizes path dependence and lock in effects and therefore enables an evolutionary approach as done in OIE. Second, ideas are useful as causal factors in institutional change. Its study seeks the underlying factors for which ideas are institutionalized or not and fits therefore with the study of energy transitions. Third, '[i]deational variables are institutionalized when they have become habitual, natural, or instinctive for a particular community' (Berman 2001). The unit of analysis are habits and institutions, and the change of them. Understanding the concept idea is crucial to explain habitual and institutional change. Fourth, ideas are manifested in the governance structures which emerge or are chosen. Through mechanisms of diffusion and path dependence of institutions and their underlying ideas institutional outcomes can have isomorphic effects (DiMaggio and Powell 1983). These mechanisms are further explained by using ideational concepts. Moreover it helps finding pattern models. Finally, ideas enable the introduction of politics in this framework. Ideas are transported through entities that possibly make them influential within the policy arenas (Campbell 1998). Framing and roadmaps of policy instruments is an important activity in this respect.

As mentioned, OIE takes that institutional change is a pattern of evolution, as opposed to punctuated equilibrium or revolution often seen in static approaches of rational choice institutionalists (Campbell 2004). These are extremes and different patterns can be identified in between. Punctuated evolution recognizes (revolutionary) events which cause institutional change; and, at the same time, it recognizes the influence of path dependence through interpretive frames embedded in the habits, routines and institutions. Institutions at different levels have different speeds of change, '[t]hus, while formal aspects of institutional change may occur abruptly, the informal aspects, notably the cultural-cognitive and normative ones, are more gradual and tend to come first' (Campbell 2004). This gives more meaning to Oliver Williamson's (2000) four layered model which describes the different speeds of institutional change at different levels of formal to informal institutions; but it does not give an order in which the different levels change. Hence patterns

of evolutionary, revolutionary and punctuated evolution can be recognized and a careful assessment at all levels should be made to identify the pattern of change which fits best (Campbell 2004).

To find patterns, the causal relations need to be identified as a group of factors and instruments. In addition, the underlying mechanisms need to be identified. Path dependence and diffusion are strong mechanisms often used in literature. Path dependence from a pure economic sense deals with the lock in effects of large sunk investments. On the one hand, institutions are often designed, negotiated or have evolved in such a way that altering them is difficult. Moreover, institutions are often in the background as cognitive interpretive frames, which accordingly change fairly slow, and therewith impede change. On the other hand, institutions can also be of the enabling kind, since it can describe how changes can be introduced in a path dependent way.

Diffusion leads to isomorphic outcomes (Campbell 2004; DiMaggio and Powell 1983). Institutions which are proven successful are copied by other agents, both public and private. Three logics are involved: material interests, appropriate and legitimate way to operate, and to cope with uncertainty (Campbell 2004). Moreover, firms become more isomorphic because interdependent companies deal with their repetitive and complex relationship by adopting each others institutions (DiMaggio and Powell 1983). During a process of translation, however, institutions are adapted, so that it fits their current cognitive frameworks (Campbell 2004).

Through the (underlying) mechanisms, of diffusion and path dependence, like bricolage, translation, transposition, etc., new institutions are formed which replace or complement old institutions. Distinctions between these mechanisms are made by the way they introduce new types of institutions and the creation of ideas. Two basic sources are addressed, the copying of institutions from outside a sector or geographic area or from rearranging already existing institutions and ideas within the sector or geographic area.

The distinction between endogenous or exogenous old institutions is vague, especially when studying a global industry as energy. This is even more so if we introduce the time factor. A time frame for change is therefore important. As mentioned a holistic approach is needed. Crucial to institutional change is the transport of ideas and their translation into institutions within the interpretive frames of the sector or geographic area.

OIE is mostly criticized on not being an economic theory, because it lacks of formal modelling and use vague concepts. Its shortcomings stem mostly from the lack of universal concepts; and it can therefore not be used for predictions. Indeed, OIE follows more the sociological principles than predominantly economic models with (bounded) rational actors. Where NIE can be used for more specific analysis

of governance structures using formal models stemming from classical economic theory, OIE can be used as overarching approach for allocating theories and use them to explain the broader context.

The analysis of geopolitics in a multidisciplinary way is possible with OIE. Both NIE as OIE, economic geography, political geography and political economy can be combined under the umbrella of institutional economics. However, with the introduction of ideational factors, the analysis becomes predominantly and historical institutionalist approach.

The four dimensions of energy transitions

The energy industry has four dimensions which need to be considered to address geopolitical issues. First, the supply chain describes the activities which take place for delivery of energy products. The energy industry has the properties of an infrastructure industry, because it has strong asset specificity. The supply chain put emphasis on the transport function. Moreover, it addresses the question of who does what and where. Economic geography answers these questions; but it mainly focuses on the relation between, on the one hand, geography and, on the other, income differences and the forming of agglomeration.

Second, the firms active in the supply chain are shaping the governance thereof. The amount of activities an individual firm performs depends on many circumstances. These circumstances influence the scale, scope and governance structure. NIE theory address this dimension. With the concept of transaction costs, it captures the governance structures of firms. It can possibly explain why a firm is active in a particular or into several activities in the supply chain. However, there are some problems with it, because it does not sufficiently take into account the institutional context, especially from an international point of view.

Third, several nation states provides the institutional context of the energy industry. Scattered over continents, they create various contexts depending of which segment of the supply chain we take into consideration. By having a static approach, NIE insufficiently address the variety of institutions, habits and ideas involved in nation states. Political geography, on the contrary, could tackle this issue. Despite this advantage, it does explain the emergence of cross border institutional arrangements. Only OIE, by not being bound by a nation state-based framework, satisfactorily explains not only the variety of institutional arrangements within nation states, but also cross border arrangements all through the energy supply chain.

Fourth, arrangements between nation states matters to cover the international character of the energy supply chain. Whether bilateral or multilateral, they govern energy infrastructures globally. Examples of these arrangements are the European

Union, the Organization of the Petroleum Exporting Countries, the International Energy Organization, etc. They provide political platforms to deal with issues, search for cooperation or resolve conflict. They give orientation at the regional, multi-lateral and global levels. Furthermore, arrangements are made for the supply or demand of energy, on transit rights, building new infrastructure, etc. Political economy often studies these issues. It misses, however, the spatial aspects of the energy supply chain and a fine-grained understanding of institutions.

Conclusion

How we can study the geopolitics of energy in a situation of transition? To solve this problem, this chapter has described the theories that might be relevant. These theories were evaluated in light of four important dimensions of the energy supply chain in an international context. We think that original institutional economics provides the best analytical framework. The reason is that it combines easily the fourth dimensions altogether. Moreover it can integrate all the other theories under the same umbrella. What integrates them are the institutions, habits, ideas, and, finally, technology.

Institutions change, according to OIE, in an evolutionary matter. Therefore, they need to be studied by using a variety of methods and theories that describe change. Hence, the activities are performed in a combination of nation states, with a variety of institutions, habits and ideas. Products, transported across borders, are subject to several governance regimes. This can cause misunderstanding, clash of values, and conflict, and possibly the creation of a governance of their own. The role of international firms becomes, thus, very important.

The activities in the supply chain can be studied through a predominantly economic analysis coupled to the technological and spatial characteristics. On the one hand, economic geography seems the perfect theory to use when we address the question of allocation of resources in space. The difference between absolute and relative geography is useful. On the other hand, economic geography focuses on the forming of agglomerations and income differences between regions and countries. It does not explain governance structures of firms explicitly. Moreover it does not address the aspect of security of supply. The focus on space and the institutional aspects thereof is interesting and useful, and brings us closer to political geographic aspects.

So, the supply chain can be described using concepts from economic geography with a focus on transport. The relative position of a country vis-à-vis another's absolute geography shapes their relative geography through transport networks. Traditionally, the locations of energy resources are difficult to change, because it

is geographically fixed by nature. This can possibly change by an energy transition, although sustainable energy is also fixed, up to a certain extent, to what nature provides. From this point of view, technology partly conditions the spatial structure of the supply chain and its economics. Innovation alters the location choices through the set of available alternatives, constrained by their economics without disregarding the institutional factors. In the end, firms govern the supply chain and determine where they want the activities to take place considering all the constraints.

We need therefore to examine firms on how they structure their activities through arrangements which has a decisive influence on the geography of the supply chain. NIE factors as asset specificity, frequency of exchanges, decentralized or centralized coordination, ownership and vertical integration can give insights. The arrangements made are the outcomes of these factors. Moreover, they are the result of institutions, habits and ideas formed in the evolution of the firm, but also by the nation states and international organizations.

In the third dimension, the behavior of the public actors are involved: mainly nation states. As mentioned, they cannot be addressed by using NIE or economic geography. Political geography seems useful, however. Still, OIE concepts can cover the political geographic issues and provides the opportunity to look at specific aspects which are important for this research. That is, the institutions, habits and ideas related to space, and the actors which are attached to it.

Finally, the fourth dimension is often studied by international political economy. For this research, however, the focus is on arrangements, which are well described by concepts from OIE. Again the concepts of habits and ideas, the mechanisms of change and economic geographic issues related technical aspects of infrastructures can be used to explain why the arrangements are shaped as they are. It integrates the knowledge gathered from the lower dimensions, but also influences behavior in the dimensions that need to cope with the international arrangements.

Thus, when studying international infrastructures, we propose to use original institutional economic concepts. Due to the very diverse nature of the actors at the different dimensions a single theory does not suffice and a holistic and eclectic approach is needed. OIE can provide the framework in which the approach can take form as demonstrated above.

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Part III

Electricity

Internationalization in electricity distribution networks required for technology innovation and sustainability objectives

Theo W. Fens

With the liberalization in the electricity markets, more and more European citizens have the freedom of choice for their electricity suppliers. This implies unbundling the transport function from the production–sales function. The monopolistic nature of the transport function, facilitated by the electricity network infrastructure, did lead to strongly regulated governance while the production–sales functions are subject to less regulation as they operate in the commercial domain. However, regulatory developments are complemented by, on the one hand, technological developments that caused the advent of innovative decentralized electricity production and, on the other hand, environmental, sustainability concerns. In order to accommodate these developments, distribution networks should be made more responsive, that is, they have to become smart. To assure that this is implemented effectively (fit for purpose) and efficient (at an acceptable costs), harmonization and standardization is required. From a European perspective, this leads to internationalization, and requires precise and agreed definitions on smart grids and smart metering on a European level.

At first sight internationalization of electricity networks primarily concerns cross border interconnectivity at transmission level. However, it also impacts distribution networks, not on cross border interoperability and interconnection aspects as is the case with transmission, but on standardization aspects in technology and on governance models. Internalization concerning distribution networks may sound far fetching. Why does it affect distribution network governance?

We have observed that technological innovation made possible cross border management and the accompanying control of networks. Main technological facilitator here is the combination of supervisory control and data acquisition (SCADA) and measurement of key parameters for governance accompanied by information exchange between actors founded on information and communication technology (ICT). This is certainly so for transmission networks, they are known to contain

intelligence or to use a more modernistic term, smartness. It is fair to state that transmission system operators networks are reasonably smart, contrary to distribution networks that, however, will have to become smarter; together with the transmission networks they will result in a so called 'smart grid.'

Distribution networks do not play a significant role in cross border interconnectivity, therefore internationalization seizes on other aspects such as standardization in applied technology and the associated governance models. Technological innovation did brought about decentralized electricity generation, for example by micro combined heat and power (CHP)—requiring gas as input and, hence, a connection to the gas distribution network is needed—, solar, micro wind, biogas combustion, etc. Nowadays decentralized generation gains increasing importance, not only from a sustainable point of view, but also from a security of supply perspective, and even from a commercial perspective as instigated by the liberalization. For instance, in the case of high electricity prices and comparable lower gas prices (in terms of MWh), it may well be beneficial to use gas in the micro CHP to generate, not only ones own electricity, but also to feed surplus electricity into the distribution network to gain advantage. Similarly, time of use contracting may also steer electricity usage in peak hours, the so called demand control, and as such helping to reach the European efficiency objective of 20 percent reduction on energy use by 2020, also in the context of sustainability.

The decentralized generation units are connected to electricity networks on a distribution level rather than the large central production units that feed in at transmission level. This implies that distribution networks should now be able to accommodate bidirectional electricity flows; the end customer can swiftly change from a user to a producer. As a consequence the distribution network should be able to accommodate this variety and the governance of distribution networks will in fact start to resemble the governance model of transmission networks, albeit with vastly different numbers of actors. Instead of a few large electricity producers (tens to hundreds of MWs), millions of very small producers (1kW or smaller) will feed electricity into the network. This brings the need for process control means similar to those of transmission networks, such as the in the process industry well established SCADA type systems, that will have to be introduced in the day-to-day management of the distribution networks. In addition, the advent of smart metering also supports governance of decentralized generation capacity in the distribution network. It is at this point where information technology enters the arena that inevitably will change the present distribution network governance model; distribution networks need to become smart. And being smart will be inextricably connected to information technology given the vast number of decentralized producers and smart meters. It was the notion of a smart grid that was extensively

discussed by Dutch policymakers, regulator and distribution network operators.

Smartness in grids

According to Erik ten Elshof, from the Dutch Ministry of Economic Affairs, a set of questions can be posed to arrive at an operational context and nomenclature of smart grids. When a grid is smart? How stupid are the alternatives for a smart grid? How smart can we get? How to get smart? Various definitions of smart grids have been devised in the recent years. However, as standardization concerning technology and governance models of distribution networks will primarily seize on a European level, we adopt the definition of the European Technology Platform SmartGrids: 'A smart grid is an electricity network that can intelligently integrate the actions of all users connected to it—generators, consumers and those that do both—in order to efficiently deliver sustainable, economic and secure electricity supplies.' Although this definition may serve as a starting point, it does not say anything about how to make the transition from the present state distribution networks to smarter distribution networks. The platform indeed acknowledges this and did formulate a set of ten recommendations that will support the transition (see Table 7.1).

Table 7.1: Recommendations of the European Technology Platform Smart Grid

1.	Promote the SmartGrids Vision to all stakeholders
2.	Encourage innovation by network companies and stakeholders
3.	Encourage a pan-European approach to the SmartGrids project
4.	Encourage early deployment of SmartGrids technologies and solutions through demonstration projects
5.	Further develop the SmartGrids Business Opportunities to build the case for deployment
6.	Engage the demand side, include the end customer
7.	Address technical standards in the electricity and telecommunications sectors
8.	Understand and manage the environmental impacts of network development
9.	Promote open access to network performance data
10.	Develop the skills base in the electricity networks sector

One recommendation (n° 3) does set out the starting point for harmonization at the level of the European Union (EU); a uniform and agreed approach for implementation. Furthermore we observe that standardization (n° 7) and the technology aspects (n° 9) are addressed. However, information technology aspects, essential

part of the technology standards have not been mentioned yet. The authors argue that this will have to be addressed in order to enable proper harmonization at acceptable cost to serve. Furthermore, a specific set of possible inhibitors will have to be addressed to stimulate and promote the transition towards smart distribution networks. For instance, the underlying business case should be solid and transparent, and will have to comply with the current tariff structures and the current RPI-X type regulation. This is to be addressed by EU regulators who may consider to harmonize the present variety of regulation models. Hence we conclude that the current efforts by member states to arrive at a European regulator should not only concern transmission system operators (TSOs) but also distribution system operators (DSOs).

Concerning the transition towards smart grids, the present functionality of the distribution networks should not be jeopardized; thus the DSOs will have, to use a imaged expression, to redecorate while the shop is open. This brings about a number of issues to be solved as indicated by ten Elshof: how to organize the national process on the road to smart grids, in relation with the international road to smart grids? Which standards are essential for the development of smart grids, at what time, and how to deal with this in on a European level? And, from a policy maker and regulatory point of view: what kind of regulation optimizes the road to smart grids, and how does this relate to the regulation in all European countries? Is the current palette of regulation models; from rate of return to cost (plus) based, adequate to support the transition towards smart grids? It may well be that regulation models for distribution networks will have to be revisited.

Internationalization

From the above reasoning we postulate that internationalization of infrastructures for distribution networks may at first sight be considered a second order phenomenon; but internationalization will have a similar impact on the governance of distribution networks as it has on transmission networks. Therefore we state that internationalization impacts distribution networks on standardization of technology and harmonization of governance. Indeed at this point we observe coevolution of technology and governance, that is, institutional arrangements that should be in place and aligned in order to secure integrity of the entire transport function consisting of both transmission and distribution. Hence these institutions ensure that critical technical functions in which the distribution networks play a significant role operate adequately.

More specifically, in the transition towards smart grids standardization is required to achieve exchangeability of technical assets and economy of scale in ap-

plied technology. Harmonization in operational governance is needed to allow both staff and procedures to be cross border exchanged and do not have to be invented locally over and over again. This requires supra national coordination on a European level in which policy makers and regulator will have to take initiative as above indicated. An example is smart metering, currently in the EU efforts are undertaken to arrive at a standard for the technical requirements of the smart meter functionality. This standardization provides economic advantages (economy of scale for the applied technology) and governance benefits (uniform governance processes in the roll out of smart meters). Comparable technical standards and a uniform economic clearing system for allocation of costs would provide a cost effective implementation of smart metering at EU scale. Legislation shows that by 2020, 80 percent of the EU end users are obliged to have remote meter reading, hence smart meters installed. This should be 100 percent by 2022. In this standardization, ample attention will have to be paid to harmonization of the involved information technology aspects, which to date has not been the case. For instance, next to technical codes, an information code at EU level may be considered.

Thus we state that, there indeed is a need for supranational regulation on both technology standards and governance. In addition this would form a solid and transparent foundation for the extensive stimulation programmes (among which subsidies) set out by governments in both United States and EU for decentralized electricity production and smart metering. Also these arrangements may stimulate international bodies that edict norms to achieve standardization.

Cross fertilization by information and communication technology

It is observed that standardization did greatly benefit other sectors and specifically those industries that make extensive use of ICT. Distribution network governance will not differ from this as the functioning of the entire energy value chain is largely based on information technology. In the context of the transition towards smart grids from a European perspective one can pose the following questions. Which countries and which sectors were fast in introducing ICT in other infrastructures? What experiences did they gain by being frontrunners? How was dealt with standardization and information of technological devices in these sectors? As there is no clear cut blueprint for the transition towards smart grids, learnings may be obtained from other sectors that are heavily depending on information technology: telecommunication in which ICT did lead to the internet, in transport and logistics ICT enabled real time supplies procedures minimizing stocks, and water management where ICT led to high quality metering and safety control.

Conclusions and recommendations

We conclude that in the transition to smart grids, standardization of both technology and governance of distribution networks on a supra national level is required. Justification for this is more effective governance at lower costs. Also the standardization for smart meter technology will allow to reap advantages from economies of scale. We recommend that the current efforts by member states to arrive at a European electricity regulator should not only concern TSOs but DSOs too. In addition, EU regulators should consider to harmonize the present variety of regulation models in order to reduce the required upholding effort. Finally, standardization of both technology and governance models should be taken up by an open dialogue at EU level between the electricity sector and the regulatory authorities, given the high importance of the electricity value chain for society as a whole.

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What can we learn from an international perspective on smart grids?

Erik ten Elshof

The growth of decentralised generation, the possible roll out of electric vehicles and demand side management are important drivers for smart grids in the Netherlands. The smart grids concept is challenging in different ways. Smart grids are a great opportunity on the transition road to a more reliable, sustainable and affordable energy system, as well in the near future as in the period after 2020. Many questions arise on this road. The international perspective, not only sheds more light on these questions, but also identifies new questions that need to be addressed.

National and international governments are putting serious efforts in smart grids. In the economic stimulus plan of the United States, 4 billion dollar is meant for smart grids. In parallel, the European Technology Platform for Smart-Grids has made a vision and strategy, a research agenda and even a strategic deployment agenda. In 2008, the Dutch government has declared the smart grids as one of the three light houses of the national energy policy (next to the gas roundabout and the North Sea as energy source). So you may expect a clear objective to justify these efforts.

If you hear the word smart grid for the first time, a logical question is: What exactly does a smart grid look like?

This is the first challenge that results from the concept of smart grids. There is no internationally agreed definition of this concept. So you cannot give a specific description of what it looks like. As a consequence, you cannot exactly point out the benefits of it.

At first sight this looks a little strange. Smart grids can then easily be seen as a buzz word with little content. To convince stakeholders to take the road to smart grids, it is not enough to state: 'You are stupid if you don't want to realize smart grids!'

At second sight the lack of a concrete definition is not so strange. Energy infrastructure is in the end only a means to a goal. The infrastructure does not produce

nor does it consume (much) energy. It connects producers of energy to consumers of energy. The infrastructure plays only a facilitating role in creating a energy system that is reliable, sustainable and affordable. Also is this not a static but a dynamic situation. Energy production and consumption are changing over time. There is not one and only best way to facilitate this, and there are more modalities. Think for instance at the different ways you can heat houses.

This facilitative and dynamic view on smart grids also lies at the base of the definition of smart grid that is used by the European Technology Platform SmartGrids: 'A SmartGrid is an electricity network that can intelligently integrate the actions of all users connected to it—generators, consumers and those that do both—in order to efficiently deliver sustainable, economic and secure electricity supplies'.

If we take an international perspective on the meaning of the concept of smart grid, the first thing that attracts our attention is the differences between countries in energy systems, and in particular the electricity systems. In the Netherlands, a large part of the energy system consists of natural gas. Not only for direct use in industry and housing, but also in electricity production. This is a different situation from most of the other (European) countries. Another important characteristic is the age and the reliability of the current electricity infrastructure. If there are few or none problems yet, as is the case in the Netherlands, why should you bother making a smarter system? This can be a very different situation in other countries, that brings us to the next question.

When is it wise to get smart?

In general, it is wise to have a grid that is reliable, because the chances on outage are very small; affordable, the investments are low, and also the costs of maintenance; and sustainable, for energy can be saved en more sustainable energy can be fitted in. In the Netherlands, and in other countries, there are several developments due to technological innovation and to the liberalization of the energy markets that make it wise to go the road to smart grids.

On the demand side, we see in the short term that grid capacity is getting older and is running short on capacity because of the—local specific—growing demand. In particular heat pumps are using locally so much energy that net investments are necessary. In the longer term, the large scale introduction of the electric vehicles can be also a risk for grid capacity.

On the supply side, we see mainly the introduction of decentralized generation that creates growing problems for the grid. The current distribution network cannot deal with these developments in a smart way.

The development of new energy services is another consequence of technologi-

cal innovation, stimulated by the liberalization of the energy sector. Smart services—behind the meter—create new opportunities for demand response. What is needed then is real time pricing. A step further on this road is the development where consumers become also producers (prosumers). And another development that crosses the border between demand and supply is the expected technological innovation in energy storage. With the extra dimension of electric vehicles as possible storage suppliers.

All these developments and future perspectives can have important effects on the reliability, the affordability and the sustainability of the energy system.

If we take an international perspective on this matter, the following questions arise. What can we learn from developments and experiments in other countries? How to prevent that new components and energy services are limited by national markets? Will uncoordinated policy lead to lock inn situations?

How stupid are the alternatives?

There are different alternative scenarios possible when the road to smart grids will not be taken. Let's take a quick look at these scenarios. Some of these alternatives can mix with each other.

The first alternative for the road to smart grids is business as usual. This has important disadvantages. To keep the system reliable, there has to be put a limit to decentralised generation. Production of energy stays then mainly based on large scale production. Also are there limits then on the changing pattern of energy demand. And innovations in energy services also will be limited.

A second alternative, when the growth of decentralized generation continues, is accepting less reliability.

Another alternative, when pattern change of energy demand is not limited, is large scale investment in net capacity (and peak load).

A last alternative is a stronger development of autarkic energy systems.

If we take the international perspective, we see that this is in fact the situation we have right now. There are different studies and experiments in different countries; but there is no common action to go on a shared road yet. Though the recommendations in the draft Strategic Deployment Document of the European Technology Platform could be a starting point.

How smart can we get?

Although there is no specific definition of a smart grid, and there are no extensive

cost-benefit analysis made for the alternatives, the perspective of getting smarter seems very attractive. The drawback, however, is that there is no blueprint for the future. Especially not in the field of infrastructure where technological and economic innovation plays such an important role. The energy sector can perhaps learn a lot from parallel sectors as the telecommunication sector, the transport sector and the water sector. In the telecommunication sector, the introduction of intelligence led to the growth of the internet. The combination of information and communication technology (ICT) and the transport sector led to real time supplies. And the introduction of ICT in the water sector lead to intelligent quality-metering and safety-control.

Putting this in an international perspective, different questions arise. Which countries were fast in introducing ICT in other infrastructures, and what experiences did they gain by jumping ahead? How can the Netherlands benefit from its characteristics (strong ICT sector, excellent knowledge position, densely populated)? How was dealt with standardization and uniformization of technological devices in these sectors?

How to get smart?

The European Technology Platform SmartGrids has given 10 recommendations in the Strategic Deployment Document (see Table 8.1). There is no doubt that these recommendations make sense. But the question is, are they sufficient on the road to smart grids? Let's take a look at the barriers that have to overcome.

A first important barrier is the lack of challenging business cases at this moment. For instance if there would be better technology for central and/or decentralized energy storage, this would be an important driver for smart grids. The control of storage, to be used for balancing and optimal use of the grid capacity, makes a smart grid necessary.

A second barrier lies in the costs and the reliability of the needed technology for smart grids. Technological complexity can be a risk for the reliability and the safety of the grid, where reliability and safety always have been at the heart of the distribution companies. What makes things even more difficult is safety of the information, a question that enters the world of energy infrastructure with the concept of smart grids.

Table 8.1: Recommendations of the European Technology Platform Smart Grid

1.	Promote the SmartGrids Vision to all stakeholders
2.	Encourage innovation by network companies and stakeholders
3.	Encourage a pan-European approach to the SmartGrids project
4.	Encourage early deployment of SmartGrids technologies and solutions through demonstration projects
5.	Further develop the SmartGrids Business Opportunities to build the case for deployment
6.	Engage the demand side, include the end customer
7.	Address technical standards in the electricity and telecommunications sectors
8.	Understand and manage the environmental impacts of network development
9.	Promote open access to network performance data
10.	Develop the skills base in the electricity networks sector

A third barrier lies in possible split incentives that follow from regulation. For instance the regulation of distribution has a strong focus on efficiency. The question is how to optimize regulation, if you put the focus on innovation.

And a fourth barrier lies in the natural resistance to cultural change that is needed for innovation, along with the resistance that may be expected from changes within the energy chain that affects positions of stakeholders.

On the base of these barriers, you could conclude that the current situation has the characteristics of a lock-in situation. The challenge is to start or strengthen the process to get out of this situation and to overcome the barriers.

If you look at this from an international perspective the first conclusion is that at least the developments in one country can and will be inspiring for other countries. The second conclusion is that, at least in Europe, countries are connected with each other with regard to technical products and with regard to the regulation of the energy markets and the distribution of energy. This leads to the next questions. How to organise the national process on the road to smart grids, in relation with an international road to smart grids? Which standards are when essential for the development of smart grids, and how to deal with this in an European (worldwide) way? What kind of regulation optimizes the road to smart grids, and how does this to the regulation in other (European) countries?

Conclusion

Smart grids offer important opportunities, if we look at future developments in energy production, energy demand and energy storage. The question is not if but how to make optimal use of the concept of smart grids in the light of a more reliable, sustainable en affordable energy system. The road to smart grids contains important barriers. The international perspective not only sheds more light on these questions, but also identifies new questions that need to be addressed.

Disclaimer

This chapter has been written on personal behalf. It does not represents the official point of view of the Dutch Ministry of Economic Affairs.

Which challenges do smart grids pose to regulation?

Machiel Mulder

It's a matter of fact that smart grids form a challenge for energy distribution operators; but, the question is, do they also form a challenge for the regulator. Should the regulation of networks be adapted in order to facilitate the development of smart grids? This chapter argues that only in specific circumstances regulation has to be adapted. If regulation is characterized by a light-handed output-oriented approach, it should be pretty well able to facilitate smart grids in the same way as it facilitates other technological choices of operators.

In order to deal with the growing significance of distributed generation, distribution network operators have to upgrade their network. The networks have to deal with the growing volatility in load as well the growing supply of electricity to the grid. In principle operators have two technological options to tackle this development. The first one is extending the grid, making the grid sufficiently large to facilitate both peak demand and peak supply to the grid. The other option is making the existing grid smarter, which mainly means the use of information technology to optimize the use of the grid. The latter option is viewed to have positive effects, both for the network operators as for energy producers and consumers. Therefore, it is said that the regulatory framework should facilitate the development of smart grid instead of only giving incentives to the operators to improve their productive efficiency.

In this chapter, we briefly assess to which extent current regulation is able to facilitate smart grids. First, we describe the main characteristics of the current framework in the Netherlands. Second, we summarize the main results of the regulation up to now. Third, we analyze how this framework affects the development of small grids.

The Dutch regulatory framework

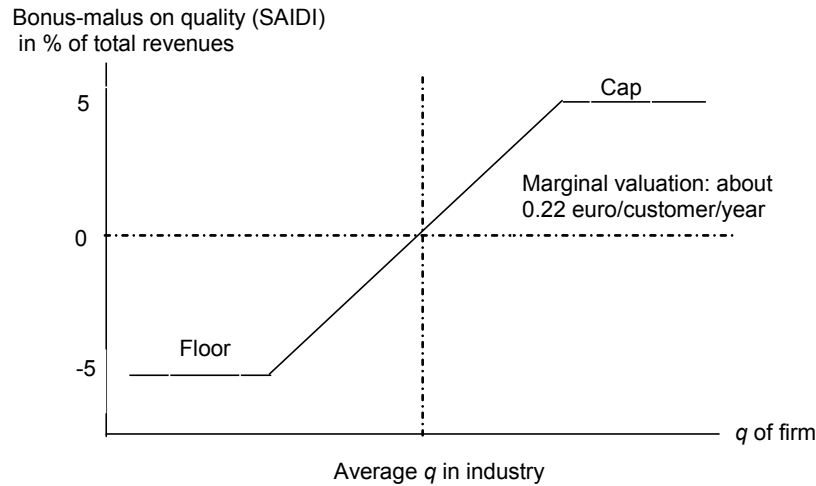
The Dutch regulatory framework for the energy networks can be characterized as light-handed output-oriented regulation. This basically means that the regulation is directed at the outcome of the networks instead of the inputs. The main outcome parameters include total revenues and the reliability of the supply of energy.

The total revenues of the networks are determined by the regulation while the operators are fully free to determine the (level and composition of the) costs they want to make. Regarding the distribution networks, the total revenues are set on the level of what is viewed to be the efficient costs. These efficient costs are calculated as the average of the costs of all operators at the end of the regulatory period. The total revenues of an operator are set on the level of this efficient cost level by the x factor. In other words, the x factor takes the total revenues of an operator at the beginning of a regulatory period to the level of the efficient costs at the end of this period.

Because of the relationship between total revenues and an indicator for efficient costs, the regulatory framework has the form of yardstick regulation. The yardstick for efficient costs includes both capital costs (CAPEX) and operational costs (OPEX). So, the framework can be characterized as TOTEX regulation. As a consequence, operators are fully free to allocate the total revenues among capital and operational costs. Some operators having a relative capital-intensive operation may use the revenues as compensation for their relatively high depreciation costs and costs of capital (equity and debt capital). Others, having a relatively old network, might use the revenues as compensation for operational costs like labour costs on maintenance and so.

In addition to setting the yardstick for revenues on the TOTEX basis, the framework includes rules regarding the reliability of the network and the services to be provided to energy users. Network operators have to take care of the network in such a way that energy users have the guarantee that they will be connected if they wish (for example, the obligation to connect) and that the supply of energy will hardly be disrupted. Regarding the latter, although the framework does not precisely prescribe standards for quality of energy supply, it does include incentives to optimize the level of quality. These incentives comprise a bonus–malus system and a compensation mechanism.

Operators receive a bonus if the quality of their network, as measured by the system average interruption duration index, exceeds the average quality of all operators in the previous regulatory period (see Figure 9.1). And vice versa: if the quality of an operator is below the average level in the previous period, it receives a malus. Both bonus and malus are capped at the level of 5 percent of total revenues

Figure 9.1: Determination of the q factor, the quality incentive

in the previous period. The compensation mechanism says that the individual energy users should be financially compensated, if they have experienced a serious disruption.

The quality incentive, the q factor, and the efficiency incentive, the x factor, together determine the development of the total revenues in real terms. In order to compensate for inflation, a consumer-price index is also included in the revenues formula. The result is the following main formula of the regulatory framework:

$$TR_{o,t} = (1 + cpi - x + q) TR_{o,t-1}$$

where TR is the total revenues of an operator o at the time t of a given regulatory period, cpi the consumer-price index, and x and q are the above-mentioned factors.

The main implication of these characteristics is that the regulator does not intervene in management decisions of operators. The general idea is that operators have far more knowledge about efficient network management than the regulators have. As a consequence, the operators should face the full responsibility of the network management. Hence, the well-known problem of information asymmetry between regulator and network operator is solved by giving the operator the freedom as well as the incentives to choose the optimal technical options in its specific situation. In principle, benefits of releasing a more efficient solution can be reaped by the operator. In order to prevent that too many efficiency benefits remain within the network firm, however, the revenues of the operator are subject to the yardstick which is

frequently reassessed.

Another argument, besides the information asymmetry argument, of giving operators freedom of operation follows from the fact that *ex ante* nor the regulator neither the operators know which technique will appear to be the most efficient one. Prescribing one technique, therefore, creates the significant risk that this technique would appear not to be the best or the most efficient one. When each operator is able to make its own technological choice, the benefits of a decentralized organization come to the fore (see Kay 2005). This means that there is a higher chance that *ex post* the best technique will be chosen (or developed) by at least one of the operators. In a centralized system, without such freedom and variation on firm level, innovation would be likely less developed.

Effects of regulation

What were the effects on static and dynamic efficiency of regulating the Dutch energy networks? Undoubtedly, the yardstick regulation has significantly reduced the tariffs consumers have to pay for using the networks (see Plug and Mulder 2009). In 2009, the total savings on transport tariffs for energy users amount to approximately 1 billion euros (see Figure 9.2). The cumulative savings since the start of the regulation are calculated to be approximately 6 billion Euros (see Figure 9.3).¹

The reduction in tariffs reflects the reduction in total costs per unit of output. This higher efficiency results partly from higher productivity of the network operators, but it is partly also the result of lower capital costs (CAPEX) due to investments being below the level of depreciation. One might expect that the latter would hamper the quality of the infrastructure, but up to now no real indication therefore has appeared.² The quality of Dutch networks has hardly changed of the past years. Compared to other European countries, the quality performance of the Dutch energy networks is still at a high level (see Figure 9.4).

Concluding, the regulation of the Dutch energy networks has had a significant effect on the tariffs energy users have to pay for using the grid. In addition, up to now there isn't any evidence that this pressure by the regulatory framework has negatively affected the quality of the networks.

1. The impact of regulation on tariff is calculated by making a assumption about the development of the tariffs in case of no regulation (the counterfactual). It can safely be assumed that in that case tariffs would annually increase by at least the rate of inflation. Without regulation, the network operators could use their monopoly power to raise prices even above that level; but one might assume that political pressure would cap the price increases to the level of the rate of inflation.

2. Economic literature shows that a negative effect of incentive regulation on quality (Granderson et al. 2002; Ter-Martirosyna 2003; Pollitt 2005; Jamasb et al. 2008). There is also evidence that these negative effects can be compensated, at least partially, by quality regulation (Ajodhia et al. 2006; Burger et al. 2008).

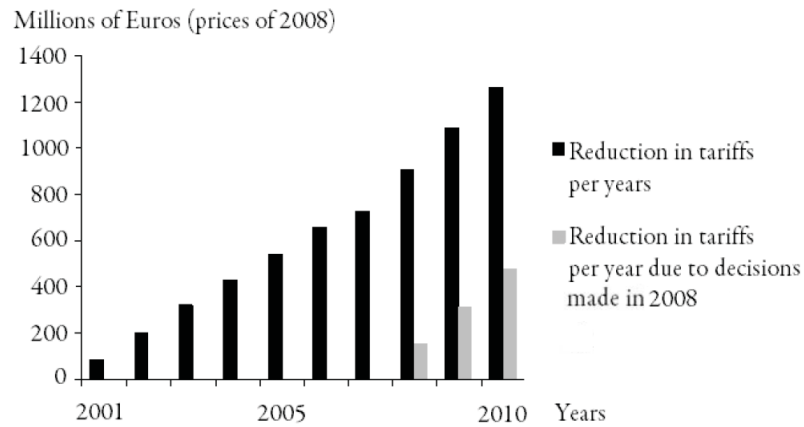


Figure 9.2: Annual reduction in total revenues due to regulation, all Dutch energy networks, 2001–2011 (*Source:* Plug and Mulder 2009)

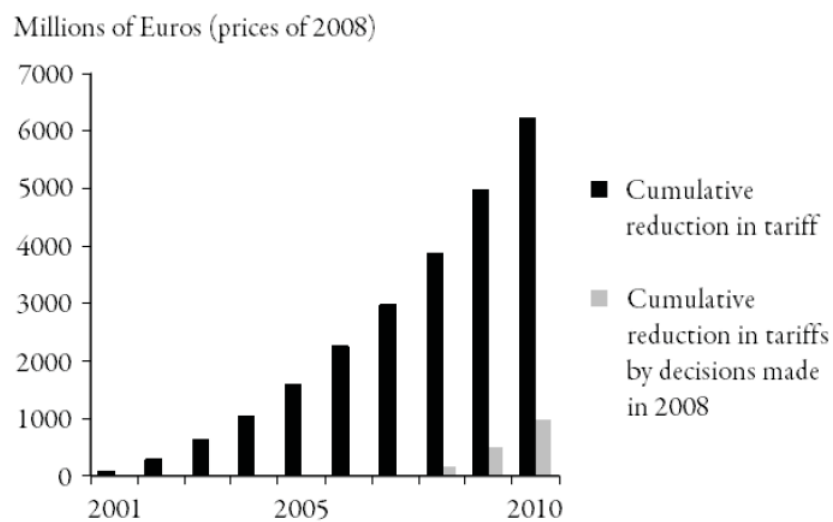


Figure 9.3: Cumulative reduction in total revenues due to regulation, all Dutch energy networks, 2001–2011 (*Source:* Plug and Mulder 2009)

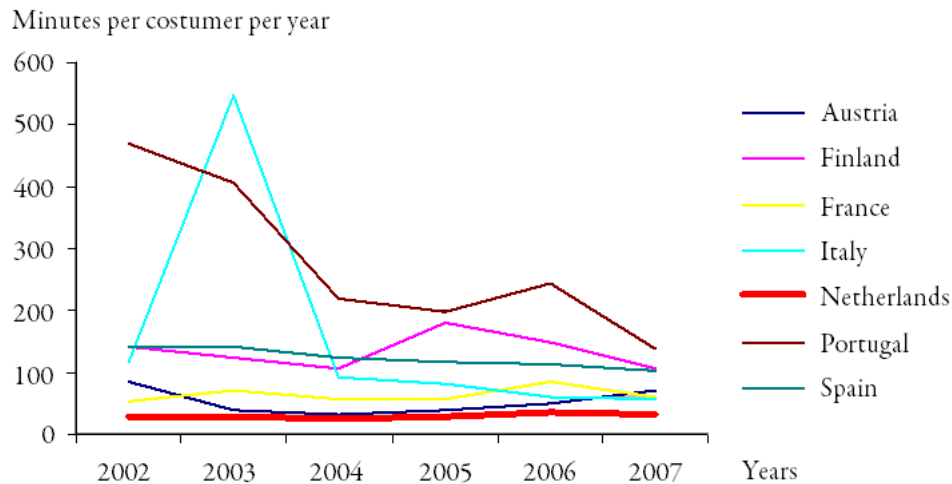


Figure 9.4: Quality of electricity networks in seven European countries, as measured by unplanned disturbances in power supply, in 2007

Regulation and smart grids

The topical question now is whether the current regulatory framework hinders the development of smart grids. It is said that smart grids require huge investments while the benefits will likely not appear in the near future. Hence, developing smart grids implies making large upfront costs for benefits which are highly uncertain in the short term. How does the current regulatory framework deal with these costs?

First of all, if all network operators would make comparable investments in smart grids, all the costs of a smart grid would enter into the yardstick. Hence, the revenues of the operators would increase by the costs of the smart grids. However, if only some of the operators would make these costs, the yardstick would only rise by the share of these operators in the total industry. Consequently, these operators would only be partly compensated for the costs they made. So, uncertainty about the investment behavior of other operators creates uncertainty for each operator about its revenues. This uncertainty might hamper investments in smart grids as well as other type of investments having uncertain benefits. The only option to recoup the costs of such investments is when the yardstick is raised. In other words, the system of yardstick compensation has as consequence that operators will be fully reimbursed for all projects, no matter whether they are welfare enhancing or not, as long as all other operators conduct the same type of projects.

If all operators believe that a specific technique, in this case smart grids, is the

most efficient technique to solve the future challenges they are facing, this view on the future technological challenges will likely appear to be true. In that case, rewarding all costs of smart grids seems also to be the optimal approach, even if the future benefits of these investments are still uncertain. If, however, some operators believe that investing in smart grids is the optimal approach, while others are more sceptical about the efficiency of such an investment, a different case appears. Then, the efficiency of the investments is unclear *ex ante*. If the investments appear to be efficient, operators having chosen for this technology will reap the benefits while others, who were hesitant to invest in the uncertain technology, will have higher costs.

Seen from this perspective, the yardstick regulation effectively deals with investments with uncertain benefits. First, the higher the number of operators believing that this technique will have positive net benefits, the higher the number of operators that will actually make the upfront costs and the more the costs will be rewarded by the yardstick regulation. Second, given the uncertainty operators have about the investment behavior of other operators, they will only invest if they expect that the investment would create benefits within the operator it self, such as savings on network extension.

However, the regulatory framework might hamper investments in smart grids (or other technologies) if these investments create externalities, that is, if other participants benefit from the investments without sufficiently rewarding the network operator. In such a case of positive externalities, the operators would invest too less. This might be the case when a new technology (or infrastructure) creates new products (such as energy-saving services or charging options for electric cars) for which no tariff products have been defined. This externality or inefficiency in the framework can be solved by defining the appropriate products in the tariff decisions.

Conclusion

It is clear that the current regulatory framework not necessarily rewards all costs of operators. In that respect, the framework hinders some activities, in particular activities which are not viewed to be efficient. Regarding to smart grids, if this technology is generally believed to be the optimal technique to deal with the future challenges of the distribution grids, the costs of investing in these grids will be fully reimbursed by the regulation because of the yardstick. However, if this technique is not generally accepted among network operators as the optimal technological choice, not fully rewarding the upfront costs seems to be appropriate. Inefficiency in regulation might exist, however, if the investments create positive externalities as a result of which operators would invest too less. Creating specific product cat-

egories in the tariff decisions seems to be the optimal way to solve this inefficiency.

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Disclaimer

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Smart grids put into practice

Else Veldman, Danny A.M. Geldtmeijer and J.G. (Han) Slootweg

The transition towards a more sustainable energy supply system causes changes in the supply and demand of energy. It requires a more flexible and efficient operation of the electricity distribution grids. It calls for a smart grid with intelligent control embedded in the grids to incorporate electricity storage and controllable loads. This will ensure cost-effective development of an efficient and reliable electricity system that allows the integration of distributed generation. To realize this smart grid, a holistic approach is needed. The issues which need to be addressed to make smart grids a successful reality are addressed in this chapter. It is illustrated that these aspects are much broader than developing and implementing technologies: a holistic approach involving all parties affected by the required paradigm shift is needed.

Now and in the future, a reliable electricity supply is of utmost importance for satisfying the needs of individuals and enabling the functioning of societies and economies. However, various developments lead to an increasing complexity of the design and operation of electricity grids. One consequence of the liberalization of the energy market is that all consumers and producers must be given unrestricted access to the grid. This increases uncertainty with respect to the future demand for capacity with respect to volume as well as to location compared to the past where vertically integrated utilities controlled both the grids and the generators. This uncertainty is amplified by the development towards more distributed generation connected to the electricity distribution grids and changes on the demand side, like the rising number of heat pumps and the advent of electric transportation. This challenge is further increased by the ageing of the existing infrastructure and the ever increasing demand for electricity. Despite all these changes and uncertainties, grid operators are legally and morally obliged to provide their consumers with a reliable power supply.

The consequences of these developments can be mitigated by enabling a more flexible operation and efficient use of the (existing) electricity distribution system,

without compromising the reliability of supply. To realize this, the medium and low voltage grids need to be adapted. A high penetration of distributed generation and the integration of electricity storage and controllable loads in the operation of the grids can be supported by applying more active network management. Making the distribution grids more intelligent and flexible than they are nowadays is often referred to as smarting the grid. It is generally accepted that making the grids smarter is necessary in the light of future developments. Making this a reality, however, asks for a paradigm shift and is still quite a challenging task. It not only asks for technological innovation in various respects; but the public interest must be visible for all parties involved. Governments must make choices and set out clear and holistic policies. To make the necessary changes possible market mechanisms and regulation must be adjusted, and also social acceptance is an important condition. Therefore, consumers must understand the need for changes affecting them. The challenges we face are global issues, and, therefore, knowledge exchange can support the search for solutions to address these challenges. Policies and regulatory and market arrangements must be discussed on as well a national as international level. The fact that there exists a global market for network components, including those enabling smart grids, requires an international approach in order to realize economies of scale.

The different issues which need to be addressed to make smart grids a successful reality are addressed in this chapter. While the future grids will be based on the existing electricity grids, it is first set out what led to the grids of today. The developments which influence the electricity grids are then discussed. Subsequently, it is explained how grids should develop and it is made explicit what smart grids in this perspective mean. The chapter concludes with a description of the aspects which should be regarded to make the next steps forward. These aspects are much broader than developing and implementing technologies: a holistic approach involving all parties affected by the required paradigm shift is needed.

The power system of today

As in most Northwest-European countries, the electrical power system was introduced in the Netherlands at the start of the 20th century. After the introduction, the scale increased and the system developed to the extensive electricity supply system of today. Due to historical developments, the electricity power system consists of a transmission system, which transports large amounts of power from large-scale generation over large distances, and a distribution system, which delivers the electricity from the transmission substations to the consumer (see Figure 10.1). The transmission systems faced many challenges, because power plants became larger

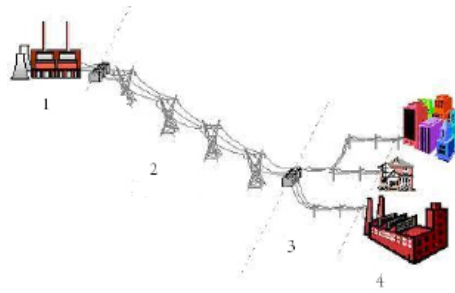


Figure 10.1: A vertically integrated power system. Legend: 1 generation; 2 transmission; 3 distribution; and 4 consumption.

and larger and operation of interconnected grids became ever more complex. Meanwhile, the distribution systems only delivered power from the transmission systems to the consumers, so that the requirements on the grids were quite obvious and uncertainty was limited.

In the past, utilities have designed their grids to meet demand. The electricity grids were dimensioned on peak demand, and the equipment capacity was designed for peak load conditions. Besides that, the engineers made various assumptions to make the design and operations manageable and not to rely on very detailed modelling and analysis. Protection and control were adjusted to ensure reliable service during the worst case conditions. These efforts have been quite successful and led to a reliable system in the Netherlands (see Figure 10.2). As a result of these design philosophies complemented with the policy to invest for future demand generously, distribution systems were typically designed with overcapacity. This overcapacity is nowadays utilized for a great part, although in some regions, grids are still profiting from this.

These past developments led to the current electric distribution systems, with very little online automation and a relatively low ratio between the used and available capacity. An analysis of the used capacity of the medium voltage distribution grids of Enexis showed that a vast amount of currently unused grid capacity is available (Veldman 2009). As a result, the grids offer a great potential to transfer extra energy without increasing the capacity of the existing grid.

Besides the developments of the energy supply system itself, in many countries the energy sector went through fundamental organizational changes. In the last decades, liberalization of the energy market transformed the sector. In the late 1970s and the early 1980s the energy sector was fragmented in a lot of small companies owned by provincial and municipal authorities. The sector had the image of inef-

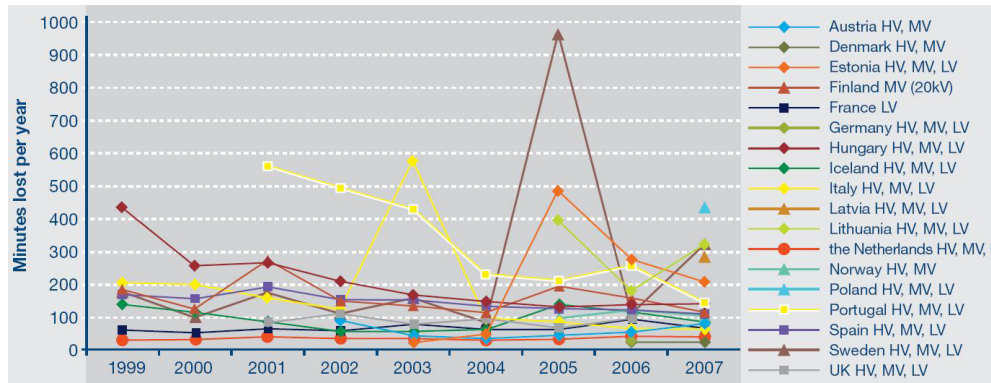


Figure 10.2: Unplanned interruptions including all events (*Source:* Council of European Energy Regulators 2008)

efficiency and tended not to be very customer-orientated. The objective of market liberalization was to grant consumers free choice, and to enable more competition between companies in the European Union (EU), which should lead to lower prices and a better service level of energy related issues. One measure to realize this objective was to separate generation activities from distribution activities. Therefore, the present role of grid operators is to fulfil a pure market facilitating task in order to physically link power producers to consumers. In practice, this means that every generator and consumer should be given unrestricted access to the grid. In order to guarantee free and non-discriminative market entrance and competition and prevent abuse of monopoly power by grid operators, network operation is supervised by national regulators.

A changing environment

The environment in which distribution system operators (DSOs) are evolving is changing rapidly. The last decade the energy market is liberalized and the gas and electricity system operators of today have the responsibility to contribute to the transition to a more sustainable energy supply besides delivering reliable and affordable energy. The transition to a more sustainable energy supply not only means that the grids need to be used more efficiently, it also brings a lot of changes in the supply and demand of energy. The penetration of decentralized generation of electricity (wind turbines, combined heat and power generators, photovoltaic solar panels, etc.) is accelerating in the Netherlands. These technologies take a growing

share in the energy supply. As a consequence there is no longer a strict separation between consumers and suppliers. Other developments in supply and demand affecting the distribution grids are developments like heat pumps, electric vehicles and self-supplying households. These developments make operating the grids more complex and require changes in the operation.

Some developments provide possibilities for operating the grids differently than historically has been done. Due to changes on the demand side (the increasing number of controllable loads) and developments in technologies for electricity storage, it becomes possible to shift the transport of electricity in time. This makes it possible to balance supply and demand without the need for grid capacity for high peak loads. More energy can be transported and the grids can be used more efficiently and flexible.

These aspects are treated in this section. First, the condition of the existing grids is addressed, while these are the starting point for a future grid. Then, the different developments we are facing that influence supply and demand are described by postulating the developments due to the energy transition to a more sustainable energy supply, and by describing the opportunities provided by the development in storage and load management of controllable loads.

Ageing assets

The largest part of the population of the electricity grids is from the period 1950–1980, with a peak in the 1970s (see Figure 10.3). This is caused by the strong growth in energy consumption in this period and the replacement of low and medium voltage overhead lines for cables in rural areas. The average age of different types of primary assets of Enexis lies between 20–40 years (Essent Network 2007). The inevitable consequence of the ageing of the infrastructure is an increase in failures of components and will result in a rising number of outages. To prevent this and to maintain the high reliability of the grids, it is required to develop a replacement strategy.

On the one hand, the need to replace assets makes changes in the grids possible. On the other hand, improving the reliability in other manners and more efficient use of the grids can delay necessary replacements.

The energy transition

Besides delivering affordable and reliable electricity, the DSOs have a responsibility to facilitate the transition to a more sustainable energy supply. As a consequence of the transition, the distributed generation is developing quickly and grids should be operated efficiently. Moreover, the liberalized energy market implies that

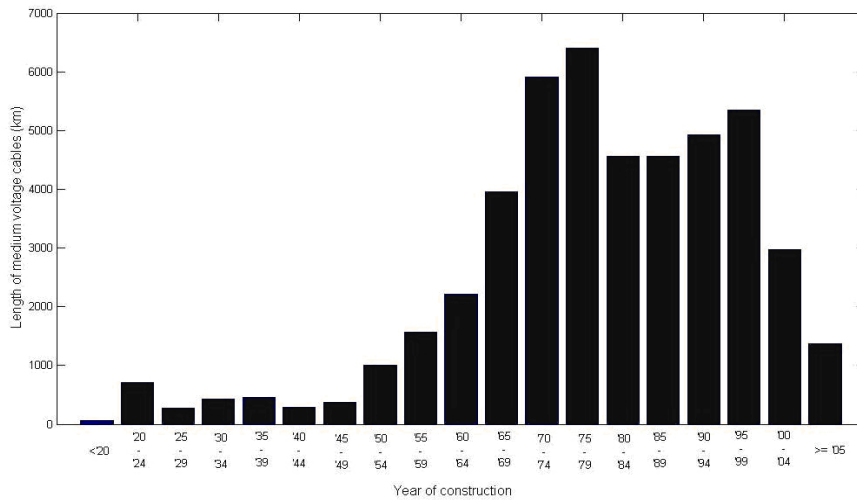


Figure 10.3: The age of medium voltage cables owned by Enexis

the utilities have no to little influence on the location of consumers and suppliers connected to the distribution grids. This makes the balancing between supply and demand more complex. The changes due to the energy transition on the supply side (decentralised generation located near end-users on the distribution level of the grid) as well as on the demand side, are treated in this section.

Distributed generation

The depletion of fossil fuel reserves urges for more efficient use of these resources and for the use of renewable energy sources. Stimulated by governmental incentives greenhouses connect combined heat and power (CHP) plants and wind power and photovoltaic solar panels take a growing share in the energy supply. All generation connected to the distribution system is called distributed generation (DG). Each different type of DG has, however, its own technical and commercial characteristics. Similar for all types of DG is that they have independent producers and often, the source is not located close to the demand. This especially accounts for wind power which is usually generated remote from the more populated regions. CHP is usually connected closer to the consumer but often primarily sized to the local heat demand and not to the local electricity demand. Another aspect of DG is the intermittent and fluctuating nature of the resource. For instance, solar power is dependent on the abundance of sun and absence of clouds. This makes the amount of solar power difficult to predict. Wind can be predicted better, however, wind can

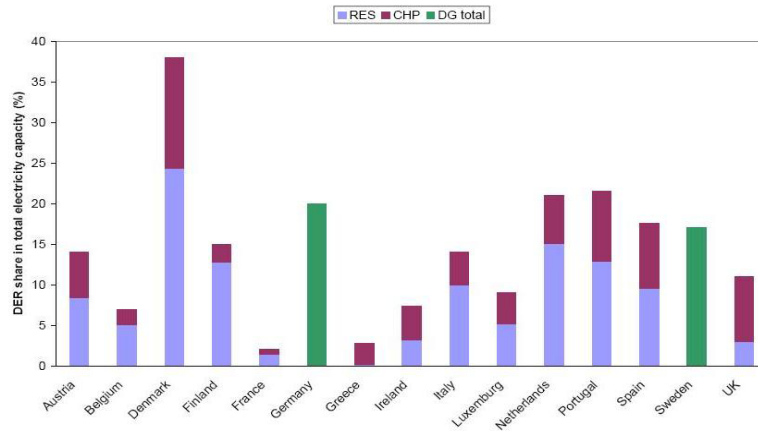


Figure 10.4: The amount of distributed energy resources in European countries (*Source: ECN 2007*)

fluctuate a lot. Figure 10.4 depicts the growing amount of DG in the Netherlands and other European countries.

The connection of DG to the distribution grids can lead to operating problems, such as voltage rise and an increase in network fault levels. This in combination with the intermittent and fluctuating characteristics makes the optimal use of these resources rather difficult and hampers their integration in the power system. Without any changes to the grids a high penetration of DG can only be reached by major grid reinforcements (Roland Berger Strategy Consultants 2008; Djapic 2007).

Changes on the demand side

Next to the changes on the supply side, the demand side changes as well due to the energy transition. Consumers start to produce energy themselves, and in that case need less energy from the grids. However, if they use for example solar energy and the resource is absent, they may still need to be fully supplied by the grid at peak moments. This means the load profiles of the consumers will be less predictable and differ more.

Other developments on the demand side include smarter household appliances, like a washing machine that may start running when the electricity prices are low, or the application of efficient technologies to save energy. Although these technologies may reduce the overall use of energy, they may lead to a growing demand for electricity. For example, the demand for electricity for heat pumps and especially electric vehicles would mean a substantial additional load for the electricity grids.

This does not inherently mean that it is difficult for the grid to cope with the

load added by loads like electric vehicles or heat pumps. The reason for that is that an important characteristic of these loads is that the exact moment at which the demand is fulfilled is less important than for normal loads. Processes with long thermal time constants can store the thermal energy for a long time and cars are on average standing still for at least 90 percent of the time. Therefore their demand for electricity is not time critical. This provides the supplier the opportunity to manage the demand in time. In the next section, the advantages of controllable loads are described in more detail.

Besides the application of flexible loads like heat pumps and electric vehicles, there are more developments providing opportunities to manage the demand side. The developments in and application of smart meters can support further integration of demand side management in the electricity supply system.

Controllable loads and storage

The grids are designed on peak demand. This is inevitable due to the fact that storage of substantial amounts of electricity has been technically and economically infeasible. However, new technologies become available for energy storage and the storage densities in storage devices have grown and costs have lowered. Moreover, the developments on information and communication technology make an optimal use of these storage techniques possible.

A large advantage of storage can be found in the fact that much can be gained by using the right resources at the right time and place within the grids. To this end, it must be possible to shift demand for electricity in time or, more precisely, to shift the transport of electricity in time. Distributed electricity storage provides opportunities to do this and it can also be realized by management of controllable loads as electric vehicles and heat pumps which were introduced in the previous section. The advantages that storage and load management of controllable loads offer in the changing energy supply, make it worthy to examine the possibility to integrate distributed electricity storage and load management in the distribution system.

An additional advantage of enabling distributed electricity storage or load management would be that it supports the integration of decentralised renewable energy sources into the electrical power system. To facilitate the integration of intermittent, distributed generation energy storage can store the energy produced by DG when the source is abundant and demand is low, and release the power during peak periods. This supports a higher penetration of distributed renewable energy sources without requiring major grid reinforcements.

Several other advantages of (distributed) electricity storage can be distinguished. From the broader perspective of the transmission system operator and/or commercial energy companies, an advantage of energy storage would be that it

supports maintaining the power balance within a control area or an energy portfolio. The fulfilment of this global, system wide requirement can as well be achieved by large-scale storage technologies, such as pumped hydro accumulation storage or compressed air energy storage.

Also storage, especially distributed storage which is applied closer to the customer, makes the system less dependent on the failure of network components and hence requires less redundancy of the system. This could improve the reliability of supply and thus counterbalance a reliability decline due to the ageing of the infrastructure.

A last benefit described here is a financial benefit. Besides the possibility to delay grid investments due to load growth or connection of DG, energy storage can generate value by charging the storage assets with cheap electricity in the off-peak periods and using this electricity during peak periods. It is, however, likely that the grid operator will not be allowed to exploit this benefit in a restructured energy sector although the technical and a commercial optimization of the operation of storage facilities overlap each other.

It can be argued that as long as load management by the DSOs does not lead to any inconvenience for the consumer, no (financial) compensation for the customer should be required. However, to put this in practice, in most cases regulation will have to be adapted because in most cases customers are given an unconditional right on using grid capacity and because the electricity market is based on the assumption that time shifting electricity demand is not possible due to lack of significant storage possibilities. Therefore, the exact description of how owners of storage assets are embedded into the energy market frameworks of the future is crucial for the quantification of benefits introduced by distributed energy storage (Klöckl et al. 2009).

Future grids

As a consequence of the energy transition, it becomes more difficult to balance supply and demand. Moreover, the grids must be operated efficiently. The grids need to support DG and integrate more flexible demand. To adapt to these changes the distribution systems will have to evolve into a more dynamic system. Concurrently, developments in storage provide opportunities to manage the grids more flexible and efficiently. Management of as well controllable loads as DG close to the end-users can increase the capacity usage of the system and result in more efficient use of our energy resources. The current status in power electronics, and in information and communication technology (ICT) can support this. The system will have to integrate controllable loads and storage facilities into the operation of the power

system and adjust (a part of the) demand to the fluctuating distributed supply of energy. The controllability of the loads and/or storage will allow for greater flexibility of the grids.

In this section, it is described in further detail how the electricity distribution grids need to prepare for the future. Furthermore, the definition of a smart grid is given and it is addressed that implementing these smart grids is more than adopting technologies in the grids.

Prepare for the future

The investment and replacement strategies which have been successfully deployed to the distribution grids until now, do not longer fulfil future requirements. The long-term optimization programme of Enexis showed that if the current replacement strategy is continued, the reliability will drop to an unacceptable level (Wijnia 2006; Essent Netwerk 2007). To maintain the high level of reliability, an intensive replacement programme is needed which will mean enormous investments. However, another possibility is to improve the reliability through increasing the speed of restoration after an interruption. This can be realized by the large-scale deployment of remote control on certain points in the medium voltage grids to detect and localise outages due to component failures. This makes it no longer necessary to rely on phone calls of people whose light and televisions turn off for outage detection and makes restoring the interruption much quicker. In this way, the increasing use of automated monitoring and control of the electricity distribution system can encounter the expected dropping reliability caused by an increase in component failures due to the ageing of the system.

A similar argumentation accounts for DG. Studies on this subject show that the penetration of these resources in the existing distribution grids is limited due to operating problems caused by them. To support a higher level of penetration of DG, the grids must be adjusted. One way is to invest in the capacity of the grids, but another solution can be provided by continuously monitoring and controlling the grid and the generators. With active management the penetration grade can be much higher (Zhang 2009). In several studies it is demonstrated that the costs for the needed ICT investments are much less than the investments for reinforcements of the infrastructure; automation technology is mature enough to justify investment in appropriate metering, communication and control (Djapic 2007; Berende 2008; Bell 2008).

Simultaneously, distributed electricity storage and controllable loads can be incorporated in the grids by applying more active network management. This contributes to a more efficient and flexible use of the grids and storage can also improve the reliability of the grids. Additionally, network losses can be reduced by applying

automation in the grids.

It can be concluded that the grids need to be adapted from a passive to a more active system to facilitate the transition of the distribution grids to sustainable power systems of the future. More active network management will ensure cost-effective development of an efficient and reliable electricity system that allows the integration of DG. With intelligent control embedded in the grids to incorporate distributed electricity storage and controllable loads the operation of the grids can be optimized and maximum utilisation of all resources connected within them can be achieved (Ilic 2006).

The definition of a smart grid

The term smart grids is a common denominator for a wide range of developments that make medium and low voltage grids more intelligent and flexible than they are nowadays. The term is gratefully utilized by developers of all kinds of intelligent devices to smarten the grid to address the capabilities of and need for their products. However, until so far, these developments tend to root in technological possibilities, rather than in a sound problem analysis and a structured approach towards its solution. Many of them have not found wide application, which can be at least partly be attributed to the fact that there were no problem for which they provided a solution, so that it was not possible to draw up a positive business case. In summary, there was too much technology push and too little market pull.

From the perspective of the DSOs, it now becomes more and more clear that active management of the grid to adapt the grids to future developments is the economic feasible solution to be able to keep reliably delivering electricity and to facilitate the integration of DG. In these smart grids, controllable loads and distributed storage facilities are integrated in the operation of the grids, and also DG is controlled (see Figure 10.5). Enexis believes an effective deployment of smart grid technologies requires a top-down approach. Therefore, Enexis is developing a vision on the role of the medium and low voltage grids in a sustainable energy future. With Enexis' vision becoming clearer over time, ever greater efforts will be spent on developing the appropriate and necessary smart grid technologies in cooperation with commercial energy companies, other grid operators and suppliers, as well as on increasingly focused discussions with the regulator and the government on the future energy supply and the role of smart grids in it.

A paradigm shift

Although the future grid builds on the existing infrastructure, the smart grid approach to operate the power system is completely different from how distribu-

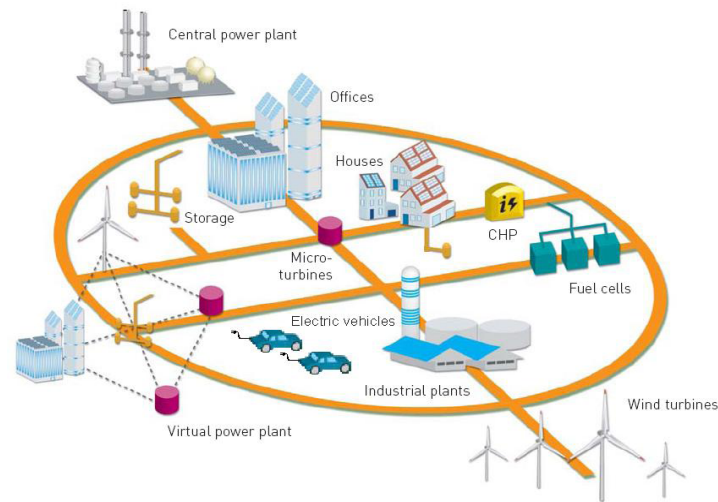


Figure 10.5: The smart grid is a grid with active network management to control integrated distributed generation, storage and flexible demand
(Source: European Commission 2006)

tion grids have been approached for decades. It provides a greater level of integration of as well generation as demand in the operation of the system. For the DSOs, this adaptation of the grids not only means that they have to equip the grids with technological innovations; but it also asks for a change in how they look at a set of technologies that can enable both strategic and operational processes. This not only accounts for the utilities, but also for policy makers and regulators who shape the environments in which the utilities can make the best strategic decisions. It is not a one-time solution but a long-term process towards a fundamental change affecting all actors, including consumers and suppliers.

A smart grid is an integrated solution of technologies delivering benefits for the DSOs. It can reduce costs for investments needed to address problems caused by ageing of the infrastructure and the energy transition. It adapts the grids to facilitate a growing share of DG and to the change in the demand of energy; it enables the grids to operate more efficiently and to keep reliability on a high level. But because of the higher level of interaction with generation and demand it also addresses customer and societal benefits. The integration and optimized utilisation of the renewable resources, the integration of storage to improve efficiency and reliability, and finding the economically best solution for the consumers and for suppliers of DG are all possible benefits. Commercial as well as technological optimization can be realized

by a smart grid. However, the benefits may not necessarily be equal for the different parties. For example, the goal of energy suppliers to economically optimize the utilisation of their generation units by balancing generation and demand may not necessarily equal the goal of the grid operators to optimize grid utilisation. In the end, the grids should facilitate the market, not constrain it. The overall cause will be to leverage the benefits of all parties involved and find the best solution for society.

While DSOs have a pure facilitating task they are at the moment not allowed to control generation and demand. The advantages of demand response and generation control by the operator must be seen by as well the owners of the distributed generators, the consumers and the governments which shape the market and regulatory mechanisms. So, on the one hand network management will evolve to include advanced applications to monitor, control, and optimize the grids and on the other hand to support these developments market and regulatory frameworks need to be addressed. All publications which write that smart grids are the solution to future challenges conclude that priority should be given to the necessary changes to meet market and regulatory requirements. Current commercial and regulatory arrangements often prevent appropriate automation measures from being implemented and without suitable adjustments it is not certain that benefits will indeed be achieved. This shows that solving questions related to the future power system calls for a holistic methodology, incorporating technical, market and regulatory aspects.

The next steps

The previous sections showed that a lot needs to be done to transform the electricity supply system. This transition process to the energy supply system of the future will take many years. Nevertheless, it is time to make progress to evolve to this future system and to focus on the first next steps to get there. This section is divided in three parts to describe the most important aspects to address at this moment. From a technological viewpoint it is important to focus on improvements in the field of storage technologies. Storage can bring a lot of benefits for future grids, but is not yet mature enough to be implemented. Subsequently, it is revealed that it is necessary to adjust regulatory frameworks to support investments and to make technological innovations in the grids possible. Also it is described in more detail what the role of market mechanisms is or may be in the deployment of smart grids. Finally, (international) cooperation is treated in this section. The importance of cooperation between all parties involved was already touched upon, but to realize an effective transition to smart grids it is a very important aspect. Fundamental and decisive choices have to be made and a lot of issues need to be considered from the

points of view of all parties.

Further development of storage technologies

The integration of distributed electricity storage in the electricity system plays an important role in the smart grids of the future. While energy stored in storage systems can provide consumers with energy in case a fault in the grid occurs, it can contribute to the reliability of the grids, and, therefore, it will make the grid less dependent on the components, the redundancy of the system and the time it takes to restore an interruption. Besides that, storage can facilitate the large-scale introduction of renewable electricity. A high penetration of DG without the need for large investments requires controllability. Distributed electricity storage creates this by adding an extra degree of freedom in the grids; it enables shifting the transport of electricity in time. This provides the possibility to flatten the load profiles to supply consumers from the storage facilities with electricity at peak moments and to charge the storage units when the generation of electricity is available but the demand is low. In this way, the efficiency of the utilisation of as well grid capacity as the resources available is improved. The principle of electricity storage allows for much more controllability and flexibility in the grids and is therefore an ultimate driver for successful smart grids.

Technological developments in the field of electricity storage, driven by its large-scale application in mobile ICT, have until so far led to batteries with a high specific energy density, high specific power density, high reliability and long lifetime becoming available as can be concluded from Figure 10.6. However, the technology is not yet easily available. Moreover it is not mature enough for wide application of storage in the operation of the grids. At the moment, the different techniques are still expensive. But new developments grow fast and will ultimately be an integrated part of the distribution grids. An important development towards economic availability of batteries is the development of electric vehicles. Although these cars are still expensive, because of the battery packs, large-scale application in electric cars will definitely lower prices. In this way, the contrast of applying electricity for powering cars are effectively overcome, and, while the advantages of electric mobility still hold, the electric cars are on the verge of breaking through (Enexis 2009). Subsequently, a growing share of electric vehicles connected to the grid will add a substantial controllable load that can be used as storage.

The possibilities, implementation and consequences of storage in the operation of the grid are not yet fully understood. To be able to use the opportunities that (distributed) electricity storage delivers as soon as possible, further research on this subject is necessary. Also, it is required that attention is paid to regulatory issues concerning storage. These will be further addressed in the next section.

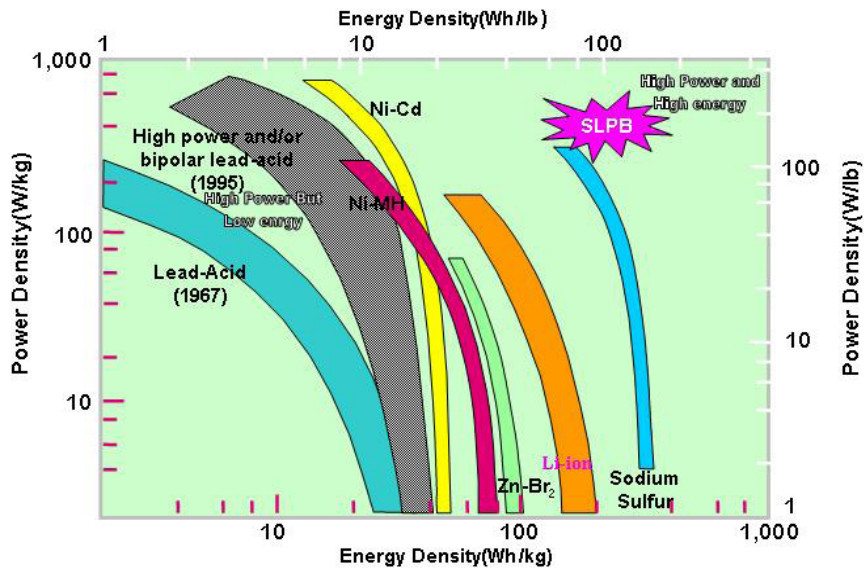


Figure 10.6: Characteristics of batteries (Source: Enexis 2009)

The role of regulatory frameworks and market mechanisms

The current regulation in the Netherlands emphasizes cost reduction and gives little attention to reliability and sustainability. This hampers innovation and implementation of new technologies in the grids. Large investments for innovation and also for replacement programmes are at this moment impeded by the regulation. Besides that, because of the monopolistic nature of DSOs, they are not allowed to control generation or demand or to apply storage in the operation of the grids. These matters can constrain a successful implementation of the smart grid.

Although liberalization was expected to be stimulating innovation, the current institutional framework relevant to the sector of electricity grids in the Netherlands has some important barriers for innovation that need to be altered to fulfil the critical function of radical innovation (Jonker 2008). The liberalization has a strong focus on cost saving and efficiency, and the focus of the current regulation is short-term. Furthermore, investment levels are based on history and benchmarking between grid operators (Nillesen 2008).

As a consequence, the current regulation does not necessarily stimulate DSOs to make the necessary or desirable investments. To support future investments and innovations the regulation of the energy sector needs to be altered. These investments

include investments to guarantee the reliability and quality of the grid and the investments needed to facilitate the generation of sustainable energy. The investment level of these investments is unpredictable and depends on a lot of factors. Above that, driving forces for investments come from a local level. Municipalities, project developers, producers and other parties make technological choices for generating and consuming energy. These choices have a different impact on local grids and thus on the investments. The sort of investments will differ, therefore, between regions in the Netherlands and the investment level will increase (Suurmond 2009). Although the regulator in the Netherlands confirms that, to ensure public interest in the future, large investments are needed, and that a better investment climate is desirable to realize this, they want to investigate the alternatives further before making changes to the regulation (Energiekamer 2009), which could take too much time given the importance and urgency of the challenges ahead.

To address long-term values, local differences and in particular inherent dynamic and unpredictable nature of future developments, the regulation need to be adjusted. Suurmond (2009) argues that this new regulatory framework needs to address the following issues, which are less important in a stable period. First, prevent future sustainable options to be hampered in their development in an early stage because the investments in the infrastructure have not been sufficient (technological lock-in). Second, promote cooperation over the whole value chain to match the construction of the future infrastructure with distributed energy technologies. Third, deal with divergent and conflicting interests of different parties, because conflicting interests can be a huge barrier to enable large-scale changes in the sector. Therefore, the role of every actor should be considered and the question how these actors should be regulated need to be answered. The regulator should quantify long-term values, facilitate negotiation between DSOs and market parties, define the public interest and make an indicative planning to make uncertainties explicit.

Besides the adjustment of the regulatory framework to change the investment climate for DSOs, it is necessary to explore possible market mechanisms to support future developments. To successfully integrate new generation technologies and use the grid efficiently, the control of not time critical loads and storage by the grid operator should be made possible. The current regulation and market mechanisms restrict this in two ways.

The first is caused by the fact that grid capacity is a local phenomenon. To stimulate efficient use of the local grid local price differences may be introduced. However, these differences in network tariffs may politically and socially not be acceptable given the monopolistic nature of electricity distribution. Hence, adapting regulation in order to socialize the vast benefits brought about by smart grids is a crucial success factor for large-scale implementation.

Also, in new market mechanisms to treat demand side management and storage the roles of the distributor and supplier may be reviewed. In most countries with a restructured electricity sector, the grid is not allowed to impose any restrictions on market transactions and should unlimitedly facilitate the electricity market. This principle implies that grid operators are not allowed to use the inherent flexibility of not time critical loads (as, for example, heat pumps and electric vehicles) without financially compensating the owners. In many cases, taking into account transaction costs, it will turn out to be cheaper to extend the grids than to structurally compensate the owners. Therefore, regulation must be changed in such a sense that in case control actions by the grid operator do not in any way hamper the customer, no compensation by the grid operator should be required. This fundamental but rational change would pave the way for smart grids by giving new degrees of freedom to the system operator, which can only be utilized by smarting the grid and therefore would strongly support the transition to a sustainable energy supply.

International cooperation

The depletion of fossil fuels and the climate change as a consequence of burning these fuels are widely recognized as serious threats to economic prosperity and even international stability and world peace. Therefore, securing the supply of reliable and affordable energy and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply need to be addressed on a global level (International Energy Agency 2008). On an international level choices need to be made to set clear policies and make our energy supply sustainable. Social acceptance and suitable regulatory frameworks are very important to make the policies work. Choices will help to formulate and implement solutions. Although many solutions will be implemented on a local level, future developments we face are similar in other countries and the solutions will often be the same. This makes it important to share knowledge on an international level and support the development of new technologies by setting standards and cooperation between DSOs, suppliers, other market parties and knowledge institutes. Cooperation over the whole value chain is a key enabler for a successful implementation of smart grids, paving the way towards a sustainable energy supply system (Kema 2008).

First, it is very important to make choices and define clear policies. The governments are responsible to deliver a policy for greener energy, greater energy efficiency and guard the availability of energy and quality of the energy supply system. They need to reveal the public interest and clarify this for the different parties as well as for civilians to gain social acceptance for their policies. The policies need to be discussed between the EU member states, while European laws, market mechanisms and regulation will influence national systems. The regulators face similar

difficulties in the different countries in Europe. For example, the United Kingdom was the first country to start liberalizing the energy market and the national regulator Office of the Gas and Electricity Markets (Ofgem), was the first regulator to understand that the regulation hampered essential innovations in the grids. Now, Ofgem started to adjust the regulation to support investments for innovation. This is done by developing possible future network configurations. Subsequently, the scenarios are used to establish views on the scenarios' implication for the grids to be able to determine suitable regulation for future needs and determine new tariffs (Ofgem 2008). Sharing knowledge about projects like these can be useful for regulators in other countries and help them to adjust the regulatory frameworks within the needs for their own nation.

For DSOs supporting the ability to make the right choices means that they will have to clarify the technological possibilities and impossibilities the grid has to deal with. It may also be useful for the DSOs to jointly formulate the best choices and the vision from a DSO's perspective as well as communicate with governments and regulators. Another role for the DSOs is to start up pilot projects to better understand the opportunities and risks of new technologies.

Besides the needed social acceptance for policies, there is a growing need for DSOs to cooperate and communicate with customers. Within the liberalized energy market and with more variability in the available energy sources customers have more choice and expect high quality, a high reliability of supply and efficiency. As a consequence, the customers have more influence and are more involved. Not only as consumers, but also as private individuals generating energy the customers of the electricity distribution system must understand the collective gain in the changes affecting them. This complicates the integration of generation and demand in the grid. Demand side management and controlling DG is for DSOs seen as a solution to add flexibility to the grid and improve operation, but for customers this is perceived as a problem while it may harm their rights. Until now, customers are given an unconditional right on using grid capacity. This may need to be limited to introduce demand side management. Also, in case of exchanging data for optimal control systems privacy issues need to be regarded.

Smarting the grid for better control of the electricity flows in the grid enabling more efficient use and better integration of distributed, renewable sources and new demand side technologies requires exchange of data and information between the energy suppliers, the grid operators and the consumers of the electricity. This calls for good communication between these parties and agreements on the application and specifications of technologies should be made. It is the responsibility for manufacturers of these technologies to clarify the future product requirements in consultation with the grid operators and possible other users. Pilots initiated by grid

operators can demonstrate new products and initial research and consultation in pilot projects can be provided by research institutes and universities. This accounts for all kinds of technologies, for the development of the desirable components for further automation of the grid and power electronics, but also for storage and end-user technologies like controllable electric vehicles. The electric vehicle is an example that shows that cooperation between all different actors is very important for the development and especially the adoption of new technologies in society. It is necessary to work together on an international level to set standards and conquer barriers that may hamper important steps towards a sustainable energy supply. Some technologies are still in an early development phase, like energy storage. Although developments so far gave a huge boost in the application of electricity storage, research activities in this field may still be increased. Other technologies are already mature enough for implementation, starting with the application in pilot projects. But for a successful development and a good selection of the best technologies it is very important that knowledge is shared and powers are bundled, on as well a national as an international level.

Summarizing, it is an established fact that cooperation with all different parties involved in the energy sector is an indisputable necessity to be able to adapt the energy supply system for future needs. Governments and regulators will need to determine the right policies, set the suitable frameworks, reveal the public interest and protect long-term values. The development of technologies can only be successful when DSOs, market parties, research institutes and customers work together. Taking into account the benefits for and impacts on all parties, sharing knowledge and involving consumers are necessities to successfully deploy the smart grids that meet the needs of all and that support the public interest best.

Conclusion

In the current, ageing distribution systems very little automation is embedded and the ratio between used and available capacity is relatively low introducing a great potential to transfer extra energy with the existing capacity of the grid. New developments towards a more sustainable energy supply system require the support of DG, integration of more flexible demand and a more efficient use of grid. Also, due to liberalization of the energy sector and the connection of generation on the distribution level of the power system, there is no longer a strict separation between suppliers and consumers. As a consequence, it becomes more difficult to balance supply and demand. All this leads to the need to adapt the energy supply system and apply more efficient and flexible grid management. Additionally, developments in storage and the possibilities to control flexible loads provide possibilities

to do this. This calls for a different approach of grid management.

The grids need to be adapted from a passive to a more active system in which storage, controllable loads and DG are incorporated. Active network management will ensure cost-effective development of an efficient and reliable electricity system that allows the integration of DG. With intelligent control embedded in the grids to incorporate electricity storage and controllable loads the operation of the grid can be optimized and maximum utilisation of all resources connected within them can be achieved.

The evolvement to these smart grids is not a one-time solution, but a long-term process towards a fundamental change affecting all actors. Governments and regulators need to determine the right policies, adapt the regulatory and market arrangements that no longer suffice, reveal the public interest and protect long-term values. Cooperation and knowledge sharing between DSOs, market parties, research institutes and customers is needed for a successful development and integration of technologies. It is important to take into account the benefits for and impacts on all parties to develop the energy supply system that supports the public interest best. Cooperation between countries as well as between the different aspects over the whole value chain is of importance. It is a versatile theme that asks for a holistic approach, incorporating technical, market and regulatory aspects. Cooperation with all different parties involved in the energy sector on as well a national as international level is vital to successfully develop the smart grid and put it into practice.

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Part IV

Telecommunications

The public interest, spectrum markets
and the American experience with radio regulation:
historical and comparative lessons
for the European Union

Michael R. Fein

This chapter reflects on radio spectrum management in the United States, with the aim of identifying useful historical and comparative lessons for European Union policy makers as they contemplate the adoption of pan-European market mechanisms to allocate radio frequencies. It explores the history of American radio regulation and the impact of conflicting interpretations of that history on contemporary policy debates surrounding the liberalization of spectrum markets. The public interest theory of policy making has long been critiqued as inappropriate to spectrum management by economists following the lead of Ronald Coase. But the American experience with radio regulation suggests that economic efficiency, consumer welfare and the promotion of technical innovation are better understood as variants of the public interest, and ought to be weighed against other public interest dimensions of broadcast regulation, including the importance of preserving localism and diversity on the airwaves.

Between 2001 and 2005, the United States (US) Federal Communications Commission (FCC) was locked in a pitched battle over the policy changes advocated by then FCC Chairman Michael Powell. In a sweeping deregulatory initiative, Powell had recommended a striking series of rule changes designed to eliminate long-standing regulatory barriers to spectrum allocation by easing a variety of media ownership prohibitions. The move sparked a heated public debate that pitted large media corporations against a growing media democracy movement, committed to the preservation of broadcast diversity and composed of independent media organizations, and labor, consumer, religious, parent and other activist groups. Economists entered the debate early on in support of deregulation, arguing, in one instance, that the Commission could best 'advance the public interest' by eliminating regulatory barriers to the productive use of radio spectrum' and expressing their wish that 'momentum builds to go much farther than the modest measures' already

proposed by the FCC (Rosston and Hazlett 2001).

At first glance, there is little surprising about these recent developments or the role economists played in them. Ronald Coase (1959) redefined the study of American broadcast regulation in a landmark article by rejecting the prevailing notion that the establishment of the Federal Communications Commission served the public interest. Rather, he claimed that the complex regulatory apparatus developed under the Federal Radio Act of 1927 and recodified in the Federal Communications Act of 1934 was built on the flawed assumption that scarce resources—in this case radio spectrum—had to be allocated by government fiat. In the decades following the publication of this seminal article, his claims about the faulty economic reasoning that underpinned American radio regulation have gained wide acceptance.

There is, however, one oddity worth exploring: in their push for spectrum deregulation, Coase and subsequent analysts of radio regulation, in particular economist Thomas Hazlett, have subjected public interest arguments to withering critiques. How ironic it is, then, that scholars such as Hazlett (1990), who, in their scholarship are quick to attribute the actions of legislators and regulators to self-interested, rent-seeking behavior, have nonetheless lobbied hard for deregulation, and done so explicitly on public-interest grounds.

Though the public interest theory of policy making has long been dismissed as naïve, the history of radio regulation in the US suggests its remarkable staying power. Indeed, proponents of the media democracy movement and their allies in Congress and the US court system used similar public interest language to beat back many of the rule changes proposed under Powell's chairmanship. In brief, they put a check on changes that would have further consolidated television, radio and newspaper ownership in the US.

Notions of the public interest, however defined and however difficult to define, have been and still are of tremendous importance in shaping the spectrum policy debate (Moss and Fein, 2003). Economists' and regulators' efforts to equate the public interest with narrower ideas about consumer welfare downplay the significant role non-efficiency matters played in the establishment and development of the American regulatory regime (Hazlett, 2001).

Indeed, a careful analysis of the origins of American radio regulations is instructive on this point. Multiple forces set in motion the establishment of the Federal Radio Commission (FRC) in 1927: the limited nature of the radio spectrum, concerns over interference by broadcasters competing for bandwidth, desire for economic efficiencies, and—most important of all—anxieties over the potential political concentration of broadcasting powers. Coase, Hazlett and other economists have long advocated the use of market mechanisms to more efficiently allo-

cate radio spectrum, and over the years their work gained significant traction at the FCC. In both academic and policy circles, their arguments undermined the public interest model—with its focus on the relationship between media diversity and democracy—as the theoretical foundation for radio regulation in the US. Moreover, public interest theory has faced further challenges with the opening up of new media outlets, such as cable television and the internet. This has made concerns about monopolizing the airwaves appear less compelling.¹

And yet there are good reasons to conclude that it is too soon to write an obituary for a public interest defense of spectrum regulation. While economic pressures continue to raise serious questions about the scale and scope of the media consolidation movement, the story here was never really about anti-competitive behavior of media conglomerates. Interest in preserving localism and diversity of expression has always been distinct from the narrower politics of anti-trust. In the American experience, there is little evidence to suggest that interest in preventing the political monopolization of the airwaves will go away anytime soon. Indeed, these concerns—so critical to the evolution of early spectrum management policy—were at the heart of the recent federal court case, *Prometheus Radio Project vs FCC* (2004). Here the court delivered a stinging defeat of the FCC's proposed rule changes, calling them unjustified, arbitrary, and capricious, and doing so on public interest grounds. In the words of the court, all the proposed FCC recommendations 'have the same essential flaw: an unjustified assumption that media outlets of the same type make an equal contribution to diversity and competition in local markets.' Moreover, the court ruled that 'no matter what the Commission decides to do to any particular rule . . . it must do so in the public interest and support its decision with a reasoned analysis.'²

The historiography of radio regulation chronicling these debates has significantly shaped the way American regulators have defined the public interest. There can be little doubt that Coase's ideas about the optimality of a market-based approach to spectrum allocation have ended up playing a central role in driving the deregulation of the industry. Since the 1990s, a series of FCC chairmen has cited Coase's work as having provided the theoretical underpinning for weakening FCC

1. Importantly, studies reveal that most people continue to receive local news from traditional sources (local newspapers, radio, television) rather than cable or internet sources (Cooper 2006).

2. Note Judge Sciria's dissenting opinion makes the argument that sometimes spectrum regulations have been relaxed based on the economic hardships they cause, citing, for instance, deregulatory moves in the 1970s that allowed for AM-FM cross ownership when it appeared that such cross ownership was necessary for FM radio survival. But the occasional trumping of diversity concerns with economic efficiency ones is not an example of FCC inconsistency. Rather it is an acknowledgement that the public interest standards of localism and diversity can *sometimes* be achieved through the loosening of regulatory restrictions. It does not follow that any contemplated loosening of such restrictions *necessarily* serves the public interest.

regulations. And yet, while Coase's policy conclusions have since gained wide acceptance, the historical work on which they are based has taken quite a beating. For instance, Coase (1959) had contended that legislators failed to adopt a price-rationing mechanism to allocate radio spectrum simply due to poor economic reasoning. By contrast, Thomas Hazlett (1990) has argued that federal lawmakers of the 1920s were in no way blind to the property-rights option that Coase suggested they were unaware of. Rather, as Hazlett sees it, legislators knowingly rejected a property-rights solution in favor of a command-and-control regulatory framework that would serve policy makers and incumbent broadcasters. At the heart of Hazlett's critique was a rejection not only of Coase's 'error theory' of radio regulation, but also a rejection of the public-interest theory of policy making that lay behind it. In Coase's version of the story, policy makers seemed to have meant well, failing to adopt a property-rights solution—and thus failing to serve the public interest, according to Coase—only as a result of bad reasoning, not of bad motives. By contrast, in Hazlett's version, lawmakers were fully aware of the property rights option but rejected it on the basis of 'self-interested rationality.'

These distinctions matter, because these readings of the historical record—and I would argue that they are misreadings—have had profound policy implications. If Hazlett were correct, then surely one would be hard-pressed to defend a system that sacrificed consumer welfare to the whims of rent-seeking legislators. But, as it turns out, there is only weak evidence to support the contention that lawmakers subordinated the public interest in establishing a regulatory framework for radio in the 1920s, as Hazlett maintains.³ And the oft-repeated claims made by legislators and judges about radio's limited spectrum, which first prompted Coase to advocate a law-and-property-rights solution, in fact had less to do with their desire to find an economically efficient allocation of scarce bandwidth than with their determination to prevent a potentially dangerous concentration of political power (Moss and Fein 2003). Coase and Hazlett have argued that efficiency concerns were—or at least ought to be—paramount in asserting the public interest. But the historical record reveals that it was in fact democratic principles that came into conflict with—and ultimately eclipsed—economic ones in the legislative debates of the 1920s.

The regulatory framework for American radio broadcasting that emerged during this period was catalyzed by a series of critical events. First, in 1923 and 1926, federal courts ruled that Congress had, in fact, not granted the Commerce Department discretionary power over radio licensing in the Radio Act of 1912, which was designed to cover only point-to-point communication. Then, the Commerce Department responded, perhaps strategically, by allowing wave jumpers to broadcast

3. For instance, Moss and Lackow's (2008) close analysis of the FRC's historical record reveals more disconfirming evidence of the capture thesis, particularly in the critical FRC decision not to expand the radio spectrum in 1927.

at will, allowing chaos to consume the airwaves. In the midst of this, a federal court allowed one of these wave-jumpers the right to homestead on a frequency within 50 kilocycles of a more established station with a longer record on the contested frequency. At this point, Congress moved decisively to pass the Federal Radio Act of 1927 (Twight 1998; Hazlett 1998). In so doing, Congress short-circuited the possibility of establishing property rights in the spectrum, resolved the interference problem, and, most importantly, created the public interest standard to ensure that control of radio would not be concentrated in too few hands. Importantly, what drove legislators toward a regulatory rather than a common law solution was the combination of spectrum scarcity on one hand and radio's enormous political significance on the other (Moss and Fein 2003).

As legislators coalesced around a regulatory solution to the spectrum allocation problem, and as the courts offered critical backing to subsequent FCC regulatory actions, they drew several important conclusions. The first was that political monopoly and economic monopoly were two different things. Legislators and judges were in agreement that establishing tradable rights in the spectrum could produce a dangerous concentration of media control that was conceptually distinct from narrow notions of anti-competitive activity. The public interest standard allowed the FCC to block consolidated control of the airwaves in advance of corporate action; by contrast, weaker anti-trust provisions barring activity in restraint of trade could only be imposed after the fact. Again and again, courts defended the FCC's efforts to promote diversity and localism on the airwaves by distinguishing a socially desirable allocation of spectrum from an optimal economic one. The kind of scarcity the court was concerned with—the lack of a diversity of viewpoints on the airwaves—would hardly be solved by a price-rationing mechanism, and so the courts repeatedly rejected that form of spectrum valuation.

The second and related finding that emerged from these legislative debates and judicial decisions is that spectrum policy would not be determined with reference to abstract principles applied on a national scale. Instead, it would be hashed out at the community level, often in the context of particular urban markets.⁴ For instance, when legislators first debated creating the FRC back in the late 1920s, Congressional legislators repeatedly voiced concerns over preserving diversity on the airwaves. Senator James Couzens of Michigan quizzed a representative of the Commerce Department over the already over-crowded Chicago market. With 40

4. See *National Broadcasting Company vs United States* (1943), which Coase used to critique Justice Frankfurter for upholding FCC regulatory framework on narrow scarcity grounds. In fact, Frankfurter's decision was much more sophisticated. He reasoned that, absent a public interest standard, there was nothing to prevent a community that could only support two stations from having one person broadcast the same material over each. The FCC standards of localism and diversity were justified on the grounds that they could ensure that stations would be evaluated based on their responsiveness to the needs of their communities of license.

stations in the area, Couzens argued that there was no current danger of freezing out competing voices. If tradable rights were established in the spectrum, either directly or through the creation of secondary markets for radio licenses, Couzens believed that the result would be the monopolization of the whole district. Were radio simply a resource like any other, most legislators would have been content to allow the Justice Department to pursue anti-trust actions to address combinations in restraint of trade. But again and again, legislators described radio as a 'potent' political force that could 'mold and crystallize sentiment' like no other. Such logic was almost uniformly accepted. In fact, it underpinned another section of the FCC's enabling legislation, a prohibition on foreign ownership of radio stations, in order to ensure, as one member of the House of Representatives put it, with a shade of jingoism, that 'the means of communication within our borders should be in the hands and control of those loyal to our country' (Moss and Fein 2003).

The distinction between political and economic monopoly, the prohibition on foreign ownership, the emphasis on ensuring diversity of viewpoints within local markets, the commitment to preserving an open marketplace of ideas: all these were consistent with prevailing definitions of the public interest—with regard to spectrum allocation—that reigned throughout much of the early and mid-20th century. But as such public interest claims have been dismissed as either politically or economically naïve in more recent decades, it has become increasingly difficult to defend the old regulatory structures, or to justify any regulatory reform that maintains a commitment to preserving the public interest dimensions of broadcast regulation.

What lessons can European Union (EU) policy makers draw from Americans' past and current experiences with spectrum allocation, as they contemplate a shift toward international spectrum markets? Above all, it is imperative that they not replicate the American debate, which pits, often in a starkly oppositional way, public interest claims made by those committed to media democracy against efficiency claims made by free-market advocates, who define the public interest in the narrower sense of consumer welfare (Hazlett 2001). Better to accept the notion that economic optimization, efficiency, and maximization of consumer welfare are, themselves, particular variants of the public interest; and that a robust debate over how best to weigh competing visions of the public interest is essential, even if the exercise produced, as it surely would be in the international context of EU policy debate, uncertain conclusions.

The absence of such a robust debate has hamstrung real regulatory reform in the US for much of the recent past, with little in the way of a common language to support such dialogue. During this time, the FCC has largely been under the sway of Coase's economic theory, culminating in Michael Powell's pursuit of sweeping

deregulation in 2003, and followed by more piecemeal attempts at policy change by his successor, Kevin Martin. Meanwhile, media democracy advocates won a major victory in the *Prometheus* case, in which the court appeared to validate their concerns over the impact of deregulation on corporate consolidation of the media, over the loss of diversity on the airwaves, and the homogenization of news offerings at the expense of meaningful local broadcasting options.⁵ Had Powell paid greater heed to the federal court's long-standing commitments to preserving the public interest dimensions of radio and television broadcasting, the very same commitments dismissed by Coase and Hazlett as unwarranted, perhaps he might have crafted a set of deregulatory policies less likely to be derided by the courts as 'arbitrary and capricious' (*Prometheus vs FCC* 2004).

This, then, is another lesson for EU spectrum allocation: the public interest dimensions of the radio spectrum cannot simply be imagined away in pursuit of a new system of spectrum allocation governed by free markets. Once a regulatory pattern has been set in place, either in the US or in EU member states, the adoption of market mechanisms is certainly not a neutral activity (Akalu unpublished). Deregulatory policy, like regulatory policy, will continue to generate winners and losers; favor some technologies and uses over others; advance or limit the consolidation of corporate control over these technologies; serve one version of the public interest over others; advance one nation's vested interests over another's. Which variant of the public interest is most vital? The one that privileges economic efficiency? Technological innovation? Consumer welfare? The pursuit of localism and diversity? The vitality of democracy? While these questions defy easy, statistical analysis, they remain the most important ones to address.

The final lesson to draw from the American experience is the significance of localism. Much of the debate surrounding American radio regulation has revolved around the political significance of broadcasting, and the fundamental contests over competing ideas of the public interest. These contests have largely hinged on the desires of particular corporations seeking particular media outlets in particular markets. All of the landmark court decisions and legislative debates turned on these issues: from wave-jumpers sending the overcrowded Chicago market into chaos in the late 1920s to Rupert Murdoch, in 2008, seeking waivers from the FCC to allow him to control two television stations and three newspapers in New York City, despite rules limiting such extensive cross-ownership in the nation's top 20 markets (Becker 2007; Labaton 2008).

The FCC has discovered no easy way to resolve these issues. Even now, in 2009,

5. I write 'appeared' because the federal court gave the FCC a chance to better justify its rule changes. It chose not to reverse the rule changes, only to remand them for further consideration. The Bush administration decided not to pursue the case further and instead opted to pursue a more modest deregulatory agenda.

long-standing opponents to spectrum deregulation have apparently reversed themselves, entertaining the possibility of lifting the market caps and cross-ownership bans in order to encourage the injection of new capital into failing city newspapers. Certainly EU policy makers seeking to adopt a larger role for markets in the allocation of radio spectrum will face even greater challenges in preserving diversity of ownership and localism in media coverage across a variety of urban markets within multiple member nations.

In seeking useful historical and comparative lessons for EU spectrum management, there are, no doubt, other factors and forces that I could have addressed here: the differences between broadcast and non-broadcast regulation, the expansion of media outlets, the importance of recalibrating spectrum management policy in order to take greater advantage of emerging technologies. I've chosen to focus on the connections between media and democracy, however, because it is this relationship that has stood at the heart of the US regulatory debate since the 1920s, and remains no less relevant today.

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The internationalization of internet governance

Y.J. Park

Starting from 1998, the government of the United States took up responsibility for creating and overseeing the Internet Corporation for Assigned Names and Numbers. That Corporation manages the global infrastructures of identifiers on the internet. Beginning with 2003, the United Nations has addressed lack of internationalized coordination mechanisms in managing critical global internet infrastructures through World Summit on the Information Society and Internet Governance Forum. Those who are engaged with the Forum's Global Internet Governance negotiation, as of 2009, are divided into two groups: those who demand immediate change including the government of China; and those who support gradual change without discussing when and how such change can take place.

The internationalization of the internet governance touch upon the challenges of establishing a global coordination mechanism for the globalized domain name system (DNS) and internet protocol (IP) addresses. Under our globalized environment, the internet is a part of our daily life. However, certain centralized features of the management of the global internet infrastructure are in the hands of one government—the government of the United States (US)—without a global consensus. The power imbalance at the global institutional level has been addressed by governments and civil society since the 2003 United Nations (UN) World Summit on the Information Society (WSIS). As the consequence of the contention in WSIS between those who asked for globalized and inter-governmental internet resource management and those who supported the current status quo of US's oversight of a private sector-led institution, both parties compromised to host UN Internet Governance Forum (IGF), from 2006 till 2010. This chapter explores the challenges of the internationalization of the internet governance.

A regime of contractual relationships

The Internet Corporation for Assigned Names and Numbers (ICANN) is sustained

by a series of contractual relationships with several parties involved in the management of internet addresses. It has contract with generic top level domains registries like <.com> and <.org>; country code top level domains registries like <.uk> and <.nl>; registrars like GoDaddy and TuCows; and the US Government. ICANN's contracts with the US determine whether the Corporation has the authority to perform its missions.

ICANN has two main contracts with the US as of 2009: the Joint Project Agreement (JPA) is scheduled to expire in September 2009; and the Internet Assigned Numbers Authority (IANA) contract runs until September 2011. At the beginning of ICANN's launch, the US Department of Commerce made it clear that ICANN will experience transition from US government's sole control to a global institution when ICANN is ready to be on its own (US Department of Commerce 2000).¹

The Joint Project Agreement

The first round of oversight contracts between ICANN and the US Department of Commerce (1998–2006) were called as Memorandum of Understanding. The parties are actually under their sixth round of contract (2006–2009). The contract between is now called JPA that allows the US to monitor regularly ICANN's performance. With the upcoming expiration of the sixth contract, the global internet community is debating whether the JPA should be extended or not (US National Telecommunications and Information Administration 2009). Regardless of the global internet community's debate on the future of JPA, the recent US Congress Hearing of Committee of Energy and Commerce in Washington, in June 2009, demonstrated US government's strong will to extend the contract (Congress Hearing 2009).

The Internet Assigned Numbers Authority

If JPA is a symbolic contract that recognizes US as ICANN's supervising authority, IANA contract provides the US with a mechanism to intervene in the operation of the global internet. Milton L. Mueller stressed that the US Department of Commerce has right to audit, control modifications to the root zone file. The IANA contract, therefore, is considered as the key framework of ICANN. The lesson from the recent JPA discussion is how the global internet community can collectively identify an institution that can replace the role of the US before 2011. Yet the US will most likely not give up the IANA contract.

1. In withdrawing the US Government from DNS management and promoting the establishment of a new, non-governmental entity to manage internet names and addresses, a key US Government objective has been to ensure that the increasingly global internet user community has a voice in decisions affecting the internet's technical management.

The Cyber Security Act of 2009

The recently presented Cyber Security Act 2009 proposes that 'National Telecommunication and Information Administration (NTIA) cannot renew or modify IANA contract unless a proposed Cyber Security Advisory Panel considers the commercial and national security implications of the action and approves it' (US Congress 2009). The current legacy structure of contracts with the US provides leverage for its interference. Mueller predicted that this situation will provide an impetus for other governments to get involved. He raises the questions: 'Why should US have special powers? Why intergovernmental control and interference?'

Dynamic evolutions and global internet governance

With the expiration of the JPA contract in late 2009, the UN Secretary General's requirement to make decision on whether IGF will be continued after 2010, the expiration of IANA contract in 2011, and another WSIS Review in 2015, the global internet community keeps presenting the challenges of the internationalization of internet governance as a legacy from the WSIS. Meanwhile ICANN has conducted its ceremonial internal reform in the name of the Increasing Institutional Confidence Initiative under the pressure of internationalization outside.

Early in 2009, Norwegian and Dutch government organized a workshop on the internet governance. The European Commission (2009) also organized a workshop on this theme in May 2009. Just the day before this workshop, Viviane Reding, the Information Society and Media Commissioner, proposed an alternative to replace the US government. According to Reding's proposal, twelve geographically balanced government representatives should supervise ICANN. However, she did not identify who the twelve countries would be (Reding 2009).

A few days later in Geneva, during an IGF open consultation meeting, China made the following intervention asking for a new intergovernmental forum to discuss the internationalization of internet governance:

We feel that the IGF has contributed a great deal in light of its historic mandate. . . . But it's not enough for developing countries who don't have enough resources and don't have the capacities to participate in this kind of dialogue without further commitments being made, which is why the points of views of developing countries, especially when it comes to Internet Governance, . . . are not sufficiently reflected in our discussions, which is why we don't agree that the IGF should continue its mandate after the five years are up. (UN Internet Governance Forum Open Consultation Meeting 2009)

China's official position disagree with extending IGF's mission beyond the five years

period. Indeed, is plead for an evaluation of the results being achieved through an intergovernmental discussion.

Continue or discontinue

Despite this strong intervention from China, IGF is expected to continue. After three years of IGF meetings (2006–2008), those who are defensive of US government's role in the governance of internet learned that IGF can be useful to consolidate the current governance structures, because IGF was created mainly to discuss the issues without decisions. IGF became an effective tool to incorporate the developing world to the current internet governance framework through development discourse and educational workshops.

The possibility of IGF becoming a substantial institution disappeared, therefore, those who had been worried about the creation of IGF during WSIS, ironically, became strong supporters of IGF. Those who explored IGF with a hope that it will be able to address the core issues of global internet governance. These issues concerns country codes top level domains delegation and re-delegation mechanism, coordination and institutionalization of root server operators, globally accountable supervision of ICANN and the creation of multilingual names in the top level domains. Yet they realized that IGF had degenerated into an annual meeting of the global internet community.

The upcoming 2009 Sharm El Sheihk IGF's programme recently published confirms it as an annual meeting for the global internet community (UN Internet Governance Forum 2009). This year meeting will broadly discuss privacy, openness, security, access, diversity and critical internet resources on the internet; but it will decides nothing for two days out of four-day event. The rest of the programme will be allocated to keynote speakers, opening and closing ceremonies.

Governments' agony in the new rules and new settings

Peter Anker, from the Dutch Ministry of Economic Affairs, discussed how governments will be able to adjust to the new settings of global internet governance negotiation without knowing the role of governments. Anker declared that 'the definition of internet governance provided by WGIG (2005) refers to governments as one of stakeholders together with civil society and private sector. However, it is unclear what roles are expected from governments. Anker added that 'government should provide continuity, stability, interoperability, security and privacy of the internet ensuring consumer protection.'

Revisiting to the principle of multi-stakeholder

In 2010, IGF only one year ahead, those who challenged the US's sole control in global internet governance during the WSIS have raised the following issue. The multi-stakeholder principle in global internet governance should be reconsidered. Moreover negotiations among only state actors should be developed. Such reaction came from the fact that the multi-stakeholder principle applied in global internet governance turned out to be non-state-actor-oriented process, by making state actors as observers, which is very unusual. It has been quite different from the typical UN's state-actor-oriented multi-stakeholderism in other global negotiations like climate change negotiation.

A look at the future

At the conference, Viktor Mayer-Schönberger shared his views of how US, China and the European Union are responding to the challenges of the global internet governance. He said that:

The US under Obama administration will be re-nationalized with rhetoric of responsibility. US is going back to 20th century New Deal. China will also reshape multi-stakeholderism into mulilateralism de-emphasizing rights debate through rhetoric of ethics and order. China is going back to 20th century Sun Tzu Realism. EU is going to replace multi-stakeholderism to multilateralism confirming the private sector leadership principle in ICANN. EU is going back to 20th century multilateralism redux with a strategy to replace structures and processes arguments with substance.

Conclusion

Under this dynamic global internet governance situation, many are still skeptical about the possibility whether the US is willing to transfer ICANN to the hands of a globalized institution. As of 2009, ICANN regime is still an immature regime. It is used as excuse to sustain the current US government's leadership by stakeholders involved in the negotiation. The main challenge of ICANN and the global internet community ahead is how to present the legitimate institution that can replace the role of US realistically before 2020. Success of such a task will depend on how the second round of IGF after 2010 will be developed.

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Part V

Water

International developments in the water sector with a view toward achieving the Millennium Development Goals

Dennis Wichelns

For several decades, investments in infrastructure in the water sector have not kept pace with the increasing needs for such investments in many countries. As a result, many residents of developing and industrialized countries lack access to reliable supplies of clean water and sanitation. In addition, many farmers have inadequate access to water for irrigating crops and raising livestock. These problems are most severe in developing countries, where new investments in water infrastructure are needed to support achievement of the Millennium Development Goals adopted by member countries of the United Nations. Investments are needed also to ensure that future supplies of food and fiber will be sufficient to meet increasing demands, while maintaining desired levels of environmental quality and sustaining important natural resources. We describe the types of infrastructure investments needed in the water sector and in complementary activities to achieve the Millennium Development Goals and to provide sufficient food and fiber for a world population that likely will exceed 9 billion persons within 40 years. We discuss also the roles of the private and public sectors in bringing about the necessary investments.

Water scarcity is largely a local or regional phenomenon that often has national or international implications. The gap between water needs and water availability is felt most keenly in households, on farms, in communities, and along rivers from which many households, farms and communities obtain their water supplies. The direct costs of water scarcity include the health implications, lost income and food insecurity at household and community levels. Indirect costs, or secondary impacts, can include reductions in regional output and economic growth rates, productive inefficiencies caused by misallocating water and other inputs, and any conflicts that arise as households or communities compete for limited water resources. National and international implications include the costs of providing relief to water scarce areas, resolving regional conflicts, and moving residents away from areas that can no longer support viable livelihood activities.

The international community suffers also from the opportunities lost due to increasing water scarcity. Inadequate water for crop and livestock production can limit the growth rate in global food supplies (Molden et al. 2007). The health implications of inadequate access to safe and reliable water and sanitation can reduce labor productivity, thus reducing economic output, employment opportunities, and wage rates. Education rates also are impacted when household members must spend large amounts of time fetching water supplies from distant sources and when children are persistently unhealthy, due to consumption of unclean water or exposure to unsanitary conditions (Buor 2004; Bardasi and Wodon 2006). Inadequate education compounds the problem of declining employment opportunities and falling wage rates in water scarce areas. By contrast, higher rates of educational success often are associated with greater employment opportunities, rising wage rates, and declining birth rates, particularly when girls and women obtain higher levels of education (Schultz 2002; Herz 2004).

Objectives

The Millennium Development Goals (MDGs), adopted in September 2000 by member countries of the United Nations, reflect the international community's interest and responsibilities in assisting developing countries to reduce poverty, improve food security and enhance livelihoods (UN 2008). Several of the eight MDGs pertain directly or indirectly to issues involving water scarcity or inadequate access to clean and reliable water and sanitation. The MDGs include long-term goals, such as ending extreme poverty and hunger, ensuring universal access to primary education, and reducing child mortality. Each goal comes with one or more interim targets to be achieved by 2015 or 2020. Examples include the interim targets of reducing by two thirds, between 1990 and 2015, the under-five mortality rate, and halving by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation.

Investments in water infrastructure and in complementary activities, such as rural roads, transport systems, and telecommunications, are needed to achieve the MDGs and improve the quality of life for millions of rural and urban residents of developing countries. In recent decades, the pace of investing in water infrastructure has declined internationally, due partly to the rising cost of such investments, declining world prices of agricultural commodities, and increasing concern regarding the environmental impacts of water infrastructure projects (Rosegrant and Cline 2003). The trend of decreasing investments must be reversed if the MDGs are to be achieved within a reasonable time horizon. The international community must take the lead in establishing a new and viable path of investments in infrastructure.

The European Union (EU) shares this perspective regarding the essential role of the international community. The following quote is from the European Consensus on Development, adopted in 2005:

Never before have poverty eradication and sustainable development been more important. The context within which poverty eradication is pursued is an increasingly globalized and interdependent world; this situation has created new opportunities but also new challenges. Combating global poverty is not only a moral obligation; it will also help to build a more stable, peaceful, prosperous and equitable world, reflecting the interdependency of its richer and poorer countries. In such a world, we would not allow 1,200 children to die of poverty every hour, or stand by while 1 billion people are struggling to survive on less than one dollar a day and HIV/AIDS, TB and malaria claim the lives of more than 6 million people every year. Development policy is at the heart of the European Union's relations with all developing countries. (Council of the European Union 2005: 4)

This statement of the EU is consistent with the notion that industrialized countries have a notable stake in the economic development of poor countries. Neither the EU nor other industrialized countries bear full responsibility for economic development, as noted also in the Consensus document:

Developing countries have the prime responsibility for their own development. But developed countries have a responsibility too. The European Union, both at its Member States and Community levels, is committed to meeting its responsibilities. Working together, the EU is an important force for positive change. The EU provides over half of the world's aid and has committed to increase this assistance, together with its quality and effectiveness. (Council of the European Union 2005: 4)

The quality and effectiveness of international aid begin with good decisions regarding the types of assistance needed and the mechanisms chosen for implementing that assistance. These issues are particularly important within the context of water infrastructure, given that investments generally require large initial expenditures and substantial annual outlays for operation, maintenance and repair. Many past investments in water infrastructure projects have not achieved their projected outcomes. Poor performance has contributed to the declining support for such investments within international donor organizations. Reversing the downward trend in international investments will require better investment decisions and notable improvements in project performance.

Table 13.1: Extract from the United Nations Millennium Development Goals

Goal	Target
1. Eradicate extreme poverty and hunger	1. Halve, between 1990 and 2015, the proportion of people whose income is less than \$1 a day 3. Halve, between 1990 and 2015, the proportion of people who suffer from hunger
3. Promote gender equality and empower women	1. Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015
4. Reduce child mortality	1. Reduce by two thirds, between 1990 and 2015, the under-five mortality rate
5. Improve maternal health	1. Reduce by three quarters the maternal mortality ratio
7. Ensure environmental sustainability	3. Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation 4. By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers.

Source: UN 2008.

Investments

We describe infrastructure investments that might be helpful in achieving the MDGs by first defining each selected goal and then examining pertinent interim targets (see Table 13.1). The goal most closely related to investments in water infrastructure is Goal 7, which involves ensuring environmental sustainability. Investments in water infrastructure will be needed to achieve two of the interim targets pertaining to this goal.

Domestic water supplies are limited, unreliable, and less safe than desirable, in many areas of the developing world. As a result, many residents of developing countries spend inordinate amounts of time and money obtaining water for household purposes. Many also suffer from inadequate, unsafe sanitation, both in rural and urban areas. About two-thirds of the population in sub-Saharan Africa and a similar proportion in South Asia lack access to improved sanitation. The proportion is about one-third in eastern and southeast Asia (UN 2008).

In some areas, investments in water supply have preceded complementary investments in sanitation, thus further complicating efforts to treat or discharge efflu-

ent safely and with minimal long-term impacts on residents and the environment. Investments in water supply and sanitation are needed to improve access, safety, and health, particularly in urban areas. At present, more than 80 percent of urban households in Niger, Sierra-Leone and Mali lack access to improved sanitation. More than half of urban households in Ghana, Nigeria and Burkina Faso are in this category (UN-HABITAT 2008: 83).

Hutton and Bartram (2008) estimate the spending required in developing countries to achieve the MDG target pertaining to water supply and sanitation. In their view, the sums of \$42 billion and \$142 billion are required for new coverage in water supply and sanitation, respectively. The equivalent annual expenditure is \$18 billion. An additional \$36 billion is required annually for operation and maintenance of existing services.

The goal of improving the lives of slum dwellers is somewhat daunting, yet must be achieved. At present, more than half the residents of some large cities in the developing world live in slum conditions. An estimated 60 percent of urban households in sub-Saharan Africa are described as existing in slum conditions, while the proportions are about 40 percent in southern and eastern Asia (UN 2008: 43). Within Africa, the proportions of urban households in slum conditions are greater than 90 percent in Sierra-Leone, Niger, and Mali, and about 80 percent in Benin, Nigeria and Burkina Faso (UN-HABITAT 2008: 83).

The lack of a safe and reliable water supply is one of the four defining characteristics of slum conditions. Given the density of population in most slum neighborhoods, the current situation regarding water supply and sanitation is unhealthy and unsustainable. As we consider ways of improving livelihoods in slum areas or replacing slums with much better living environments, we must consider also the complementary investments in water supply infrastructure that will enable residents to greatly improve the quality of their lives.

Most of the world's residents who earn less than one dollar per day and suffer from hunger live in the cities and rural areas of developing countries. At present, most live in rural areas, and they depend—either directly or indirectly—on agriculture for their livelihoods. Increasing water scarcity is threatening agricultural production in large areas of many developing countries. If we expect to achieve Goal 1 and the longer-term goals of eradicating poverty and hunger, we must ensure that water is available to support agricultural production. This will require the right investments in water supply facilities and the right incentives to ensure wise water management. Investments in regional irrigation and drainage systems are needed in some areas to improve agricultural production, while investments that enhance rainfed agriculture are needed elsewhere. The potential gains from investments in water infrastructure and complementary assets, such as roads, communication

systems, and market centers, are quite large. Investments that increase average productivity will improve farm incomes while reducing average food prices; thus generating financial benefits for both rural and urban households.

Women perform much of the work in agriculture in developing countries (Gladwin 2002). They also spend much of their time fetching water in areas that lack public water supply facilities. The time and work devoted to fetching water and performing farm chores limits the time available for attending school. The benefits of education, particularly for women, are well known. So too are the potential benefits of providing clean, reliable water for households in developing countries. Investments in water supply infrastructure are needed to assist in reducing the time spent fetching water, and to improve agricultural productivity, thus enabling more girls to attend primary and secondary schools. Providing clean water and sanitation in schools also is helpful in improving the attendance rates of girls (Pearson and McPhedran 2008).

Given that child mortality and maternal health are linked to issues regarding nutrition, we consider MDGs 4 and 5 together. On average, worldwide, an estimated 1,200 children below the age of five perish every hour, due largely to diseases and complications made worse by malnutrition and the lack of clean water and sanitation in developing countries. This is equivalent to 20 children per minute—a number somewhat difficult to fathom in the 21st century. The highest rate of child mortality is found in sub-Saharan Africa, where an estimated 157 children younger than age 5 perish, per 1,000 live births. The rates in southern and western Asia are 81 deaths and 40 deaths per 1,000 live births, respectively (UN 2008: 20).

The number of women who die during childbirth also is excessive in Africa and portions of Asia. In sub-Saharan Africa, an estimated 900 women perish during childbirth, for every 100,000 live births. The rates in southern and western Asia are 490 deaths and 160 deaths per 100,000 live births, respectively (UN 2008: 25). All of these rates are much higher than rates observed in most industrialized countries.

Water infrastructure lies at the core of the investments needed to improve water supply and sanitation. Investments in water infrastructure are needed also to improve agricultural productivity, reduce the cost of food in rural and urban locations, enhance household food security, and improve family nutrition (Barrios 2008; Parker et al. 2008; Hanjra et al. 2009). These achievements are essential in both reducing child mortality and improving maternal health. Complementary investments in education, health care facilities, roads, and communication systems also are needed to support achievement of these MDGs.

In summary, investments in water infrastructure can be helpful in achieving at least five of the eight Millennium Development Goals. There likely are linkages to other MDGs, as well, but these five goals provide sufficient motivation for focusing

on the role of water infrastructure in achieving economic development.

Priorities

In a world with unlimited funding, it would be desirable to invest in many projects involving water infrastructure and complementary assets as soon and as broadly as possible. In the current financial environment in which many asset values have fallen substantially and the supply of investible funds has diminished, tough choices regarding investment priorities are needed. Donor agencies, national governments, and regional authorities must make investment choices carefully to maximize the values generated with their limited financial resources. Choices will involve project-level decisions and broader questions, such as whether to focus on improving water supply and sanitation or improving agricultural production.

Water supply and sanitation

Much of the current assistance provided to developing countries is focused on domestic water supply and sanitation, as it should be, given the fundamental requirements of safe water and sanitation, and the remarkable lack of coverage in many poor countries. To date, we have achieved greater success in expanding water supply than providing sanitation, due partly to political priorities and partly to the logical order of providing life-sustaining inputs first and managing or treating effluent second.

The emphasis on improving water infrastructure to provide water supply and sanitation must continue and must likely be redoubled in future to keep pace with increasing populations in both rural and urban areas. Substantial investments are needed in Asia and Africa, and elsewhere, particularly in countries that lack sufficient wealth to make the investments on their own. Official Development Assistance is needed to support initial investments, train operators and maintenance personnel, and to subsidize operation and maintenance until private or public agencies can assume responsibility successfully.

Investing in agriculture

The Comprehensive Assessment of Agricultural Water Management, completed in 2007, was charged with determining whether or not the world could achieve its food production requirements in 2050. The conclusion was affirmative, provided that correct investments are made in the near future (Molden 2007). Those investments include construction of new water supply facilities, irrigation projects, and enhancement of crop production in rainfed areas and those that rely on supple-

mental irrigation.

Donor organization support for investments in infrastructure to expand irrigation declined substantially in the 1980s and 1990s, due partly to the declining world prices for grains and other food crops, and partly to increasing societal concerns regarding the environmental impacts of dams, reservoirs, and canal systems. This slowing in the pace of investment has brought the world to a challenging situation in which the demand for food and fiber continues to increase, while the rate of growth in our productive capability is declining in several key areas.

The Green Revolution of the 1960s and 1970s generated impressive gains in food production in parts of Asia and Latin America. But the gains achieved by intensifying agricultural production in those areas have largely run their course. Crop yields have stagnated in large areas in which the Green Revolution was implemented. In addition, water resources are being used in ways that are not sustainable, thus threatening large numbers of poor peasants with the prospect of losing their irrigation supplies. The prospect of climate change adds further concern regarding efforts to maintain and enhance food security in large areas of Asia (Gregory et al. 2005).

Substantial investments and policy reforms are needed to reverse the course of declining productivity and encourage sustainable use of agricultural water resources. New dams, reservoirs, and canal systems likely are needed in key regions, particularly in sub-Saharan Africa. These facilities must be constructed carefully and in environmentally sound fashion. The cost of achieving such care will be substantial. But the costs of not enhancing productivity also would be quite large.

Financing options

The authors of a recently published report, *Managing Water for All: An OECD Perspective on Pricing and Financing*, describe three sources of funding for investing in water infrastructure: tariffs, taxes and transfers, known also as the three Ts (OECD 2009: 15). Tariffs, of course, involve fees for using water, whether on a volumetric or a fixed-rate basis. Taxes involve assessments on water users and other beneficiaries within a community, watershed, or region. Transfers largely pertain to Official Development Assistance, which is generated by taxing residents of other countries.

Somewhat by definition, the full cost of providing water and sanitation services must be funded by a combination of the three Ts. If total funds from the three sources are lacking, the infrastructure will degrade, with the possibility of generating a vicious cycle in which degraded facilities lead to reductions in the quality of service, which reduce the willingness to pay for water and sanitation services, thus leading to further reductions in funds for operation, maintenance, and investment.

Unfortunately, this vicious cycle occurs too frequently in developing countries, both in urban and rural areas.

One of the challenges in designing cost recovery programs is to determine how much reliance to place on each of the three Ts. Residents of poor countries have limited ability to pay for water supply and sanitation; but this characteristic should not prevent the requirement for some payment from water users. In many urban areas, the near-term and long-term costs of water will be smaller if users are asked to pay some portion of the cost. Many residents already pay exorbitant prices for water of questionable quality from vendors who ply the streets of crowded cities in developing countries (Kayaga and Franceys 2007). Those residents and others would benefit notably from enhancements in water supply infrastructure, even if they are required to pay some portion of the cost, within their range of affordability.

Private and public roles

Private sector participation in providing water supply and sanitation has gained notable traction in recent years, in both industrialized and developing countries (Kirkpatrick et al. 2006). Issues of pricing, revenues, and equity arise often in discussions pertaining to private sector roles in providing what some observers consider to be a public good. Yet neither water nor the delivery of water services is truly a public good (OECD 2009: 25).

Economists define pure public goods as those for which consumption is non-rival and exclusion is not possible. The best example is national defense, which must be provided by government precisely because it is non-rival and non-excludable. Pure private goods have opposite characteristics. Consumption is rival and it is easy to exclude someone from consumption if he or she does not pay for the privilege. Examples of pure private goods abound, including our cars, clothes and computers.

Along the continuum from purely private to purely public goods, lie two categories of interest to water professionals (see Table 13.2). One is the notion of a common pool good for which consumption is rival, yet excludability is problematic. Examples include ocean or lake fisheries and groundwater aquifers (see Table 13.3). One person's withdrawal of fish from a lake or groundwater from an aquifer certainly reduces the potential withdrawals of others, yet exclusion can be problematic. Hence, we observe over-fishing of the oceans and over-drafting of aquifers around the world.

Finally, we have the notion of a club good for which exclusion is possible and—up to some limit or threshold—consumption is non-rival. Beyond that threshold, one person's consumption reduces or degrades the consumption of another. A good example of a club good is the use of lake or beach for recreation. Exclusion is possible, and up to some point, consumption is non-rival.

Table 13.2: Defining characteristics of public, private, club, and common pool goods

	Excludable	Non-excludable
Rival	Pure private goods	Common pool goods
Non-rival	Club goods	Pure public goods

Table 13.3: Examples of rival, non-rival, excludable and non-excludable water supplies and services

	Excludable	Non-excludable
Rival	Drinking water supply Irrigation water	Groundwater
Non-rival	Recreation in a lake or along a beach	Flood protection Storm-water drainage

Regarding purely private and public goods, it is helpful to consider domestic water supply as a private good, as it is both excludable and rival. Herein lies a common misstatement of many observers and practitioners of water resource policy. Water supply for drinking and irrigation has largely private good characteristics. Hence there is some rationale for having these services provided by private sector companies, albeit with helpful oversight by public agencies.

The public or social benefits associated with providing water for drinking and irrigation are beneficial spin-offs or positive externalities that deserve consideration when choosing infrastructure investments and establishing water prices. But those benefits are not sufficient to characterize water as a public good that must be provided only by public agencies.

We will continue to see the private sector involved in providing water and sanitation services, but much of the initial investment in infrastructure will be financed largely by the public sector. In many developing countries, uncertainty regarding the potential rate of return on private sector investments will limit the pace at which companies invest their funds in water infrastructure. Resolving that uncertainty and providing investment guarantees and other assurances to private firms will be helpful in motivating firms to invest.

Challenges ahead

Most observers would agree that we must continue investing in water supply and sanitation, particularly in developing countries, where most of the increase in the

world's population will occur during the next 40 years. Most would also agree with the need to continue investing in agriculture to ensure adequate supplies of affordable food and fiber, while maintaining the quality of environmental and natural resources. The following questions reflect the challenge that donor agencies and national governments will encounter as they consider long-term scenarios and investment opportunities. First, can donor agencies and national governments maintain, and perhaps increase, the pace of improvements in water supply and sanitation? Second, can donor agencies and national governments increase the pace, breadth, and scale of investments in agricultural water infrastructure?

The answer to the first question likely is affirmative, provided that investible funds can be secured through Official Development Assistance and by involving the private sector in appropriate ways. Funds obtained through tariffs and taxes will be needed to operate, maintain, and sustain the infrastructure investments.

The answer to the second question is somewhat less clear, although the question is equally pressing. While water supply and sanitation attract much of the international focus on water infrastructure, the world must redouble its efforts to improve, expand and sustain water infrastructure in the agricultural sector. In the past, international donors have provided substantial support for investments in agriculture. National governments and private companies seeking opportunities to expand agricultural production to enhance national food security, open new markets, or enhance international trade, likely will provide a greater share of the investments in agriculture in the future.

Some of the challenges we will face in future include the continuing increase in global population, with notable increases in population density, particularly in urban areas. An estimated 60 percent of the world's population will live in cities by 2030 (World Economic Forum 2009: 34). The number of megacities (with populations exceeding 5 million) is expected to increase from 40 in 2000 to 58 in 2015 (Varis 2006: 201). Such cities will require substantial investments in water and sanitation infrastructure (Varis et al. 2006: 380; Cashman and Ashley 2007). The funds available for those investments will be limited, in part, due to competition with other sectoral needs, such as investments in energy supply, housing, transport and communication (Cashman and Ashley 2008). In many of these sectors, the demand for investible funds likely will exceed the supply for the foreseeable future.

Rural areas also will require continuous investment in water and sanitation infrastructure, as well as in housing, transport, and communication. In addition, we must invest continuously in upgrading agricultural resources and improving productivity. The twin problems of waterlogging and salinization continue to degrade large areas of cropland, worldwide, with consequent reductions in productive capacity (Qureshi et al. 2008). Farmers in many areas use groundwater at rates that

are not sustainable, creating the likelihood that large areas of irrigated land might revert to rainfed conditions (Shah et al. 2003; Cai and Ringler 2007). Average crop yields on large portions of the North China Plain and the Indo-Gangetic Plain are not increasing at historical rates, causing concern regarding food supplies for large numbers of urban and rural residents.

Recommendations

Public and private investments in water infrastructure must increase in future to meet the challenges described above. Public agencies and government officials must encourage private sector firms to invest capital and expertise in infrastructure projects, particularly in developing countries. Private firms often are reluctant to invest in developing countries because there is substantial uncertainty regarding the potential returns on their investments. It might be possible to reduce uncertainty substantially by forming partnerships involving donor agencies, public agencies, private companies and home governments. Donor agencies might guarantee the rate of return on investments made by private firms. The home government and the recipient government might agree to decline taxing the returns to capital invested in infrastructure, provided that investment programs protect the rights of the poor. Alternatively, the returns on capital invested in such projects could be taxed at a lower rate than returns on other projects.

With respect to agriculture, public agencies and ministries must consider ways of allowing the increasing value of food crops and biofuels to enhance the pace of investments in agriculture. Governments must also ensure that farmers are allowed to capture higher prices and retain the associated revenues. Higher net returns in agriculture will enable farmers to pay for operation and maintenance of water infrastructure over time, while also creating investment accounts to support new projects.

Governments and donor agencies must also consider the role of complementary investments in a wide range of activities outside the water sector. Investments in rural roads, railways and ports along rivers and on the coast can reduce the costs of providing agricultural inputs and bringing agricultural output to market centers. Other complementary investments include upgrading communication systems and increasing the supply and reliability of electricity. In many areas, investments in complementary activities will notably increase the return to investments in water and sanitation infrastructure.

We note also that investments in infrastructure, alone, will not be sufficient to achieve sustainable economic growth and development. Institutions and pricing policies must also be revised, and governance must be improved, to promote sus-

tainable management of limited resources (Spencer et al. 2008). Scarcity conditions must be communicated to resource users in the form of appropriate prices, allocations, or restrictions. We cannot expect farmers and other resource users to manage limited resources wisely if the prices and rules they face do not reflect scarcity conditions.

In some cases, it will be helpful to convert existing subsidy programs into investments that enhance resource management. For example, India has long subsidized farm-level investments in tubewells, with the goal of increasing agricultural production and improving farm incomes (Shah et al. 2008). Many farmers also receive electricity at highly subsidized prices. In the near term, and in areas with large reserves of renewable groundwater, such a policy approach seems sensible. Yet in densely populated regions with limited groundwater resources, such policies can lead to groundwater overdraft on a very large scale, thus threatening the sustainability of irrigated agriculture. As groundwater overdraft continues, the depth to groundwater increases, causing the cost of obtaining irrigation water to increase. If pumping costs are not passed along to farmers, they will have no incentive to reduce water use. In the end, irrigated crop production in the region might cease due to persistent overuse of the groundwater resource. Rather than providing farmers with low-cost electricity, the government might consider using public funds to invest in infrastructure that will support sustainable improvements in agricultural productivity.

In summary, just as investments in water infrastructure are needed worldwide to improve livelihoods and enhance economic development, investments in new policies and institutions are needed to provide appropriate signals to those who use water and other limited resources. We should not expect infrastructure investments, alone, to generate the outcomes we seek regarding improvements in human welfare. Resource users in most settings respond to prices, allocations, restrictions, and market opportunities. Hence we must ensure that prices, allocations and other policy parameters reflect and communicate true scarcity conditions.

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Value chains in water cycles Innovations in water governance

Jacko van Ast and Jan Jaap Bouma

Water management deals with great challenges regarding the demand for the many valuable functions water systems provide. The objective of optimization of the benefits related to the different values that are generated by water systems takes place in an international context with a crucial role for infrastructures. Institutional arrangements are needed to include the values that are related to the assessment of the functions of water systems in decision-making processes. Instruments like (societal) cost benefit analysis and participation of stakeholders and public could enhance this optimization, resulting in a more sustainable water management. The concepts of value-based governance and covaluation are presented, that enable value chains to provide the highest collective benefit to society. These insights are to some extent reflected by the theoretical approach of Elinor Ostrom (1990) towards common pool resources management. The different theoretical insights and approaches to water management are confronted with managing of water system in practice. Further exploration requires extended research about how the valuation process should be institutionalized, about which values are to be included in the value concept and about which variables are relevant for value-based governance.

Water management and managing river basins evolved from an engineering dominated approach towards a more multiple, ecosystem oriented approach. This modern approach is known as ‘adaptive management’ where water managers continually adjust their actions in response to monitoring data and insights that inform about changes in the characteristics of a river and its catchment area, economic conditions and social preferences. Besides, water resource agencies no longer dominate the decision-making process related to managing the flow of the river, its quantities and quality. These agencies become more and more focused on providing technical support to actors within the process of participation. Herein the costs and benefits among the different stakeholders in water systems could be distributed and become acceptable to the stakeholders. Adaptive and participative water management can be characterized as interactive water management (Van Ast

2000).

However, in practice here the implementation of innovative water management project often strands. Looking closely at the current management approaches there is a need for insights into the processes of valuation by these stakeholders and how processes of these values are and can be institutionalized. It considers the impacts of relevant mechanisms of the processes of institutionalization (DiMagio and Powell 1983) and is based on the general notions on the role of institutions in the coordination mechanisms in infrastructures (Williamson 1979, 1998; North 1990). A theoretical framework will be used to provide insight into the role of institutionalized valuation processes in the field of the coordination of goods and services of water systems. The framework builds upon other valuation concepts such as co-valuation (van Schie and Bouma 2008) and insights into the role of cost benefit analyses and assessment methods in water management (Schuijt 2003; Bouma et al. 2008; van der Veeren and van Cleef 2008; van Ast and Bouma 2008). Illustrations are given by the regional implementation of the European Water Framework Directive (WFD) and the valuation processes in the Dutch regional planning case of Arnemuiden.

The basis of the theoretical framework starts at a physical layer (the physical water system) and the mapping of the different stages of a value chain. Figure 14.1 presents this in a simple way, indicating how several actors are involved that have different stakes in the outcomes of the interventions in the physical water systems. These actors may be motivated to participate in the governance of the water systems because of numerous concerns and values.

In this chapter, firstly a theoretical framework for the governance of water systems is presented. This framework should help to map the valuation of effects of an intervention in a water system, in an integrated governance approach. The framework is confronted with the insights obtained from Elinor Ostrom (1990), leading to lessons to be learned from Ostrom's approach. In the second part the theoretical framework is illustrated with the implementation of the Water Framework Directive (WFD) in a regional setting. Finally, some conclusions are presented and suggestions are given for the design of institutional arrangements to further integrate and facilitate the process of valuation into the governance of water systems.

Value chains, water cycles and valuation instruments

The concept of value chain refers to the order of different activities, starting with resource generation and ending after production and consumption with the disposal phase of the product or service. The analytical concept of a value chain provides insight into the competitive position of a firm in the life cycle of products. The vari-

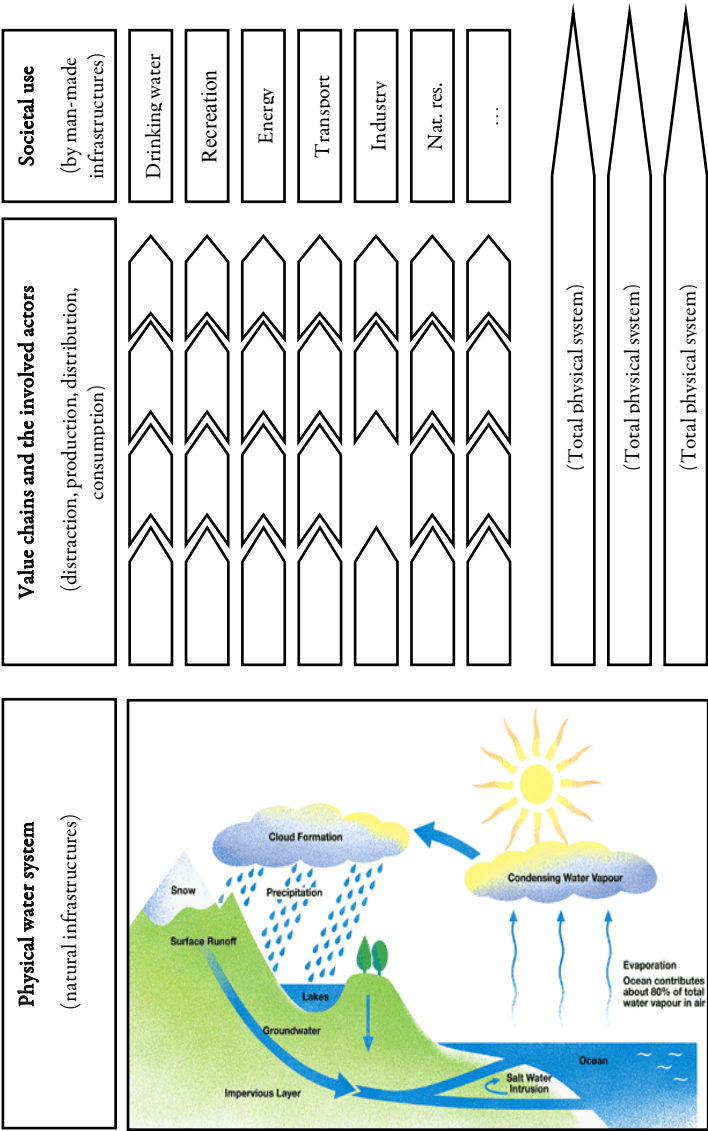


Figure 14.1: Multiple value chains in using the physical water system

ous uses of water systems and their institutional coordination show that many value chains are involved in the governance of these systems. Goods and services of water systems have different values in the different chains and in the different phases of the chains. It is clear that no single price for water or water systems services exists. Traditional value chains related to fresh water systems are related to drinking water, sanitation, energy, navigation and the production of various industrial and consumer products. More recently the generation of values related to recreation and ecology are increasingly important.

The analytical concept of a value chain provides insight into the competitive position of a company in the life cycle of products (Porter 1990). As far as the main good of a water system is concerned, water, in almost all value chains it is extracted as a natural resource. However, the life cycle of a specific product may also start with the re-use of disposed or recycled water. This means that the start and finish of the value chain are connected. In fact, the governance of water systems implies the management of water cycles. The water cycle concept takes the water system as a starting point and incorporates the ecosystem approach and the river basin approach. Similarities with the environmental policy concept cradle to cradle can provide more lessons for sustainable water management (Braungart 2007).

The aim of sustainable governance, including water management, can be considered to be directed towards optimization of the total value of the concerned systems. Both traditional economic values and more recently accepted social and ecological values are included. Various instruments can add to this overall aim. For example an innovative approach like the concept of virtual water or water footprint analysis could make important contributions (Hoekstra 2009). Virtual water calculations make it possible to allow trade in products based on their use of water during production. Optimization could be reached when products that do not use much water are produced in water rich areas where products that do not demand much water are produced in the dryer zones of our planet. Concepts such as virtual water are not yet worked out to an extent that they can be implemented in real life policy contexts for the coordination of value chains. There is a strong need for institutional design of the organization of water allocation where the water related infrastructures manage the flows and stocks of water. This is a process of constant change that is boosted by far-reaching threats related to climate change and economic developments. The driver behind these changes can be framed as conflicts between natural and man-made infrastructures (for example the issue of flooding) or between actors who compete for water to be used in different economic value chains. The conflicts themselves are not necessarily perceived as threats but instead can be regarded as opportunities for further institutional innovations that increase or sustain welfare.

Another way of dealing with this kind of issues is by introducing market mechanisms. The role of the market however is subject to an ongoing debate. Some services of water systems are perceived as pure private goods, while other services may be regarded as purely public services. Between the value chains, actors can compete for accessibility to the water systems. In this respect, different value chains may be organized in different ways under different market conditions. The overall coordination of the relevant value-chains connected to water system is regarded as problematic.

In order to realize sustainable development of water systems, the value chains should be organized in a way that the value can be optimized. This requires the design of institutional arrangements that facilitate the coordination mechanisms that allocate the use of water systems. Alternative adaptation strategies for policies within water management and related infrastructures are assessed on their robustness, effectiveness and economic efficiency. This provides insight into system efficiency and the added value of adaptive water strategies that are based on the idea of multiple value chains of water systems in an international context. The focus is on the water domain, specifically the institutional coordination of water infrastructures and on the accounting of different values related to water systems that are embedded in the governance of these systems. Currently these institutional arrangements are lacking. However, the on-going process of the implementation of the Water Framework Directive (EU 2000) may help to overcome this lack.

An example in the line of economic instruments to support decision-making is based on a confrontation of costs and benefits. Important decisions require in many countries an explicit overview of all costs and benefits that are caused by a project or decision. Especially related to infrastructures, cost benefit analysis (CBA) appears to be a dominant assessment tool in modern decision-making. The design of this kind of institutions provides rules of the game in the valuation process of water management. This can be considered as an important dimension of value based governance. The simple use of a Societal (including non-financial values) Cost Benefit Analysis is clearly not enough for the water sector (van Ast and Bouma 2008). Many conflicts in the water sector are related to the distributional effects of interventions in the water systems. New ways for participation of stakeholders in the valuation processes seem to be necessary. A modification of a method such as the societal cost benefit analysis (SCBA) does not provide a final answer to these issues.

In addition public and stakeholder participation can be established in order to include all concerning values. In terms of Ostrom (1997), participation is recommendable in the context of self governed common-property arrangements. In this view, the rules of the game concerning how values are to be integrated should be designed by the participants of the decision-making on interventions in water systems

themselves. Also, the compliance to these institutions should be organized by the participants themselves. This perspective on the integration of values is reflected to a great extent in the concept of covaluation, meaning a combination of the instruments of SCBA and participation (Van Ast and Bouma 2008). In the regional planning process in the area around Arnhemuiden the covaluation procedure has been described the following:

the early and continual involvement of interested parties and individuals in the valuation and weighing of subjects (in the context of an interactive decision making process), in which values attributed by parties and individuals involved are inventoried and arranged in their respective unities and are involved in the formal weighing and decision making procedures, aiming at consensus on the values that are to be involved. (van Schie and Bouma 2009).

When we perceive a water system as a social-ecological system, the multitier framework presented by Ostrom (2007) clarifies how different concepts of values are embedded in variables. These variables can be reflected in property-rights systems, collective-choice rules, constitutional rules, formal regulation, economic value and in the set of habits and norms. The interactions between these variables produce outcomes. It is a challenge to many policy makers to capture the different stakes and values of stakeholders in the process of formulating interactive water strategies, in order to deal with potential conflicting value-concepts of actors and the costs and benefits in a national and international context.

With respect to the most effective management of common pool resources in the sense that values are protected, Ostrom (2007) warns that there are no panaceas. Every type of resource has its own value chain(s) and institutional setting, which makes one solution for all situations unlikely to exist. Sometimes liberalization or privatization could bring improvements, other times regulation or the introduction of property rights could be of help. In order to identify guidelines for such solutions, modelling could contribute considerably to the tracking down of applicable institutional arrangements for common pool resources management. In the following we focus on river basins as an example of a partial common pool resource.

River systems and common pool resources

In general many different types of non rival and non excludable goods and services, common pool resources (CPR) do exist, like the air or the oceans. Water systems also provide non excludable goods and services to human societies, of which (raw)

water is the most important.

Of all world's water only 2.5 percent is fresh and since most of it is stored as ice, only a small part is liquid fresh water. From this fresh water reserve, only the water in the hydrological cycle can be used in a sustainable way. But, since nearly all water is ground water or lake (reservoir) water, not more than 0.02 percent of all fresh water is at any moment part of river systems (Saeijs 1995). This global run off water can be considered to be a common pool. In terms of Ostrom (1990) a CPR situation is a natural or man-made resource system that is sufficiently large as to make it costly, but not impossible, to exclude potential beneficiaries from obtaining benefits from its use. These common goods and services are rival but non excludable. Most river basins, geographical areas within which waters of natural origin (rain, ground-water flow, melting of snow and ice) feed a certain river (UN 1978), fit with this definition. This makes river basins to suitable study objects for CPR management.

River systems are complex systems in terms of variables that play a role in their functioning and in their management (Teclaff 1996). Especially transboundary river basins are difficult to manage, not in the last place because they cover different types of country related institutional settings. Nearly half of the world population lives in the 214 larger transboundary river basins (UN 1978). In order to exclude complexity related to land management, an advantage would be to replace the river basin by the less complicated concept of river system. This can be understood as the set of watercourses that collects water in a certain geographical area, together with the connected physical, chemical and biological factors (Van Ast 2000: 61). Sustainable water management has to deal with the governance of the values of these more than two hundred large transboundary common pool resources situations. The value chain in CPR can be understood as the meaning of the resource for the different activities, starting with resource generation and ending with the consumption and disposal phase of the product or service.

Water systems, including rivers, are more than just streams of water; other physical, chemical and biological functions also form part of river systems. Rivers are natural allocation systems; they form natural infrastructures that sometimes are reshaped by human interventions. These interventions, generally aimed at enlarging the total value of the system, in many cases lead to pollution, scarcity and physical damage, with degradation of the total system value as a tragic result. However, according to Ostrom, a tragedy is not unavoidable. In many cases, as she proofs, management systems developed that were able to keep the systems sustainable for many years.

In terms of Ostrom (2007) we need to take a diagnostic approach for analyzing the social economic system (SES), so including the social and the physical system. In our research we try to contribute to the search for variables that are important

for models that sustain the common pool resource, and a range of questions comes to the surface. In the first place, different theories can play a role here, but which theory fits with the aim of modelling the valuation process? Secondly, the values, or outcomes in Ostrom's (2007) framework, can be expressed in many ways. For example if we take the status of a water system, the outcome is the sum of all value chains. Different activities starting with resource generation and ending with the consumption and disposal phase of the product or service for which the water system serves as input should in this case be taken into consideration. The aim here is to see what we can learn from Ostrom's approach regarding the design of a multiple framework for value based government.

Towards a framework for value-based water management

Ostrom argues that in the case that a water system manifests itself as a CPR this should be governed by means of self governed common-property arrangements if possible. In that case rules are designed and modified by the stakeholders themselves and also enforced by them. Such a situation is referred to as common pool resource situation (CPRS). Ostrom defines it as a natural or man-made resource system that is sufficiently large as to make it costly, but not impossible, to exclude potential beneficiaries from obtaining benefits from its use. Ostrom addresses the difference between the resource system and the flow of resource units produced by the system. This unit is referred to in Figure 14.1 as service or good. Clearly the dependence from the one can be framed in different ways; but in our theoretical framework, this dependence is presented as a value chain (see Figure 14.1). Resource systems are like stock variables that are capable under favorable conditions of producing a maximum quantity of a flow variable without harming the stock or the resource system itself. Resource units are what individuals appropriate or use from resource systems (Ostrom 1990: 29–30). Stakeholders enjoy the goods and services these systems provide. Depending on how water systems are governed and what interventions are acceptable or not, they may be provoked to establish activities like free-riding. Resulting in related problems of overuse and crowding out may occur. Shared norms with respect how the water system could be used. These norms may be very context specific and Ostrom states that therefore individuals should adopt contingent strategies instead of independent strategies (Ostrom 1990: 33–6).

Ostrom suggests two theories that could be further developed to tackle problem of adopting contingent strategies. One theory is dealing with the firm. Here the individual is represented as entrepreneur (the supplier of the service or good of a water system to the end-user. In the other theory the individual represents the ruler who has the responsibility of designing and supplying the needed changes in insti-

tutional rules to coordinate activities (Ostrom 1990: 39–41). In this respect three main problems occurring due to a collective-action problem. In this context the essential problems are related to designing the appropriate new set of institutions (1). How can these institutions become creditable to the stakeholders concerned (2) and how can they be monitored (3) in order to ascertain the compliance to the new rules of governing the water system. In order to have a clearer view on what rules are to be redesigned, Ostrom mentions the operational, collective and constitutional choice rules. It is focussed by Ostrom on the fact that these rules are interlinked (see Figure 14.2).

An institutional approach to CPR self-governance

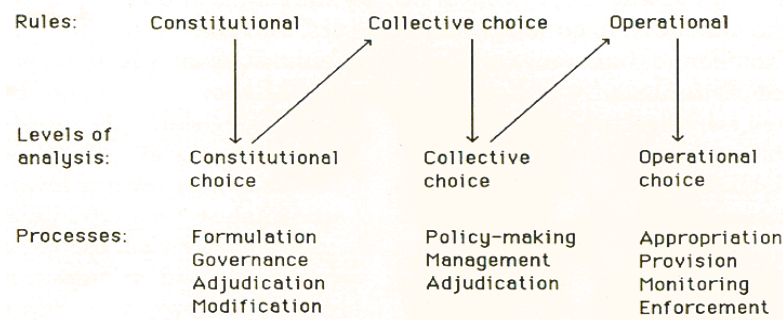


Figure 14.2: Linkages among rules and levels of analysis (*Source:* Ostrom 1990: 53)

In theory, Ostrom shows a way to imply values in decision-making processes that can lead to sustainable management of (water) systems. In the following an illustration of the value based governance approach in a regional context is given.

The development of value based governance and the implementation of the EU Water framework Directive in Flanders, Belgium

In this section the implementation of the WFD is briefly mapped by using the presented framework together with insights of Ostrom. Some conclusions will be drawn on how the problem of multiple uses of water systems is addressed in the implementation trajectory in Belgium.

In December 2000, the WFD was issued. It came in place of seven old directives

and should streamline the European water legislation. By means of this institutional arrangement the European Parliament provide its selves an approach that generates other new institutional arrangements at the lower administrative levels that are all involved in managing its water resources at a river basin level, to:

pursuit objectives of preserving, protecting and improving the quality of the environment, in prudent and rational utilisation of natural resources, and to be based on the precautionary principle and on the principles that preventive action should be taken, environmental damage should, as a priority, be rectified and the polluter should pay. (EU 2000).

The implementation of the WFD should be coherent between the different member states. For this reason guidelines and requirements are described in the common implementation strategy (CIS) (May 2001). This may look like a diversion from what Ostrom calls a contingent strategy but in fact it is not. The WFD is concerned with developing common methodologies and approaches and sharing experience and information. The crucial elements of the WFD are to reach a good chemical quality of all European and surface water; a good ecological surface water quality; and a good quantity of ground water by the year 2015. The WFD wants to mitigate the consequences of floods and droughts and secure the European water supply. Furthermore, its aim is to calculate and charge correct prices of fresh water by 2010. Revenues of water collection, treatment and supply are often not covering the costs. More adequate pricing should work as an incentive to more sustainable use of water in order to enable a long-term protection of available water resources. Finally, information, consultation and involvement of the public are also emphasized. The interest of the different stakeholders should be balanced and the transparency in a way that allows citizens to influence the behavior of their government. The European WFD says that 'decisions should be taken as close as possible to the locations where water is affected or used' (EC 2000).

In Flanders (a region of Belgium), this resulted in a breakdown of the administrative levels in accordance with the guidance the EU provides for this. The guidance implies for Flanders for each of the international river basins (Scheldt and Meuse) to design the appropriate coordination scheme (organization and planning of the achievements of the WFD objectives). Each international river basin is divided into (international) River basin districts (in total four: IJzer, Scheldt and Maas, Brugse polders). International river commissions are installed (the International Scheldt and the International Maas Commission) that develops its 'Coordinating section river basin management plans'. At the level of Flanders, a Coordination Commission Integrated Water Policy (CIW) is installed that formulated Flemish river basin

management plans and the water policy note. Furthermore the river basin districts are divided into 11 basins and 103 partial basins. Each basin has a basin administration, basin secretary and basin council. The partial basins have their water boards that formulate partial basin management plans. A study concluded that in Flanders, all regulations and subsidiary incentives did not result in concrete ecological returns yet (Vanhulle 2009):

Local water managers more and more signal that apart from purely financial resources, they also need exact stimuli, deadlines, standards and support to realize the ecological objectives in practice. (Vanhulle 2009: 13)

It can also be concluded that the WFD specifically addresses the demands put on the water systems as a result of the activities related to the drinking water sector, sewage water treatment sector and the set of environmental stakeholders with an explicit ecological quality standard in mind. Also, the water system and its degree of flood protection is regarded as a specific service of the system. Measures are to be developed to achieve objectives that are function specific. However, to coordinate and assess the measures at a meta-functional level is not clear. The use of a societal costs benefit analysis is stimulated. However, how specific functions should be valued is still unclear. When prices for the specific goods and services related to these functions exist, they could be integrated into the SCBA. Still for many services and goods no market prices are available. The participation of the stakeholders related to these non-prices services and goods is in itself not a guarantee for the facilitation of all those functions of a water system in a degree that is favoured by all stakeholders of river basin.

Concluding remarks

Governing the value chain, or Value-based Governance, implies the incorporation of socioeconomic and ecological values. Tools and methods are for example monetarization tools like 'artificial pricing' for CBA or institutional arrangements like participation of public or stakeholders. A closer look at the implementation of the WFD shows that there is a lack of coordinating institutional arrangements for the governance of the different value chains that are related to the use of the water systems at a river basin level. The invisible hand of the market system is not to be relied upon since many of the goods and services are not coordinated by the market system but the government. This currently undergoes a drastic change in the EU-member states due to the implementation trajectory of the WFD.

This chapter underpins that governing transboundary river systems implies the

coordination of a large number of stakeholders and confrontation of many values. Every local entity has its own values and on the inter-state level upstream and downstream values in many cases are opposite. This means that the level of scale of the process in the river system is crucial for any institutional improvement. When integrated decision-making about economic, social and ecological values is at stake, analyzing the role of the different institutional arrangements in the context of value-based governance could optimize functioning of a SES.

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Managing the different concepts of value in regional planning

Nienke van Schie

Water is multifunctional to society: it has many users and various purposes. Hence multiple values and value chains are involved. While useful for purposes of efficiency and effectiveness, the neoclassical economic perspective on value may not reflect and involve in analysis and decision-making all of the values attributed and recognized by stakeholders. Based on a case study on regional planning, an institutional approach to valuation is proposed, considering valuation as a collaborative process of identification and construction.

Water is multifunctional to society: it has many different users and many purposes. As a result water has multiple value chains: water has many different values in society. How to involve these values in planning and decision-making?

Generally, an economic approach to the valuation of water is applied. Water however has many values that may not (all) be incorporated in a monetary measure. Especially when stakeholder participation is involved, this may influence societal support of (e)valuation studies and subsequent decision-making.

Economic value of water

In the Netherlands, surface water policy and management is an important and pressing issue: the country has an enormous need for space, while simultaneously it feels the constant threat of rising sea levels and increasing river discharges. A considerable percentage of the country lies below sea level, which requires continuous maintenance of water safety and irrigation structures (NHV 1998; Dijk 2008).

Water management has been subject to important changes in the last decade. From water the enemy the adagio changed to water as a friend that should be provided with space (Ministerie van Verkeer en Waterstaat 2000 and 2007). Such is reflected in current Dutch water policy documents and also in the European Water

Framework Directive (WFD). As the field was traditionally dominated by engineers and technical solutions (Lintsen 2002), currently various stakeholders are involved in decision-making on water management (Sabatier et al. 2005; Scholz and Stiffl 2005). Different functions and values of space must be weighed in decision-making. In this assessment, water is considered as an economic good (ICWE 1992), like other uses of space, for example infrastructure or industry. Increasingly, economic analysis is put forward to support decision-making on water management and to involve environmental values in the assessment (Schuijt 2003a; Boot 2007). The use of societal cost-benefit analysis (SCBA) is encouraged to assess the different functions and values, from international (WFD 2000), and national (OEI guideline; Eijgenraam et al. 2000) to regional levels.

SCBA is based on a neoclassical, function-based economic perspective. Such perspective traditionally takes preferences as neutral and objective data; preferences are assumed as fixed and constant, as commensurable and measurable (or to be expressed) in monetary terms, and as exogenous to external influences (Dietz et al. 1994; Bowles 1998; Brouwer 2000). This perspective enables preferences to be involved in objective economic analysis. Following the economic approach of water, such is also applied to the valuation and decision-making on (surface-) water in Dutch spatial planning.

Water and regional planning

With its new approach, water management took turns towards a more integrative approach, in which different functions of space are approached in an integral fashion, taking into account the many value chains of spatial organization. Hence water management becomes increasingly interrelated with another policy subject flourishing in the Netherlands: spatial planning. In the densely populated country of the Netherlands space usually has other uses and functions already, resulting in the intertwining of water management and spatial planning, for example expressed in the aim for multiple uses of space.

The water management approach corresponds well with the current spatial planning approach, characterized by regional planning (*gebiedsontwikkeling* in Dutch) (Ministerie van VROM 2006). Three characteristics of regional planning are applied here: the integral approach of space; the application of stakeholder participation; and the aim for surplus value (Zeeuw de 2007).

This approach contrasts to the formerly applied sector-approach, in which different sectors and spatial functions are dealt with separately. Instead, regional planning aims at the combined and integral approach of different spatial functions. This approach is sketchy, with methods and frameworks still in development. For an in-

tegral approach—the first characteristic—, the layers approach is applied, common in spatial planning (Rijksplanologischdienst 2001; Priemus 2007). Concerning the second characteristic, stakeholder participation, interactive approaches known from the field of public administration are applied, for example, joint fact finding, joint planning approach, interactive workshops, and communities of practice. However, what is meant by surplus value is not yet entirely clear, let alone how such should be achieved or measured.

In practice, it has been observed that the regional planning approach is hindered by obstructions (Bruijn et al. 2004; Heijden and Slob 2005; Zeeuw et al. 2009); formal institutions hinder an effective integral approach of spatial functions and the proper participation of stakeholders in the planning process. These institutions are still based on a sector approach to spatial planning and water management, and on the neoclassical approach of valuation and assessment. First, a sector approach hinders the integral planning and analysis of different spatial functions. In reaction, legislation and sector-specific procedures were changed, however not yet resulting in any improvements for regional planning processes (Zeeuw et al. 2009), due to the still dominant sector approach in the administrative system.

Second, prescribed methodology for evaluation and assessment is based on the neoclassical economic perspectives on (the value of) water which may not correspond with the perspective of the different stakeholders that are to be involved. Stakeholder involvement inevitably brings along the subjective perspectives of stakeholders; perspectives and values that may not be reflected in a monetary (or monetized) value. Various studies have shown that stakeholders attribute values to environmental goods and services that are not all expressed in monetary measures, nor do they accept the translation of these values in such measures, or comparison to market-values (Jacobs 1997; Ackerman and Heinzerling 2004; Vatn 2005; O'Neill et al. 2008). Recent study of endogenous preferences in economics confirms that preferences (motivations, values) are not fixed and given, but are subject to external influences: preferences both influence and are influenced by economic institutions (Bowles 1998). Hence the observation that environmental goods and services are not measured along a single metric; they are not commensurable (Sunstein 1993). Still, the lack of monetary expression prevents values to be involved in the prescribed evaluation methodology, SCBA, which focuses on monetized effects.

Concerning these hindrances, an important issue is the effectiveness of water management and the regional planning approach currently put forward in Dutch spatial planning. How may the valuation of water in regional planning be organized in order to enable the involvement of all different value chains in the assessment? An institutional perspective enables to study the influence of the external setting on preference formation—valuation—of environmental goods and services.

Case study on valuation

In an interactive regional planning project in the southwest of the Netherlands we focused on this question. We experimented with the collaborative valuation of water by stakeholders, and we studied possible institutional arrangements that might stimulate such approach of valuation. Our experiment was based on the expectation that the active involvement of stakeholders in the valuation and an integral approach of regional planning would lead to improved results; that it would lead to surplus value in a regional planning process.

The interactive planning project, called *Around Arnhem*, developed scenarios for reorganization of a rural area. Stakeholders, involving inhabitants, local organizations, businesses and others involved, developed these scenarios in a collaborative process. These scenarios were based on the values the stakeholders attributed to (surface) water in the project area, which they expressed during interviews, in questionnaires, interactive workshops, and discussions. The researchers inventoried the different values and studied the process of and developments in valuation (Schie et al. 2007).

The stakeholders attributed various values to the water in the project area. The project however showed that these values were not readily available; they needed construction, in a (collaborative) process of identification and negotiation. Hence the values were not fixed and stable, and not ready for measurement. Also, the values were not exogenous, but were subject to external influences, consistent with the ideas on endogenous preferences mentioned before. These values—when identified—were well suitable to use in scenario development. The stakeholders expressed their agreement with both the outcomes and the planning process in an *ex post* evaluation. The involvement of the values in evaluation and assessment however was met with difficulty. Experts involved (from both governmental organizations and non-governmental organizations) pressed the need for cost-benefit analysis, as they were used to financial assessment only. Also, in the representative democratic structure of the Netherlands, politicians did not know how to deal with the interactively achieved results that were based on more direct democratic approaches. The integral outcome was again separated in its different spatial sectors and political decision-making focused on a single aspect (housing), neglecting the other spatial functions considered (including water).

Analysis and concluding remarks

Based on the experiment we can reconfirm the earlier observations that the integral approach of regional planning was hindered in practice. Also, we can reconfirm

that this hindrance was caused by (overreliance on) existing institutions still based on a sector-approach and not allowing for multiple value chains to be involved in assessment and decision-making. We can conclude that for the integral and participative approach put forward in water management and regional planning to come to effect, changes in the evaluation and decision-making praxis are needed. Embedding of this integral and participative approach in the existing institutional situation is difficult however, and should be organized on various levels (Edelenbos et al. 2009) .

A more integral perspective on value is needed to allow for the involvement of different values and of stakeholder participation in evaluation. Such however contradicts to current trends in (inter-) national regulation. To come to actual integral assessment, another approach to valuation is needed. Based on the case study we propose an approach of covaluation. Covaluation, or collaborative valuation, aims at the joint identification of relevant values and value chains, and the involvement of these values in planning and assessment. Such may well include the application of economic valuation and SCBA (Schie and Bouma 2008). While such contradicts to the currently applied neoclassical interpretation of value, it corresponds with current insights in endogenous preferences and institutional analysis. It will enhance possibilities for a true integral approach of space and for proper stakeholder participation in decision-making on regional planning and water management. Reconsideration of the use of SCBA in regional planning and the simultaneous involvement of stakeholder values in planning is needed.

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Part VI

Railway

Railway separation European diversity

Didier M. van de Velde and Eduard F. Röntgen

The European railway sector currently exhibits a wide variety of institutional configurations as a result of the reforms initiated by European legislation. This chapter describes the situation in the Netherlands, Germany, Switzerland, Great-Britain and France, providing a good coverage of the current variety of institutional arrangements in the European railway sector, with some additional information about Japan as an illustration of an alternative and inspiring organizational form. The chapter shows that much has been achieved on the basis of very different institutional choices. The facts and opinions collected show that some countries are clearly satisfied with the choices made, while one has to observe that other countries realize that they still face a number of unsolved issues. Elements allowing to understand the main changes and achievements are synthesized.

The creation of an integrated European transport area and a genuine and successful market for transport by train is central to the transport policy of the European Union (EU). The railway sector was for many decades dominated by state owned railway companies, a strong national focus forgetting about potential international markets to the benefit of road transport, and concerns about its customer-friendliness and the efficiency of its operations. Pointing to its declining share in the market for the mobility of people and especially freight, the European Commission (EC) developed a policy to revitalise the Community's railways (EC 1996, 2008). This policy included several measures to strengthen the railways' competitiveness through the introduction of market opening and competition starting with freight transport. It also includes measures aimed at generating a greater technical harmonization throughout the whole sector such as to facilitate international connections across the EU by fostering interoperability. Several legal measures (and so-called packages of directives and/or regulations) have consequently been adopted starting from 1991 onwards, both within national markets and in a cross-border sense. The 91/440 Regulation (adopted in 1991), which forms the basis for these reforms, asked the member states to put the railways in a position that enabled them to

independently manage their affairs in a sound financial manner, this included a reduction of the railway debts that heavily burdened many European railways. A separation between infrastructure and transport is central in this policy ever since 1991. While the original basic requirements only demanded an accounting separation between infrastructure management and train operations, it is quite clear that the favoured institutional configuration is an organizational or even institutional separation between an infrastructure manager and (several) train operators and further legal measures developed by the EC have been moving in that direction. These further measures also aimed at gradually allowing railway companies to operate across the territory of the EU, at standardizing a number of requirements for market access, infrastructure charging, technical requirements, signaling and safety systems, passenger rights, etc. Fundamentally it also required the allocation of track capacity to become independent from train operations.

As a result, the national and international rail freight markets are now completely deregulated and liberalized. Even international rail passenger services will be liberalized from 1 January 2010. Railway reforms were initiated in the member states. Interestingly, these have led to a wide variety of institutional configurations. This chapter describes the widely divergent situation in the Netherlands, Germany, Switzerland, Great-Britain and France, with some additional information about Japan as an illustration of an alternative and inspiring organisational form.

The emerging question is whether these different institutional arrangements are compatible with the requirements of the EC. The recent actions taken by the EC, such as infringement procedures in 2006 and letters of formal notice in 2008, point in this direction. According to the EC, almost all of the member states are failing to properly implement EU railway legislation, even if they are referring to relatively minor issues. In October 2006, the EC began infringement procedures against 13 member states that failed to notify the EC of the transposition into domestic legislation of two key directives of the second railway package. In June 2008, the EC sent letters of formal notice to 24 member states regarding their failure to properly implement the First Railway Package legislation. Only the Netherlands appeared to be fully in conformity with all requirements at that moment.

The more fundamental question that arises is whether the institutional changes induced by the EC will deliver in the long term the expected improvements and whether they are the only solution to a successful railway sector. The numerous reluctances to follow the indications from Brussels could actually be symptomatic for more fundamental genuine arguments against at least some of the institutional requirements included. Moreover, we have to acknowledge the reality of the success of alternative organizational configurations that also succeed in making the railway market grow; and thus achieving a main policy goal set by the EC. Both the

Japanese passenger railways and the American freight railways are growing. They are substantially more profitable, while not adopting a separated management of infrastructure and train operations.

In this chapter, the most important elements of the institutional reconfigurations chosen by the different countries will be examined. They will be presented according to a standardized figure, explaining the relationship between authorities, infrastructure provider and transport operators, including the kind of the relation and the main financing linkages. The conclusion of the chapter will provide some general remarks and observations about the observed variety.

The Netherlands

The Ministry of Public Works and Water Management (Ministerie van Verkeer en Waterstaat) is responsible for general railway policy, payments to the railway sector and for issuing of concessions for passenger transport on the main railway network and for infrastructure management on the whole network (see Figure 16.1). The regulation is the responsibility of several bodies. The transport inspectorate

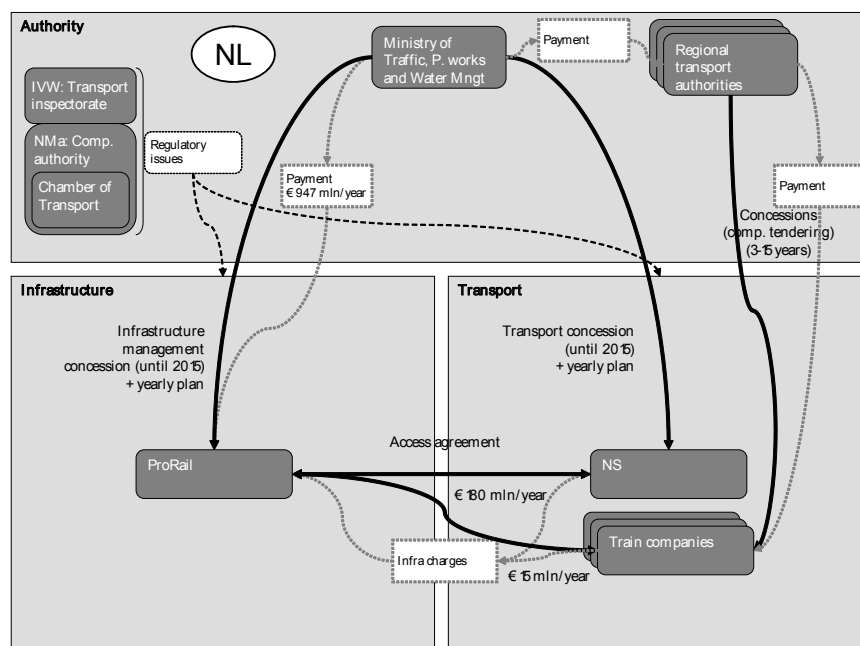


Figure 16.1: Institutional configuration of the railway sector in the Netherlands

(Inspectie Verkeer en Waterstaat) is responsible for railway safety issues, and the chamber of transport, part of the Competition authority (Vervoerskamer van de Nederlandse Mededingingsautoriteit), oversees the fair access to the railway network, access charging and capacity allocation.

ProRail is the infrastructure manager of the Dutch railway network. ProRail is a company organized according to private law but owned for 100 percent by the Dutch government. It results from the separation of the historical operator into an infrastructure management company, a train operator and several other businesses. ProRail holds a railway infrastructure management concession for the whole network, this concession was directly awarded and lasts until 2015. The Ministry pays a yearly subsidy to ProRail for maintenance, management and building of infrastructures. ProRail receives access charges from the train operators for the use of the tracks, these charges are far below full costs. Access agreements regulate the relationships between ProRail and the various train companies.

The Dutch national railway operator (Nederland Spoorwegen, NS) is a company organized according to private law but owned for 100 percent by the Dutch government. Differently from the situation in many other European countries, NS has since its creation, in 1938, always been a private law shareholding company owned by the Dutch state. The NS holds a transport concession for the provision of non-subsidized passenger railway services on the main railway network. This concession has been directly awarded and lasts until 2015. The responsibility for the contracting of (subsidized) regional train services has been decentralised to regional transport authorities, these contracts are gradually submitted to competitive tendering. These contracts regulate the service level provided and the payments involved.

Both NS and ProRail have, according to the text of their concession, to maintain a certain service level. The chosen principle for the concession relations is that of a gradual transition from input steering to output and outcome steering during the concession period. To realize this, an essential element within the obligations of the concessions is that both companies have to produce a yearly transport plan (NS) and infrastructure management plan (ProRail). These plans are similar in that they require the companies to establish a set of performances that have to be delivered. During the first years of the concessions the companies specify these in terms of specific actions aimed at achieving specified performances. These are then gradually, in the latter years of the concession migrated into new and better yearly threshold values that the companies guarantee to realize, effectively resulting in a transition to output steering. Both plans have to be judged and agreed upon yearly by the Ministry. The idea behind this arrangement is to follow a continuous but realistic improvement path resulting from common agreements between the parties with, however, sufficient pressure for effective improvement via political and social

focus and pressure, and *in ultimo* some financial penalties.

The first period of the reform (from 1996 up to 2001) was based on a harsher and more one-sided type of financial incentive contracting. That did not, within the institutional context of the time, result in good performances. Rather to the contrary, general discontent grew. The current regime is the result of the second reform that started with the policy update introduced in 2001 and based on a more cooperative approach, realizing the necessity for all actors in the new institutional setting to get to grips with the new institutional context in a more gradual fashion. Following the recently published governmental position paper on the official evaluation of the current railway legislation, it appears that the government considers that the current regime is now working satisfactorily and that no further major change to the regime is needed (Ministerie van Verkeer en Waterstaat 2009).

Germany

The Ministry (Bundesministerium für Verkehr, Bau und Stadtentwicklung) is responsible for railway policy and financial support to the railway sector (see Figure 16.2). The German States and their regional transport authorities contract regional

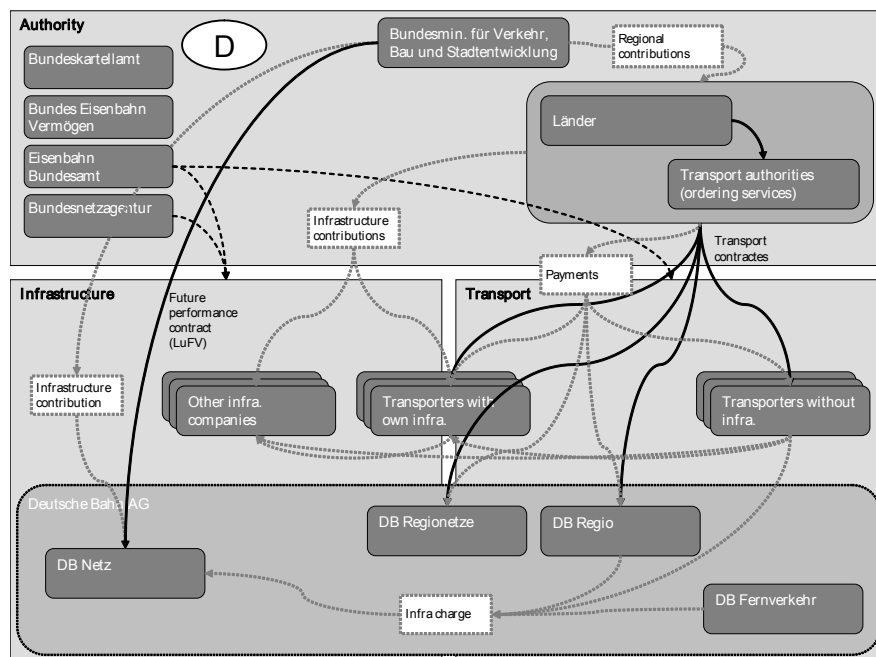


Figure 16.2: Institutional configuration of the railway sector in Germany

train services. The Bundeskartellamt is the competition authority, since 2007 is the Bundesnetzagentur (BNA), as department of the Ministry of Economic Affairs, responsible for the railway network. The Eisenbahn Bundesamt allocates the track access authorizations and is responsible for safety and separation issues. The Bundes Eisenbahn Vermögen, established in 1994 when the former East and West German railway companies were merged, is in charge of those assets that needed to be separated from the new railway company Deutsche Bahn (DB) to be able to face competition.

A company organized according to private law, DB is owned for 100 percent by the German State. The infrastructure belongs, within the holding, to a separate infrastructure company (DB Netz). Several other small infrastructure companies exist and are mainly owned by local authorities. DB Netz is both owner and manager of the infrastructure. There is no concession nor contract that regulates this position. It is obliged to open its network to competitors who have to pay an infrastructure charge. The Ministry pays DB Netz for maintenance, management and building of infrastructures. The payments used to be project-related; but a new regime is being developed (*Leistungs und Finanzierungs Vereinbarung*). This multiannual contract will award about €2.5 billion per year and replace the existing arrangements. DB developed an infrastructure register to facilitate this.

DB provides passenger transport services under several brands. DB Fernverkehr is responsible for the long-distance transport. These services are not linked to any contract nor concession, neither are they subsidized. A few independent private companies also provide other long-distance passenger service upon their own market initiative; but this remains hitherto rather marginal. The Ministry transfers sums of money to the German states to contract regional train services. Most of that market is still contracted directly to DB Regio. Critics find that some of these contracts provide DB a substantial financial advantage. These contracts are, however, increasingly subject to competitive tendering and private operators are currently providing about 12 percent of the total number of train-km in Germany. DB Regio provides the regional train services on most of the regional railway lines besides about 50 other operators.

There are in general no specific complaints about the long-distance services provided by DB. The main criticisms against DB are about its possible anti-competitive behavior, although—it must be said—opinions tend to vary a lot on this issue. There is for instance a broader recognition of the fact that the competitive behavior of DB has become much more neutral in recent years. The allocation of track capacity is perceived to work rather satisfactorily although there are still a number of concerns about the access to other infrastructural facilities. The problem facing BNA in its regulation of this market is an apparent lack of cooperation by DB, a lack of legal

power to obtain the necessary data from DB (differently from the British regulators) and a lack of personnel capacity. Furthermore, rather little is known about the true efficiency of DB Netz and there are currently no specific efficiency target or sanctions that the authority could impose. BNA, amongst others, would favour the introduction of a form of price-cap regulation that is currently non-existent.

The pending privatization of DB dominated much of the debates of the recent years. The complex arrangement for a partial privatization in three holdings where only the transport (passengers and freight) and logistics activities would have been privatized for 24.9 percent while the infrastructure (tracks and stations) would have remained for 100 percent in the hands of the Federal State has now been postponed due to the world financial crisis.

Interestingly, the focus of the Federal ministry seems to be directed at reinforcing and stimulating the entrepreneurship of DB. The development of extensive contracts seems to be seen as an element that would hamper the realization of this aim.

Switzerland

The Ministry of the Environment, Transport, Energy and Communications (Eidgenössisches Departement für Umwelt, Verkehr, Energie, Kommunikation) and the Federal Office for Transport (Bundesamt für Verkehr, BAV), as part of the Ministry, are responsible for the general railway policy (see Figure 16.3). Several bodies are in charge of regulation: the Competition Authority (Wettbewerbsbehörde) is an independent institute, the Price Control Body (Preisüberwachung) oversees prices charged in non-competitive sectors and the Railway Arbitrage Commission (Schiedskommission im Eisenbahnverkehr) is in charge of conflicts, for instance in capacity allocation.

A specific characteristic of the Swiss regime is the vertical integration between transport and infrastructure. It is often underlined in Switzerland that this integration is important in order to be able to realize an efficient timetable and an efficient operation under efficient investments in infrastructure and rolling stock. Despite the integration, railway companies are nevertheless obliged to maintain a separate accounting for both departments. The Federal railway company (Schweizerische Bundesbahnen, SBB) is designed by law to be the infrastructure manager without need for a specific concession. BAV signs four-yearly contracts with the infrastructure departments of SBB and those of the other operators. This contract requires SBB to make its infrastructure available to other operators, in good shape, besides various aims related to safety and capacity. No coercion resources are included in the text. However, SBB is required to report to BAV every half year about the extent to which contractual goals have been realized. This is based upon an extensive re-

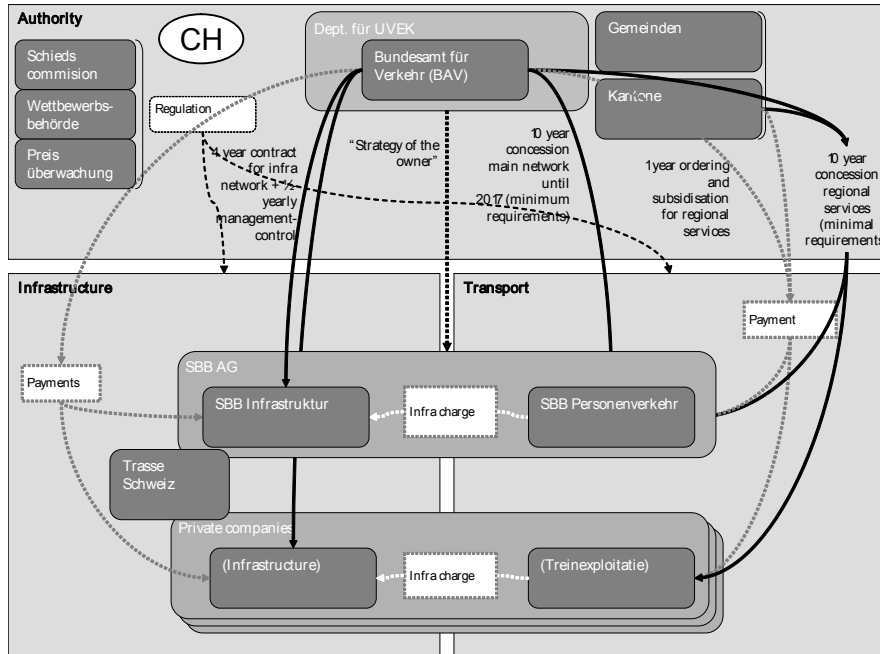


Figure 16.3: Institutional configuration of the railway sector in Switzerland

porting of 30 performance indicators that SBB has to provide to BAV. If non-compliance is expected or observed, SBB is asked to formulate corrective measures. BAV is also allowed to formulate specific indications to the management or to amend the targets. At a second level, the Swiss government also gives to SBB an owner strategy to follow, including aims that have to be achieved. This document is—following Swiss consensus culture—the result of discussion between the government and the operator. The follow-up of this is assured through regular talks between SBB and the minister. The capacity allocation for the normal gauge network (composed of the three operators SBB, BLS and SOB) is assured by Trasse Schweiz, as independent organization set up for this purpose to fulfil the European neutrality requirements. The operators pay an infrastructure charge. Numerous regional private operators, who own regional lines, also run through trains on to that main network.

SBB provides the long-distance passenger transport and a part of the regional transport. SBB was set up as a shareholding company that has to behave as a fully private company, but owned for 100 percent by the Federal state. Numerous so-called private operators provide regional services on their own lines. These companies are, however, mostly owned by the Cantons and the Federal government. BAV grants a 10 year concession to SBB for the non-subsidised long-distance pas-

senger transport. This concession only includes few concrete obligations amongst which the definition of a minimum frequency to provide between the cities. BAV grants, together with the Cantons, concessions for 10 years for regional operators (including SBB and the privates). These concessions also include only very globally formulated obligations for the operator. In practice, these agreements are extended at expiration. It is in the yearly service orders that BAV and the Cantons add yearly to these concessions that the subsidization of those regional services is organized. The Swiss legislation includes important integrative features in public transport. This allows for the absence of a specific regulation of fares within those contracts. Fares are to be established in common by all operators, whom the legislation also force to cooperate within a timetable conference.

The absence of separation between infrastructure management and train operations is certainly a cornerstone of the configuration choices made in Switzerland. The general opinion of actors and observers in Switzerland is that the current regime works satisfactorily and that vertically integrated railway companies are an important basis for this to happen. Despite integration and the fact that the timetable is established by the operator, it is perceived that fair access for entrants in freight transport has nevertheless been achieved.

The general principle of the existing railway legislation is based on consensus and absence of strong coercive instruments. Understanding the Swiss consensus culture is essential to understand the functioning of the Swiss railway regime. Problems are being discussed and solved even before the need to take hard coercive action. Due to this, SBB benefits from a substantial amount of freedom and efficiency control does not play a prominent role. Strikingly, formal regulators play only a very marginal role in the Swiss regime. The fact that subsidies do not increase substantially, in combination with rising ridership, leads to a general feeling of satisfaction in the sector and society, and to an assumption that the system works efficiently. Under these circumstances, it is perceived to be very likely that the concession for long-distance transport will again be awarded to SBB after 2017.

The railway actors underscore the importance of the culture in the sector that results in virtual competition, or competition by emulation between all existing railway operators. The existence of numerous railway operators is seen as a source for improvement, even in the absence of further competitive mechanisms and emulation is seen as more important than privatization. Interestingly, the Dutch railways are often cited as a source of inspiration and success for the Swiss railways (especially the traditional clockface timetable, the nodal interchange system, frequency increases, etc). These elements also formed the basis for the refinement of the supply within the investment programme Bahn2000 that, by integration between transport and infrastructure, continuously looked at the most sensible in-

vestments from a system-wide perspective rather than from the point of view of the train and the track separately, as would have happened in a separated railway regime.

Further changes to the regime are not to be expected. The sector and society is satisfied with the current regime and the Parliament seems even tired of further reforms after the various (attempts) at further reforms that took place during the recent years.

Great-Britain

The Department for Transport (DfT) determines the railway policy and is responsible for the competitive tendering of the railway concessions (called 'franchises') since 2006 (see Figure 16.4). The Passenger Transport Executives (PTEs) in the six major urban areas outside London cooperate with DfT. The Office of Rail Regulation (ORR) functions as an independent body besides the Office of Fair Trading and the Rail Safety and Standards Board.

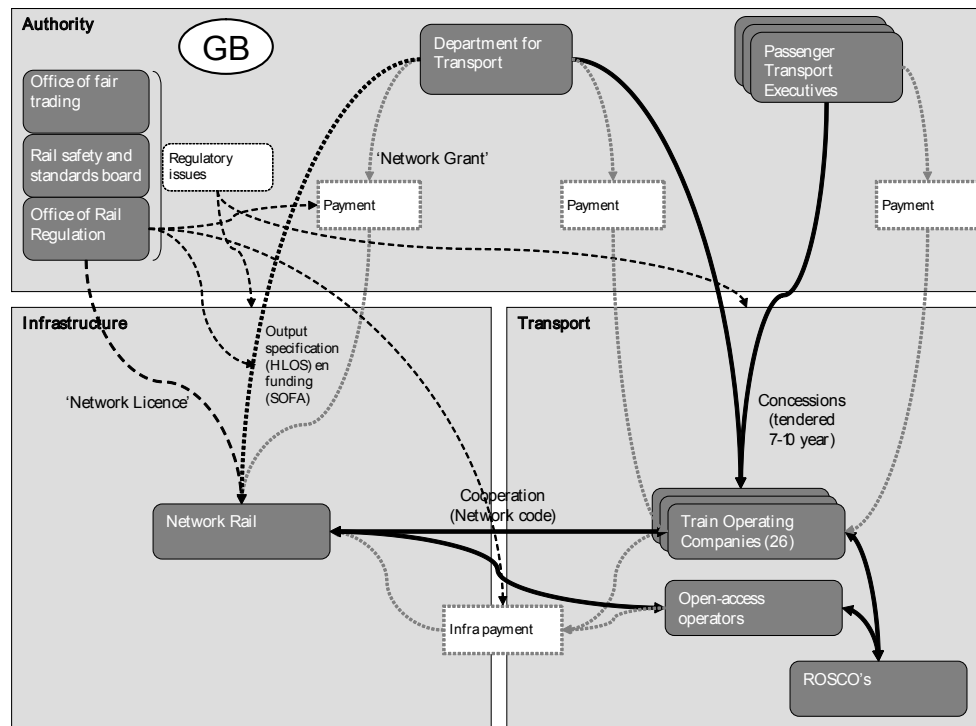


Figure 16.4: Institutional configuration of the railway sector in Great-Britain

Network Rail manages, maintains and builds the railway infrastructure. It is also responsible for the allocation of track capacity, under the oversight of the ORR. Network Rail works under a network licence that is valid for at least 25 years, and that includes general obligations pertaining to the maintenance and availability of the track infrastructure. Specific infractions could lead to a cancellation of the licence. Network Rail is company limited by guarantee, established in 2002, that is controlled by members, that is, various private and public actors. Profits are to flow back to investments in infrastructure. The relationship between Network Rail and DfT is essentially a financial relation, supervised by the ORR. The relationship between Network Rail and ORR is a regulatory relationship where ORR determines whether the level of public grant to Network Rail is sufficient for the tasks expected from Network Rail. ORR also supervises Network Rail through 5-yearly control periods according to which the infrastructure charges are established by ORR.

In 2007, DfT published its White Paper with requirements for safety, reliability and capacity in the high-level output specification (HLOS) and the accompanying budget in the Statement of Funds Available (SOFA). This way, DfT specified what it expects from the railway sector in the next 5 year period (which is identical with the 5 year review period of ORR). This also shows the more prominent role that DfT gives to the railway sector in the current policy.

DfT awards the various railway networks to privately owned Train Operating Companies (TOCs) after a competitive tendering procedure. These concessions (the so-called 'franchises') last for 7–10 years and include detailed specifications of the transport services to be provided. The competitive tendering leads to the determination of a concession price. This payment can be both from the government to the operator (unprofitable concessions) or from the operator to the government (profitable concessions). The fare freedom of the operators is limited by a number of regulatory measures. These are rather strict on those relationships where the customer has no or little alternative for the train, while it is less constraining on those relationships where intermodal competition exists (such as with long-distance buses or airlines). Various sanctions are included in the contracts (for punctuality, seat availability, etc.) The concessions do not provide exclusivity as a limited number of open-access operators are allowed to operate on the network besides the TOCs.

The general opinion in Britain is that the institutional changes that have been implemented in the railway sector since the days of the unitary British Rail have led to a lot of turmoil and that it is now time to observe a period of institutional rest. The general evaluation is also that the current regime works satisfactorily: the rolling stock was significantly modernized, there has been a substantial growth of supply of train services and the ridership has also risen substantially. The railway system is also very safe, also in historical perspective, despite a more or less tendentious

media reports. The original set-up of the British railway reform (as implemented in 1994–1997) was more modelled according to a clear and unique chain of actors: the authority specified general aims and guidelines and created a specific agency, the Office of Passenger Rail Franchising (OPRAF) to organise the competitive tendering of the routes and networks. The companies that won those concessions had to cover all production costs (personnel, lease rolling stock and infrastructure charge). The OPRAF was replaced by the Strategic Rail Authority (SRA) in an attempt by the newly elected Labour government to reinstate the planning model in the railway sector. However, policy-making through the SRA was difficult, and some observers consider this was one of the reasons for its abolition and integration of its tasks—especially the competitive tendering of the franchises—within the ministry. As a result, DfT now has more power on the railway than ever before. Existing concessions were lengthened, rearranged or renewed during this process. But they were also to a large extent submitted to much more detailed specifications of the expected output. Operators have, however, kept most of their commercial freedom (for example, on fares) and further passenger growth was generated.

The strong growth in supply and ridership led to problems after the first franchising wave at the end of the nineties. This growth could hardly be accommodated on the existing, poorly maintained network. The resulting problem for the privatized track owner and manager, Railtrack, that had been created at the time of privatization were huge and led to its failure. This led to a policy change in 2001 with the creation of Network Rail, as new not-for-profit infrastructure manager. This re-created infrastructure manager then started receiving government subsidies again, very much at odds with the original set-up of the British railway reform. This was needed, however, due to the maintenance and investment backlog of the British railway network.

The current concessions (franchises) contain much more extensive financial incentives than what can be seen in other countries with a separated configuration (such as the Netherlands). This is very much in line with the Anglo-Saxon tradition. The control on the infrastructure manager continues, however, to be seen as a weak point in the current institutional configuration. Government has less direct control on this institution than in some other countries (such as the Netherlands), while the regulator, ORR, has relatively more powers. The introduction of HLOS and SOFA will somewhat amend this balance of powers though by creating a slightly more contractual setting than previously.

The discussion on the reintegration of the infrastructure management and train operations ceased to be a main theme. Joint Control Centres have, however, been created between Network Rail and the TOCs to realize a better integration of operational processes (traffic control).

France

The Ministry for Ecology, Energy, Sustainable Development and Planning (Ministère de l'Écologie, de l'Énergie, du Développement durable et de l'Aménagement du territoire) is in charge of policy concerning the long-distance passenger rail services (see Figure 16.5). The French Regions sign contracts for their regional train services with the respective regional division of the state railway company National Society for French Railway (Société nationale des chemins de fer français, SNCF). The Mission de contrôle des activités ferroviaires is in charge of taking care of the complaints on access to the network, etc. The Établissement public de sécurité ferroviaire is in charge of safety regulation. The Conseil de la concurrence is charged with general competition regulation.

The French Railway Network (Réseau Ferré de France, RFF), created as a public company charged to operate according to commercial principle, is the owner of the railway infrastructure. It is also charged with formulating policy pertaining to the maintenance and development of rail infrastructure. RFF receives infrastructure

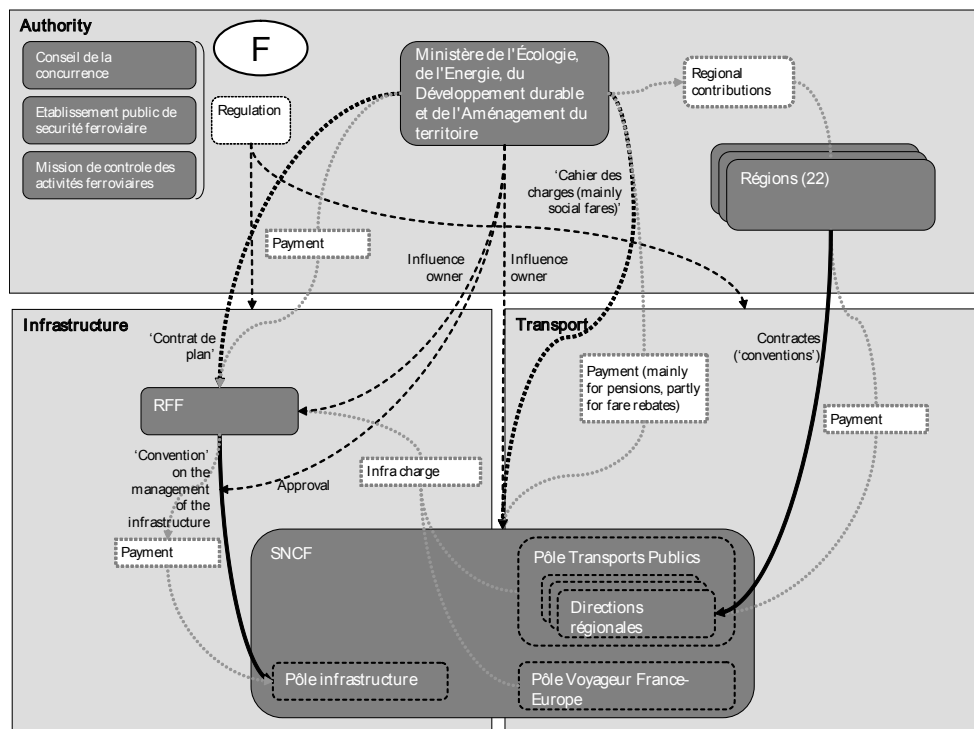


Figure 16.5: Institutional configuration of the railway sector in France

charges from operators on the network. It owns the rail-related real estate that is not used for train operations and it is in charge of selling those assets. The legislation does not foresee a contract between RFF and the State. The State, however, controls RFF through a Government representative in RFF's board. Interestingly, the official separation between infrastructure management and train operations introduced with the creation of RFF is partially neutralized by the French legislation which requires RFF to delegate a number of its infrastructure manager tasks back to SNCF, which is then officially designated as 'delegated' infrastructure manager. According to this, SNCF prepares all necessary calculations to carry out the task of capacity allocation, it is in charge of traffic control, network maintenance and of the development of most new infrastructures.

SNCF is the operator of passenger train services. SNCF is organized in a number of departments, each having specific tasks in passenger and freight transport. A special law created SNCF as a public company charged to operate according to commercial principles. According to this, SNCF is asked to cover its costs with passenger receipts, freight rates and contractual payments from regional authorities. SNCF actually benefits from a substantial degree of freedom. Its long-distance services are not submitted to a contract. The status of the company, however, allows the State to exert various influences on SNCF. There is in principle also a contract (*contrat de plan*) between the State and SNCF that establishes pluri-annual budgetary agreements, but this contract does not seem to be enforced. The general principle is that the high-speed services and the other long-distance services must be profitable. They are akin to free market services and are not submitted to a contract. There is however one intervention by the State on SNCF's fares as defined in a list of requirements which contain essentially a number of social fare obligations. The regions pay SNCF for the expected deficit of the regional railway contracts they order. These are paid for with money received by the Region from the French State.

The French institutional configuration is rather unique due to the remarkable circular relationship taking place between RFF and SNCF. According to this SNCF Pôle Transports Public pays RFF, as owner of the network, for the usage it makes of the network. RFF received further money from the State for the development and maintenance of the network. RFF then contracts out the maintenance and management of the network back to SNCF for a period of four years, including traffic control and SNCF is paid for these tasks by RFF. Few financial incentives and penalties are included in this contract. The level of infrastructure charge is determined by the State after a proposal by RFF. The State also pays substantial yearly amounts to SNCF for its pension obligations, and this is the main payment to the railways. According to these arrangements, the power of the French authorities on the railways essentially takes place outside of a contractual setting. The influence of the State

is, however, substantial through its role as owner of SNCF and RFF and through its representation in their boards. The power of the regulators was until rather recently very limited.

The choice for an institutional reconfiguration that maintains the 'unicity' of SNCF was essentially dictated by the power of the trade-unions, that block changes with threats of strikes. Competition and competitive tendering are, therefore, not to be expected in the short run. However, it can also be observed that the introduction of contracts for the regional railway services has, in the meantime, led to a growth in ridership. Furthermore, French observers tend to say that SNCF has managed to improve its performances in recent years. But these improvement seem to be more the result of what was achievable within the social agenda than by a drive to realize substantial efficiency improvements. The sociopolitical consensus to avoid really splitting up SNCF continues to dominate all discussions. A report by the French Audit Office even points at this situation as the source of substantial problems that will hamper the railway to tackle the challenges it currently faces in terms of market opening and growth. The study also points at the extreme focus of the authority on prestigious rail investments that take place at the expense of an adequate level of maintenance of the regular network, on the almost total absence of incentivized contractual relationships, on the slow pace of reform due to the focus on the sociopolitical problem.

Japan

The Ministry of Land, Infrastructure and Transport is responsible for the general railway policy (see Figure 16.6). Japanese railway companies keep the traditional integrated configuration. There is no separation between infrastructure and transport. These operators have to obligation to cover all their expenses, both infrastructure and train operations, with passenger fare revenues. On a few routes, separate infrastructure companies have been created, though. This is the case on those routes where such prohibitively expensive infrastructure investments were needed (such as new tunnels under city centres or mountains) that profitable operations is not possible without public support. The background for this is the fact that the Japanese legislation prohibits direct subsidization of railway companies, but allows the authority to participate in the capitalization of such infrastructure companies, together with railway operators. The creation of these infrastructure companies has thus a financial rationale and, contrary to the situation in Europe, nothing to do with the desire to make competition on or for the track possible. It should be noted though, that some limited subsidization does nevertheless exist for punctual measures. The authority formulates for instance policy measures related to the realiza-

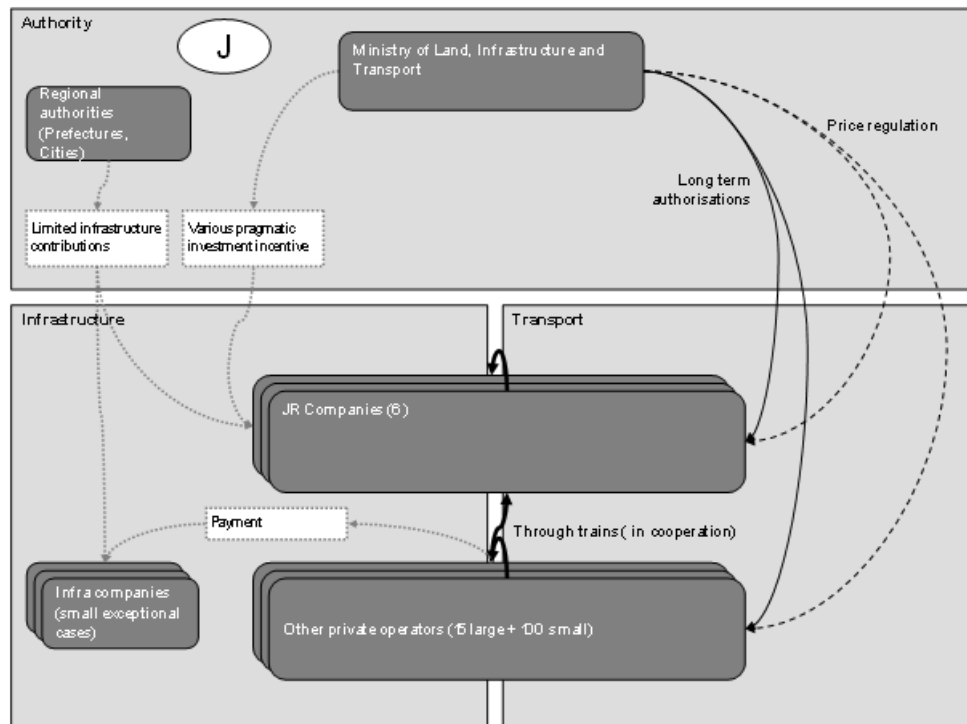


Figure 16.6: Institutional configuration of the railway sector in Japan

tion of better interconnections, more accessibility, higher capacity, etc. These aims are then furthered by ad hoc financial incentives (such as taxation advantages or other forms of financial participations in investments costs).

The former Japan National Railway (JNR) was split into six private Japanese railway (JR) companies in 1986, each operating in one region of the country. The three major JRs, which operate in the main Japanese island of Honshu, have now been floated on the stock exchange and are known as very successful companies. The three minor JRs, which operate on the three islands of Kyushu, Shikoku and Hokkaido, have remained in state hands. The JRs provide commuter services in the main cities, long-distance intercity services and high-speed services (*shinkansen*). Many private operators exist besides these six JR companies. Actually 15 main private operators are mainly active in the central metropolitan areas; and more than 100 smaller private operators exist throughout the country, some of which in cooperation between the public and the private sector for the operations of branch lines.

These operators provide services on their own tracks but also often cooperate with neighboring operators by organizing through-train services between their respective networks. This happens in cooperation, not in competition.

The authority plays a rather background role in the supply of train services. There are, for instance, no specific contracts between authority and operator; and there are no generic subsidies for the operations, as the services have to be profitable, including all infrastructure costs. The licences of the railway companies are not limited in time; and the sector is not submitted either to competitive tendering nor to competition on the tracks. The only competition to take place is that between overlapping networks of railway operators. The railway companies are, however, submitted to various forms of economic regulation that are partly based on competitive elements (such as a fare regulation based on yardstick competition for the operational costs and rate-of-return regulation for the infrastructural costs).

Competition on or for the tracks was no part of the reforms put in place in 1986. Despite this choice, the operators are nevertheless submitted to numerous competitive incentives (yardstick competition, rate-of-return regulation, intermodal competition, competition between networks and competition on the capital and labour markets). Typical for the configuration choices made in Japan is the choice to maintain integral companies, together with their privatization. The success of the many Japanese private railway operators, who already operated successfully for many decades besides the former JNR, was the main role model for this choice.

The synergetic development of railways and neighboring real estate is also another key to the success of the railways as life-style developers. This takes place without cross-subsidization between real estate and train operations as each of these departments have, by law, to prove its own profitability. The integration of infrastructure with train operations, together with the absence of direct subsidization, forces the railway companies to avoid excessive infrastructure developments. The infrastructure is tailor-made for the timetable being provided. This is then coupled with typical Japanese step-by-step improvements (*kaizen*) and these practices have led to performance levels that are unheard of in Europe, with a number of trains per track-km that is oftentimes at least twice as high as current European practices, while the technology used is—essentially—as traditional as the European one.

Conclusions

The countries presented here provide a good coverage of the current variety of institutional arrangements in the European railway sector and Japan. A regime with a combination of a direct award for passenger services on the main railway network,

and competitive tendering on the subsidized regional network in the Netherlands, with a relatively strong steering position of the government via the concession agreements and the yearly production plans. A regime formally based upon open access in Germany (no concession, exclusive right, nor direct steering of the operator), with *de facto* little competition and a dominant position for DB, complemented by contracted routes in regional transport (competitively tendered or not). A regime based on tough competitively tendered contracts in Great-Britain, with a strict separation between infrastructure and train operations. A regime based on a compromise with trade-unions in France, where the separation is such that SNCF *de facto* continues to carry out most tasks, and with almost no contracting. A regime based upon a strong belief in the importance of not separating the railway in Switzerland, where consensus and mutual control between the actors play an essential role, but with substantial guarantee for fair access by entrants. A regime based upon pure commercial incentives in Japan with privatized non-separated businesses who benefit from long-term positions through the absence of contracts or competitive tendering, with an authority that sporadically distributes *ad hoc* subsidies where it is really needed.

Four of the six countries presented here have kept some form of integration between infrastructure management and train operations (Switzerland, Germany, France and Japan). The configuration chosen in Germany led to considerable scepticism as to the role of the infrastructure manager and fair access to the network, although this seems to have waned in recent years. The configuration chosen in Switzerland is based upon a strong belief in a non-unbundled railway. France adopts a rather hybrid configuration by combining a formal separation with a delegation of many tasks from the infrastructure manager to the traditional train operator. Great-Britain and the Netherlands chose for a fully separated configuration. This is combined with extensive regulation in Britain as there is no strong contractual link between the Ministry and the infrastructure manager. In the Netherlands, on the contrary, the contractual link is stronger and the regulatory oversight weaker than in Britain. Japan chooses to keep the traditional non-separated configuration. This is even a cornerstone of the regime as Japanese railways are important actors in Japanese society, benefiting from a long-term position and by being integral developers of land and transport, providing real estate, including shops, offices and residential areas at stations and along railway lines.

It is interesting to see that there appears to be much more discussion on the public interest in connection with railway provision in the Netherlands than in the other countries presented here. Interestingly, one can also observe that the control power of the Dutch authorities on their railway already includes more monitoring and coercion resources than in most other countries, with the notable exception

of Great-Britain. The German railways are essentially free in their actions. The authorities mainly take action through the subsidization of infrastructure and growingly through the contracting and competitive tendering of regional train services. The French railways constitute a particular case. Influences take place mainly in an indirect setting, through the role of the State in the management of the state owned company. Regional railway services are already contracted, but with a monopoly for the state company. The Swiss railways are submitted to various forms of steering and control at arm's length. These instruments include almost no coercion resources. This is, however, not perceived to be a lack in the system as the relatively cooperative and constructive way in which the Ministry performs its steering role in a non-confronting and indirect fashion is seen to have lead the sector to a high(er) level of performance. The British railways are, amongst the railways presented here, those that are submitted to the largest amount of rules and regulation, despite the strong private character of the sector; which sector—incidentally—sighs under the growing weight of state regulation that has appeared during the last decade. The Japanese railways are at the complete opposite of this, being fully independent from authorities, both financially and as far as their service supply is concerned.

The facts and opinions collected in writing this chapter show that some countries are clearly satisfied with the choices made, while one has to observe that other countries realize that they still face a number of unsolved issues. The French case showed that substantial issues will have to be resolved in the near future. The German debate was for a long time dominated by the privatization plans that have now been put on hold. But there remains substantial discordance between interviewed actors on many topics pertaining to competition, regulation, etc. The Swiss case is quite opposite to this. Here discussions have been conducted at a slow but constructive pace and consensus seems to have been reached. The Dutch case was positive at first, but now seems to have reached a satisfying equilibrium. The British regime is perceived to be a success in Britain, the current main preoccupation being a search for stabilization after the numerous institutional changes that have been implemented in the last decade. The Japanese case is the benchmark for very successful railway companies with unknown financial and operational performances seen from a European point of view. The main railway challenge in this country is the aging and, in term, declining population.

This chapter has provided an overview of the institutional diversity that can currently be observed in the European railway sector. A few of the challenges facing some countries have been presented. Elements allowing to understand the main changes and achievements have been synthesized. It would then be tempting to try to establish a link between institutional choices and the highest achievable levels of performances. But one has to be careful when considering an institutional transfer

from one country to another because of differences in context, traditions, history and culture. Some of the institutional reconfigurations implemented in the countries presented here delivered performance improvements. This does not guarantee that the same reconfiguration would deliver the same improvement when implemented in another context, nor does it guarantee that the highest possible level of performance is reached.

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Coordination in railway hinterland chains

An institutional analysis

Martijn van der Horst and Larissa van der Lugt

In the last two decades, the European railway market has been liberalized: more competition and less government involvement should lead to higher efficiencies. The central message from an economic perspective is that more market coordinates transactions more effectively and efficiently. In the rail freight market, liberalization did bring positive effects: quality improved and costs went down. However, by focusing on seaports, this chapter shows that liberalization does not in any case bring an optimal allocation of resources. In the new liberalized situation, new parties have entered the market, roles have changed and functions sometimes have split-up over several actors or even disappeared. This chapter shows that additional institutional arrangements or coordination mechanisms are needed in such a process that is highly interdependent in terms of time and capacity. This paper builds on a conceptual approach rooted in new institutional economics for analyzing coordination arrangements in hinterland chains. Based on an in-depth study into the economic organization and performance of the rail transport in the port of Rotterdam we will empirically use the framework.

Many studies on seaport-hinterland relations indicate that containerization has expanded the hinterland reach of seaports. As a result port competition has intensified (Hayuth 1981; Slack 1993) and the relevance of smooth hinterland connections has increased tremendously. Recent empirical evidence shows that deep-sea container carriers select container ports and container terminals in the Hamburg–Le Havre based on the availability of hinterland connections, reasonable tariffs and immediacy of consumers. As a consequence coordination in hinterland transport networks has increasingly become subject of study among scholars in port economics and management (Wiegman et al. 2008). It has been studied from an operational and technical perspective (for example, Bontekoning 2006). Such studies are valuable, but the proposed hardware solutions will work in a model or process simulation; but it will usually fail when they are implemented due to organizational and process questions like distribution of costs and benefits, distrust, strategic behavior and too limited economies of scale (Van Binsbergen

2007). Coordination in hinterland networks has also been approached from a supply chain management perspective, focusing on chain configuration and integration (Panayides 2002). Van der Horst and De Langen (2008) use insights from institutional economics, with transaction costs economics playing a central role, to study coordination in hinterland networks. They come up with an analytical framework that can be used to further analyze coordination problems and evaluate coordination arrangements that can be introduced in hinterland chains.

This chapter stresses the relevance of institutional economics in analyzing coordination in hinterland transport networks. It extends the work of Van der Horst and De Langen (2008) in developing a framework for analyzing and evaluating coordination arrangements in hinterland transports networks by using Williamson's (1996) layers as an analytical framework. This study specifically stresses the relevance of taking into the account the institutional environment in the analysis of coordination in hinterland networks. This is based on an empirical analysis into the rail freight sector that has been subject of major institutional changes over the last two decades. The chapter focuses on rail transport in seaports where the coordination issue is most relevant and where the institutional changes have had severe impacts. Gouvernal and Daydou (2005) demonstrated what the effect was of European liberalization on the degree of involvement (vertical integration) of shipping lines, terminal operators and port authorities in the provision of rail services. The analysis in this chapter has a broader perspective on coordination also including horizontal forms of coordination, and the new role of rail infrastructure managers.

The chapter is structured as follows. The next section explains the principles of institutional economics and introduces the Williamson's (1996) layers as an analytical framework to analyze coordination in hinterland chains. The framework shows that coordination problems and coordination arrangements do not arise in a vacuum; but there is an influence of an institutional environment. In the third section, an overview is given of policy changes in this institutional environment linked to the liberalization of the European transport market in the 1990s. Based on an in-depth study into the economic organization and performance of the rail transport in the port of Rotterdam, the effect of this regime change on the rail freight market in the Port of Rotterdam will be discussed. Moreover, a number of coordination arrangements is analyzed and their ability to solve the coordination problems.

Analytical framework

In analyzing ports and their hinterland networks institutional economics is scarcely used as a theoretical lens. Some scholars contributed to the institutional analysis of seaports (for example, Stevens 1997; Jacobs 2007); but institutional eco-

nomics in port-hinterland relations has received little attention. In institutional economics actors are assumed to have two human factors: opportunism and bounded rationality. Due to these actor's attributes coordination problems arise and coordination beyond price is required to ensure an efficient transport chain (De Langen 2004). Whereas neoclassical economics shows how (equilibrium) prices in markets inform actors about efficient allocation of resources, new institutional economics (NIE) focuses on different organization modes and how transactions can be coordinated efficiently.

The quality of a port's hinterland chain depends on the behavior of many actors, including terminal operators, freight forwarders, container operators, and the port authority. Van der Horst and De Langen (2008) identified a set of coordination problems among these actors and analyzed and categorized different coordination arrangements. All the coordination arrangements have one purpose: coordinate economic transactions in the port-hinterland relation in the most efficient way. Efficiency deals with efficient use of resources (technical productive efficiency), satisfying of consumer's preferences (allocative efficiency) and that new processes, product and services are innovated (dynamic efficiency). Once a coordination problem in the hinterland transport chain is identified and analyzed on its specific character, coordination arrangements can be identified that should lead to the improvement of the coordination in the hinterland network. For analyzing governance in a port's hinterland chain four main categories of arrangements are distinguished: introduction of incentives, interfirm alliance, changing of scope and collective action (see Table 17.1). The four main categories include coordination

Table 17.1: Four coordination mechanisms and possible coordination arrangements

Coordination mechanism	Possible coordination arrangements
Introduction of incentives	Bonus, penalty, tariff differentiation, warranty, auction of capacity, deposit arrangement, tariff linked with cost drivers
Creation of an interfirm alliance	Subcontracting, project-specific contract, standardized procedures, standards for quality and service, formalized procedures, offering a joint product, joint capacity pool
Changing scope	Risk-bearing commitment, vertical integration, introduction of an agent, introduction of a chain manager, introduction of an auctioneer, introduction of a new market
Creating collective action	Public governance by a government or port authority, public-private cooperation, branch association, ICT system for a sector of industry

arrangements beyond price or in addition to the (neoclassical) price mechanism. The coordination arrangements include amongst other different types of contracts, both vertical and horizontal arrangements, the involvement of branch organizations, and public actors. Main goal of coordination arrangements is to reduce transaction costs.

It should be stressed coordination problems and coordination arrangements that can be chosen do not arise in a 'vacuum'. There is a strong influence of the institutional environment on the emergence and development of governance; in different sectors, regions or national environments, different governance modes emerge. This is conceptualized by Williamson (1996) in his three layer model (see Figure 17.1).

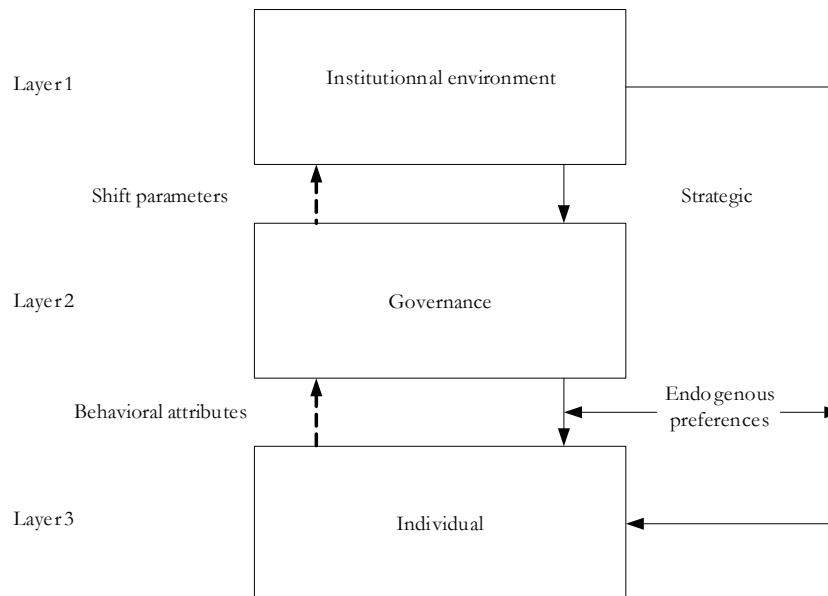


Figure 17.1: Williamson's three layer model (*Source:* Williamson, 1996). Applying Williamson's layer model to an infrastructure market with a liberalizing institutional environment like the railway market is relevant. Earlier, the model has been applied to assess road management liberalization in Nordic countries (Groenewegen and De Jong 2008).

The institutional environment is placed at the first layer. This is the area of formal and informal institutions. Formal institutions refer to national and international (EU) laws, regulations and procedures. The basic question in this layer is who owns what. In the port-hinterland relation this layer deals with ownership structure

of ports, competition rules in the field of antitrust, mergers and state aid, or the European directives on unbundling infrastructure ownership and opening international traffic to private companies. Informal institutions include traditions, norms and customs which are deeply rooted in society. Between ports and its hinterland differences in culture exist, but these differences seem to become smaller and value gets blended because of dynamics in ports and hinterland are caused by internationalization and technological innovation (De Langen and Chouly 2003).

The impact of the institutional environment on choosing a coordination arrangement (layer 2) is represented in the model with shift parameters. The influence of individual economic actors on the transactions and governance structure is represented in the three layer model with the behavioral attributes: opportunistic behavior and bounded rationality. As mentioned earlier, these human characteristics contribute to coordination problems.

Williamson also included so called secondary effects in his framework (the dotted arrows in Figure 17.1). The secondary effects are called endogenous preferences and strategic or instrumental effects. A strategic effect is the influence of the governance structure on the institutional environment. For example improvement in contract law, brought about at the request of parties who find that existing law is poorly suited. Endogenous preferences are found in the influence of the institutional environment and governance structure on the individual economic actor. Although Williamson included these secondary effects in the model, he argues that the solid arrows are more pertinent (Williamson 1996: 225).

According to the model coordination arrangements are chosen given the rules of game in the institutional environment of seaports and given the behavioral attributes of individual actors in the port-hinterland transport chain. This (linear) way of reasoning is a fundamental critical point on the model. With neglecting the interdependencies between the governance layer and both the institutional environment and the individuals the model becomes static; it compares static situations. When and how a process of selecting a coordination arrangement takes place and will really end in an efficient equilibrium is not part of the analysis. Building on Williamson's model, Aoki (2001, 2007) introduced the comparative institutional analysis (CIA). One goal of CIA is to understand the mechanism of institutional evolution and change in a framework. Aoki neglects the linear way of reasoning and explicitly allows for feedbacks between the actors and their environment. Aoki attempts to answer the question why on the one hand multiple coordination arrangements exist and how the process towards a coordination arrangement can be understood. Aoki's contribution lies in his analysis of the process of institutionalization (by means of evolutionary game theory); actors maximize their trade-offs in each action they take in a sort of self-organizing process. This takes the analysis a fundamental step further than NIE, which only assumes a competitive selection

efficiency, and how coordination problems in container rail transport are affected. The last section discusses the consequences of the changes in layer 1 on layer 2 where the new and additional coordination arrangements are chosen by actors in the hinterland chain. Here the four main categories of arrangements are distinguished: introduction of incentives, interfirm alliance, changing of scope and collective action

Changes in the institutional environment of the railway market

Over the last two decades the rail freight transport sector has undergone a substantial transition, initiated by the European Commission. From the beginning, the European Transport Policy has been based on a liberal market approach, resting on the Commissions' conviction—at least until recently—that the market should play the central role also in providing mechanisms (for example pricing, incentives) for overcoming problems of congestion and pollution (Giorgi 2002). The EU Commission's approach focuses on privatization, vertical unbundling and liberalization. Vertical unbundling refers to the separation of infrastructure and operations. Infrastructure remains in the hands of one (in most cases) public organization and operations are carried out by one or more other (in most cases) private organizations. Privatization means change in ownership structure from public to private. Liberalization means that legal entry barriers are removed and open access is introduced enhancing competition. These arrangements are of different nature but all contribute to the liberalization process that the European Commission has followed strongly the last two decades.

The first step in European rail freight liberalization was Directive 91/440 of 1991. It focused on vertical unbundling, based on the Commission's feel that this was the best way to introduce competition on the railroad network: where the market for rail infrastructure is seen as a natural monopoly, with little possibility for competition due to scale effects (Gruyaert 2007), competition for the provision of rail transport services can very well be introduced and should be introduced to improve performance.¹ The core aspect of unbundling is the separation of the financial administration of the two activities. There is no obligation to strictly separate the two activities in two distinct legal entities. In different countries, different configurations have emerged (Gouveral 2005).

Based on a further analysis of the performance of the European rail sector, a rail

1. The rail transport sector is a network-industry, characterized by use of network infrastructure, leading to extreme high fixed costs and low variable costs. The consequence is scale economies and therewith a tendency towards a natural monopoly. Potential new entrants are confronted with high sunk costs (the investment in the infrastructure network that the existing company has done and depreciated already) and rather choose for getting access to the existing network than to develop a new one.

package consisting of three directives (2001/12/EG; 2001/13/EG; and 2001/14/EG) was developed.² The rail package permitted railway companies to offer services in all EU countries under equal and non-discriminatory conditions. To qualify for this status, railway companies have to acquire a specific license. In 2004, a second package was adopted with the following content: first, further liberalization of the market for rail freight transport, not limited only to the Trans European Corridors but operational on the whole European rail network; second, directives to ensure the safety of European civilians and create a level playing field; third, the formation of a European Rail Agency; and, fourth, measures to enhance the interoperability of the different national rail networks. In 2007, the European Parliament and the Council of Transport Ministers adopted the legislative proposals making up the Third Railway Package: market opening for international rail passenger services, rail passenger rights and obligations as well as the certification of train drivers.

The introduction of a new rail market regime has not run smoothly. It took almost two decades from the first discussions and negotiations in the European parliament and Council of Ministers. Now the packages are accepted and all directives needed for a free open market are there, implementation is still far from completed and differs strongly in the different countries (see Table 17.2).

Table 17.2: Results of liberalization policy in the European member states

Degree of separation	Degree of competition	
	No open access	Open access, freight competition
Vertically integrated (with accounting separated)	Greece, Ireland	Belgium, Germany, Austria
Separate public infrastructure manager	France, Finland, Spain	Sweden, Netherlands, Denmark, Italy, Portugal
Separate private sector infrastructure manager		United Kingdom

Source: Nash 2006

One of the problems that Europe is facing in this is the embedding of the European Policy in the National Transport Policy schemes of the different Member states. These schemes differ strongly, both in background as in outcome. Besides, some Member States still show a rather nationalistic and opportunistic attitude when it comes to policy measures that affect their economic growth. A rough estimate is that up to now only 35 percent of the EU rail legislation is correctly imple-

2. See the White paper on European Transport Policy to 2010.

mented (ERFA 2007), with limited share of new entrants in various countries and state aids still given in some countries.

In 1995, the Dutch government implemented legal separation of the infrastructure management and operations into two different organizations. Before liberalization, all railway activities were concentrated in one single organization, the Nederlandse Spoorwegen (NS). After a couple of years of start-up in 2003, ProRail was granted a ten-year concession to maintain the Main Line Network. It was decided to have a separate organization responsible for the exploitation of the Betuweroute, the dedicated rail freight connection running from the Port of Rotterdam to the German border and also for the exploitation of the Ports' Rail Line. There is open access for rail freight companies to offer their services on the Dutch rail network. After that the former freight subsidiaries of NS (NS Cargo) and that of the German railway company Deutsche Bahn merged to create a new firm called Railion, several private firms entered the freight market, including Rail4Chem, ACTS and ERS Railways.

Many studies show that the Dutch rail freight market is highly liberalized compared with other European Countries (Gleave 2005; Ministry of Economic affairs 2008; IBM 2007). As a result in terms of allocative and dynamic efficiency the rail market in the port of Rotterdam developed well. New entrants have stepped into the market. In 2009, 14 railways are active at the Dutch railway market. Also the number of national and international rail operators increased substantially (see Table 17.3).

Table 17.3: Number of market players in rail transport in 1995 and 2009

	1995	2009
Railway companies	1	14
National rail operators	3	6
International rail operators	3	15
Rail terminals in the port of Rotterdam	3	8

Source: Railcargo 2009, revised by the authors.

As a consequence of the new entrants that have stepped into the market prices declined and efficiency went-up. The market communicates a fall in rates of between 15 percent and 25 percent (KIM 2007). An effect of the liberalization process was the introduction of the shuttle concept by operators. The development of shuttle services increased substantially the last decade. From 1995 to 2007, the

number of shuttle trains per week doubled till more than 200 (see Table 17.4). Also the number of origins and destinations increased from 29 in 2001, to 53 in 2006.

Table 17.4: Market share of railway companies in providing traction for container shuttles

Railway companies	Shuttle services per week	Market share (%)
ACTS	41	20
ERS Railways	49	24
Rail4Chem	32	15
Railion	62	62
SNCF	3	1
Veolia	21	10
Total	208	

Source: Railcargo 2008.

In terms of technical productive efficiency the Dutch Ministry of Economic Affairs (2008:184) conclude that the productivity of the rail infrastructure for cargo transport increased strongly the last decade, mainly forced by an increased utility rate of trains.³

Besides the positive effects mentioned above, we state that, focusing on ports, liberalization does not bring an optimal allocation of resources, like train paths, terminals (cranes), locomotives and wagons. Earlier identified coordination problems in container rail transport (see Table 17.5) are intensified, or become worse.

The allocation of rail tracks gives rise to coordination problems between ProRail and the railway companies. The new infrastructure managers ProRail and Keyrail allocate train paths on a yearly basis. This method is rigid and is not aligned with the market demand for flexibility in the allocation of railway tracks. With the market entrance of more railway companies, planning of slot allocation became even more difficult: railway track and rail yard capacity needed to be precisely allocated to the 14 different railway companies nowadays (see Table 17.3). In such a situation dealing with uncertainty of arrival and departure of trains is only possible if complete integrated real-time information on train positions, expected arrivals, rail terminal availability and rail track and yard occupancy is available. Where the

3. It can be questioned whether an increase of productivity an effect is of liberalization and with that has lead to an increasing transport demand. The causality could also be the other way around, namely that increased demand has lead to economies of scale and caused an increase of productivity.

Table 17.5: Coordination problems in container rail transport

Coordination problem	Actors involved
Unused rail tracks because of insufficient tuning	Railway company, infrastructure manager
Peak load on terminals; spread of terminal slots is not realized	Container terminal operating company, Rail terminal operator in port, rail terminal operator in hinterland, railway company, infrastructure manager
Limited planning on rail terminal causes regularly delays	Container terminal operating company, Rail terminal operator in port and hinterland, railway company, infrastructure manager
Limited exchange of traction	Railway company
Limited exchange of rail cargo	Railway operator, forwarder

Source: Van der Horst and De Langen 2008.

infrastructure manager has problems with the allocation of railway infrastructure, it could be said that railway companies lack incentives to use it efficiently. An analysis of the timetables of railway companies with a total market share of 80 percent in container transport shows that about 40 percent of the container trains make two or more stops in the port. The turnaround time of these multi-stop trains is between 8 and 30 hours. Nonetheless, also the average turnaround time of direct trains is in general high, namely 12 hours. In most actual pricing regimes railway companies do not pay for inefficient use of infrastructure. As a consequence they request train paths that they might not use; they park their assets at the place that is most convenient to them, but maybe not efficient from a systems perspective; they do empty repositioning in a way that is most convenient to them, but may not efficient from a systems-perspective; they use train paths at times that is most convenient to them and create peak hours.

There are 17 coordination problems that also arise on the interface between rail terminals and railway companies in ports. Terminal operators draw up a daily terminal-handling plan with time slots for each train on the terminal. However, because of the lack of contractual relations between the rail terminal operators and railway companies (see Figure 17.2), there is often mismatch between the operations of the several different railway companies and the terminal operator.

The planning of rail operations through the port is not only a complex matter because of lacking contractual relations, there are also many actors (functions)

involved, namely one or more terminal operators, the infrastructure manager, a railway company and a rail operator.⁴ Together there are at least six actors that in a joint effort must make an integrated planning followed by a smooth execution of operations in line with the planning. With the increase of the number of market players planning became even more complex.

The exchange of traction (for example, through a pool of locomotives) between railway companies or the exchange of cargo between railway operators and/or forwarder would increase efficiency, because the utilization of locomotives could increase substantially. Exchange of traction is particularly required on the last kilometers of the rail track, because of the many small shunting activities that lead to idle time for locomotives. However, the strategic considerations of the several railway companies impede the exchange of traction. This hindrance is partly explained because the local offices of some railway companies do not have the autonomy to take such decisions. In the future, with the extension of the port of Rotterdam, Maasvlakte 2, the number of rail terminals in the port area will increase. Bundling of container flows to arrange direct shuttle trains makes exchange of traction or cargo more necessary

Coordination arrangements in the railway hinterland chain

This section gives an overview of arrangements to enhance coordination between actors in the container railway transport in the port and hinterland of Rotterdam. The arrangements to enhance coordination are classified into one of the four categories of coordination arrangements (see Table 17.6). The arrangements are derived from a literature and Internet search and stored in a database. This database consists of 90 coordination arrangements from railway transport, barging and trucking. In the database the following information is recorded: transport mode, actors involved, number of actors involved, solution type, the coordination problem solved and involvement of the port authority.

This section will show whether coordination is brought with additional arrangements to solve coordination problems that are worsened due the regime change or that new arrangements are introduced due to the given room enabled by the regime change.

The first category is the introduction of incentives or changing the incentives structure. Incentives can be used to align the interests of individual firms within an efficient overall transport chain. In general, incentives internalize the harmful or beneficial effects (externalities) of a firm's decision on other firms. In our analysis we found two arrangements in which incentives are changed or introduced. In

4. In a multi-stop shuttle concept a train visits two or more terminals in the port area.

Table 17.6: Coordination arrangements in container rail transport

Coordination mechanism	Examples of coordination arrangements
Introduction of incentives	Differentiation tariffs on use of rail tracks and yards (parking) Service level agreement between stevedore ECT and railway companies
Creation of an interfirm alliance	Cooperation between rail terminals Eindhoven and Tilburg, Agreement on the exchange of locomotives/train drivers between 5 Dutch railway companies Dedicated shuttle Rotterdam-Hamburg by carrier Geest North Sea line Intra-Port Shuttle by rail operator GTO, stevedore ECT, rail way company Rotterdam Rail Feeding, terminal operator Pernis Container Terminal
Changing scope	Establishment ERS Railways by carrier Maersk Establishment Rail4Chem Benelux by Bertschi, Hoyer, BASF and VTB Lehnkering Rotterdam-Mannheim shuttles with risk-bearing commitment of terminal operator Triport Forwarder Bertschi establishes rail terminal Stevedore ECT operates train to its hinterland terminal Venlo (extended gate) Rotterdam Rail Feeding Carrier Maersk investments in inland terminals
Creating collective action	Quality Rail Rotterdam Association of Inland Terminal Operators Port infolink-rail planning Platform rail capacity extension Pilot project 'Chain Management'—introduces rules of the game to improve punctuality

2009, infrastructure manager Keyrail introduced a new tariff system for the use of rail infrastructure, including rail lane and rail yards. Before 2009, railway companies did not have the right incentives to use the rail infrastructure in the port efficiently. They requested train tracks that they might not use, they parked their locomotives and cars for longer periods at rail yards and they used train tracks at times that are most convenient to them and create peak hours. Given the entrance of new railway companies (liberalization), and given her new role as infrastructure manager (vertical unbundling), Keyrail is obliged to allocate train tracks and rail yards in an efficient and fair way. New conditions in the Dutch Railway Law give room to the infrastructure manager to introduce a system with tariff differentiation and enable better allocation of rail tracks and yards. Conditions on how Keyrail should allocate and price the infrastructure are verified by the Netherlands Competition Authority. Keyrail has an instrument to solve the coordination problem that scarce infrastructure capacity in the port is not used efficiently. The new tariff system is primarily based on the type of train lane that is reserved and the moment of reservation. This system stimulates early bookings.

Second, the system contains penalties for both Keyrail and railway companies. Keyrail should assure good connections with national (non-Keyrail) and international rail networks. Railway companies are obliged to cancel already reserved trains tracks as soon as possible. For example, in case of cancellation more than 30 days before departure 25 percent of the fare should be paid; cancellation 4 hours before departure leads to a penalty of 90 percent of the fare. In 2008, another coordination arrangement based on incentives has been launched. Deep-sea terminal operator ECT, railway companies and the infrastructure manager started to develop service level agreements. The agreements deal with operational issues like exchange of real-time information on position of trains, expected times of arrivals/departure and terminal and train lane availability. Failures are linked to penalties. These agreements can be seen as additional arrangements to solve an already existing coordination problem that is worsened due to liberalization, but also due to the fact that deep-sea terminal capacity in Rotterdam was scarce at that moment. Although such agreements are an attempt to internalize the harmful effects of decisions of the actors involved; it doesn't overcome the missing contract between the deep-sea terminal operators and the railway company. Compliance of the service level agreement could yield high transaction costs. But moreover, there is a danger for free rider behavior.

The second mechanism for enhancing coordination is the creation of an interfirm alliance between several actors in the hinterland chain. Alliances are arrangements like subcontracting and or offering a joint transport service. Alliances are a better instrument than incentives, especially in cases where coordination requires invest-

ments in new equipment or in new services, but benefits are unclear and uncertain. In 2007, rail companies Railion Nederland, ERS Railways, ACTS, Rail4chem Benelux and Veolia Cargo agreed on the exchange and the use each others locomotives for the removal of wagons of other railway companies. The agreement is a solution to use rail tracks and rail yards more efficient. In the new situation, railway companies sometimes distort the operation of the other by obstructing the rail tracks and yard. The agreement gives the possibility to remove each other trains in case of obstruction. History shows that it is hard to establish and even harder to maintain distrust between partners and liability issues, due to differing interests. It can be questioned if an interfirm alliance between railway companies is good a coordination arrangement to improve usage of the train lanes in the future. Introduction of a right incentive structure might be enough. With the new tariff system of Keyrail (in 2009), the infrastructure manager has the right instrument to stimulate efficient usage, but lacks the assets (because of vertical unbundling) and jurisdiction to remove obstructing locomotives.

The exchange of cargo to increase the utilization of locomotives and infrastructure is a serious coordination problem. Bundling of container cargo to arrange direct shuttle trains remains necessary in the future. The shuttle concept of cargo resolves not only the coordination problem of limited exchange of cargo, but also the coordination problem concerning the inefficient use of railway infrastructure in the port. Our study in the Port of Rotterdam shows that railways companies and/or rail operators do not exchange cargo mutually in interfirm alliances.⁵ Interfirm alliances to create direct shuttle trains do exist, but are mainly founded with the involvement of carriers and railway terminals in the hinterland. An interfirm alliance with involvement of a carrier is for example a shuttle service created by carrier Geest North Sea line and rail operator Hupac. They offer a joint shuttle to Hamburg; both parties are commercially responsible for the shuttle train. In 2006, a large inland terminal operator in the hinterland of the port of Rotterdam, namely Rail Terminal Tilburg, agreed a long-term contract (four years) with railway company ACTS to establish frequent rail services (two times per day) between the terminals of Tilburg and Eindhoven and the port of Rotterdam. The inland terminal operator guarantees the cargo for the train. Cargo is collected in the region of Tilburg and Eindhoven by the inland terminal operator (via truck and barge).

Besides interfirm alliances many coordination arrangements are found in which containers shuttle services are established by actors who changed their scope, be-

5. This is an important difference with container barging. An earlier analysis of Van der Horst and De Langen (2008) on the barge industry shows that the interfirm alliance is chosen more often to enable exchange of cargo. Because of the strong strategic differences interfirm alliances seem to be more effective arrangement than complete vertical integration (changing scope) in container barging.

ing a matter of hierarchical coordination of the chain. Remarkable is that mainly terminal operators are active in changing their scope activities towards establishing rail shuttles. Inland terminal operator Triport in Ludwigshaven, Germany, took a risk-bearing commitment in the operation of shuttle from and too Rotterdam. By bypassing the rail operator or forwarder Triport despatches freight for railway company. Deep-sea terminal operator ECT changed their scope into railway activities by operating highly frequent (more or less 15 times a week) a train shuttle to the inland rail terminal Venlo, also owned by ECT. The fact that ECT owns an inland railway terminal in Venlo since 1991 is not the result of the regime change in the railway transport market. It fits in the earlier identified phenomenon of port rationalization, characterized by a strong functional interdependency between ports and multimodal platforms in the hinterland as a market-driven process that mirrors the increased focus of market players on logistics integration (Notteboom and Rodrigue 2005). Through commercially operating a train ECT tries to extend the gate of its deep-sea terminal to inland terminals (extended gate concept). The hierarchical coordination of the hinterland chain by ECT reduces long stay of trains in the port due to limited planning between terminals, infrastructure manager and railway companies. The extended gate concept can be seen as an additional arrangement to improve more complex terminal planning due to the increase of the number of market players. Another factor why ECT hierarchically coordinates the railway chain are local constraints in the port of Rotterdam. First, the lack of available land for expansions is an acute problem. Second, as mentioned earlier, liberalization substantially increased the development of shuttle train services. The increased port traffic has lead to diseconomies of the port's rail network. Extended gates thus enables to partially limit local constraints by externalizing them (see Notteboom and Rodrigue 2008). Besides vertical integration of terminal operators we also observed change of scope of a trucking company.

The liberalization of the railway market offered room to trucking company GTO to operate a port shuttle from ECT Delta terminal (western part of the port area) to Pernis Combi Terminal (eastern part). Pernis Combi Terminal acts as port gate. The shuttle improves usage of the port rail and track and it relieves the road infrastructure in the port region where congestion in rush hours can also be considered as a coordination problem. Also container carrier Maersk invests heavily in an inland terminal network. The Danish carrier plans to build 20 container terminals (including barge terminals) in South Germany and Eastern Europe. Partially to improve efficient use of rail assets, partially to manage the empty container flow, because of the high share of merchant haulage in Rotterdam (more or less 70 percent) and shipping lines do not control container returns. The regime change offered room for deep-sea carriers to start railway activities. For instance, in the early 2000s

Mærsk established ERS Railways. This form of hierarchical coordination is positive in a sense that rail cargo of a container carrier is bundled within the firm.

The fourth and last mechanism for enhancing coordination is collective action. This category contains public governance by government or port authority, branch organization, and public–private cooperation. This mechanism is especially relevant in situations of high complexity, and when investments have collective rather than individual benefits. An example of collective action is the port community system Portinfolink that developed the application Rail Planning, an internet application for information exchange between rail operator, railway company and terminal operators. The system makes it possible for the rail operator to give a pre-notification for containers at the rail terminal in the port; the system also provides real-time information about the status of containers at the terminal (charged/discharged). In general, this kind of applications may contribute to coordination in the railway chain; it can improve the planning at the rail terminals, and so stimulate spread of terminal slots and avoid regularly delays. A positive and essential part of the Rail Planning application is the inclusion of the Customs Administration (Lee et al. 2000). However, it can be discussed if Rail Planning is an efficient coordination arrangement after the regime changes, because the infrastructure manager is not included in the application. Port infolink is a public-private partnership between the Rotterdam Port authority and the Port Industry Association Deltalinqs. Such a public–private partnership is an efficient governance mode given the high investments of such a system and the many and relatively small parties that (should) participate. These parties do often not have the resources to invest in information exchange systems and especially with information exchange systems there is a danger of distrust between the firms. A private partnership between the Rotterdam Port authority and the Port Industry Association reduces transaction cost given the distribution of the relatively large collective benefits, and moreover it assures trust between the firms involved. It should be mentioned that the involvement of port authorities in the establishment of port community can also be observed in other ports like Antwerp, Barcelona, Valencia and Singapore.

Another example of collective action is the pilot project Chain Management Port Rail Track that started in 2007. The purpose of the pilot is to improve the punctuality of trains in the short run by introducing (new) rules of the game. These new rules concern about information exchange on estimated time of arrivals, number of containers and real-time reservation of train lanes. Also reduce of the number of multi-stop trains is an important goal in the pilot. Besides the two largest terminal operator (ECT and Rail Service Center Rotterdam), 3 railway companies (ERS, Railion and Veolia Cargo—with a total market share of about 75 percent) and 3 rail operators (ERS, Hupac and Intercontainer) participate. Infrastructure

manager Keyrail is coordinator of the pilot, and the Rotterdam Port Authority facilitates the project. The new rules are not made and enforced by the infrastructure manager, but are made in a process of mutual consultation between the parties involved. The involvement of the port authority and the infrastructure manager is explainable because complexity is high; voluntary negotiation between the parties could lead to distrust. Keyrail's role as coordinator is in line with conclusions of the Dutch Scientific Council for Government Policy on the impacts of the liberalization of network industries (WRR 2008). This study argues that there is a high need for system coordination, especially functions like information collection and provision, fair allocation of infrastructure, but also efficient and sustainable use of infrastructure by users. The pilot can be considered as a process where new norms and rules (at layer 1 of Williamson's model) are formed within a group to prevent for inefficient use of the rail infrastructure and terminal capacity (at layer 2 of the model). The pilot is a relatively cheap way for reciprocal information exchange. The infrastructure manager, railway companies, rail operators and terminal operator cooperate to establish and maintain a collective culture, in which new rules for efficient usage of rail infrastructure can be internalized.

Conclusions

In this chapter, we explored the relevance of taking into the account the institutional environment in the analysis of coordination in hinterland networks of seaports by using Williamson's three layer model. Taking this environment into account is relevant; coordination arrangement to improve the efficiency of hinterland chains do not take place in vacuum.

In the first layer the institutional environment is placed. In the new liberalized environment of seaports, many new railway companies entered the market. Also the number of rail operators increased and the new role of the infrastructure manager was established. It can be concluded that the implementation of the European directives for a free open market is still far from completed and differs strongly between the different countries. In this respect the Dutch rail freight market is highly liberalized. It can be concluded that there is a liberalization paradox in the railway market; especially if we focus on the port of Rotterdam. On the one hand, the changes in the institutional environment has lead to a positive development: new entrants have stepped into the market, new train services have started and freight rates fall (allocative and dynamic efficiency). On the other hand, this chapter shows that technical efficiency developed badly: liberalization doesn't bring an optimal allocation of resources in a port's rail system, like train paths, terminals (cranes), locomotives and wagons.

At the second layer in the model, the coordination arrangements are placed in order to solve coordination problems. It was demonstrated that a lot of coordination arrangements are developed in the port of Rotterdam. Given the fact that coordination problems have become worse, additional coordination arrangements were developed. The regime change also gave room for the introduction of these arrangements. For example, on one hand there was a need for an additional coordination arrangement because the allocation of the train track in the port to 14 railway companies became very difficult. On the other hand, given her new role as infrastructure manager, Keyrail has room to introduce an incentive system with tariff differentiation to enable better allocation of rail tracks and yards. Also a lot of interfirm alliances are developed in which cargo exchange takes place to create new train services. The liberalization gave room to develop these new services. The chapter showed that railways companies and/or rail operators do not exchange cargo mutually, but shuttle train services are mainly founded with the involvement of carriers and railway terminals in the hinterland. The liberalization of the railway market also offered room to actors in the hinterland chain to change their scope of activities. For instance, shipping line Mærsk established ERS Railways. This form of hierarchical coordination is positive; rail cargo of one single container carrier is bundled within the firm.

The model used in this paper has a very linear way of reasoning: the most efficient coordination arrangement is chosen given the institutional environment and given behavioral attributes of individual actors in the port-hinterland transport chain. A new dynamic layer model should be introduced to understand the mechanisms of institutional evolution and change in bringing coordination in hinterland transport chains (see Figure 17.3). The dynamic layer model allows for feedback between the several layers. First, we observed that the institutional change at layer 1 directly affects the allocative behavior of the individual actors at layer 3. Earlier identified coordination problems have been deteriorated due to the regime changes. With the market entrance of more railway companies, planning of a port's railway system became more difficult: railway track and rail yard capacity should be allocated to 14 different railway companies. Moreover, the several rail terminal operators in the port should make good agreements with the railway companies who visit the terminals. In the new designed competitive railway market actors in the railway chain could impede better coordination due to strategic considerations. They are not familiar (yet) with the new market situation. Second, from the empirical analysis it became clear that there is a feedback from layer 2 to layer 1. This can be seen for example in the coordination arrangement Chain Management Port Rail Track where terminal operators, railway companies and rail operators discuss together, on a voluntary basis, about new norms and rules to prevent for inefficient

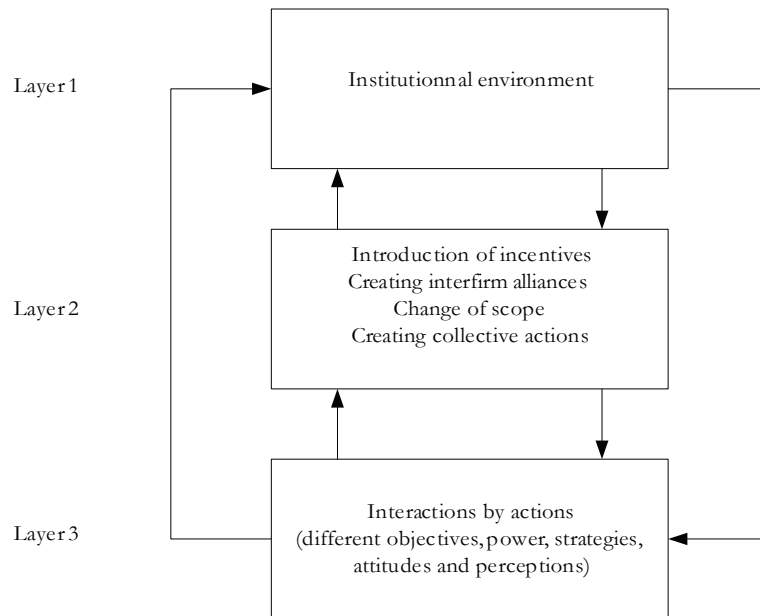


Figure 17.3: Dynamic layer model (Source: adapted from Williamson 1996)

use of the rail infrastructure and terminal capacity. In other words, arrangements are not only chosen given the institutional environment, actors also want to influence the institutional environment in which the rules of the game are formed. The dynamic framework for the analysis of coordination in a port's hinterland provides a basis for further research. The framework proposed deserves further theoretical testing by using the insights of Aoki's (2001) CIA. From an empirical point of view, a promising line of research would be to carry out the same analysis in other port-hinterland chains in Europe where the railway market has also been liberalized. The analysis will evaluate to what extent liberalization brought coordination in other railway hinterland chains.

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Part VII

Perspectives

Towards new regulatory regimes in globalized infrastructure

Mark A. Jamison

The internationalization of infrastructure raises the issue of internationalization of regulatory governance. By internationalization of infrastructure, I mean the presence if not predominance of cross-border interconnections, ownership, interdependencies, spillovers and the like. Such cross-border relationships are not new, but are growing in their significance. In several instances, this internationalization of infrastructure has led to internationalization of regulatory activity, international cooperation among competition authorities and supranational regulators. The formal authority of these arrangements ranges from completely voluntary organizations, such as associations of regulators or cooperative committees, to institutions with coercive power. There is interest in expanding international regulation with greater coercive power. I examine the issue of the scope of regulatory institutions in the presence of international infrastructure. I do not find a pressing need to internationalize additional regulatory institutions for infrastructure; but I do see a need to leverage the coevolution of service providers, customers, and governance institutions to learn through experimentation.

All organizations are perfectly aligned to get the results they get.
— Arthur W. Jones

There are numerous examples of regulatory institutions being created or reformed in response to changes in technology or industry structure. In the United States (US), changing technologies for natural gas production and transport led policymakers in the 1900s to replace municipal regulation with state regulation, and to supplement state regulation with federal regulation (Phillips 1993: 692–9; Natural Gas Supply Association 2008). The United Kingdom (UK) recently dissolved its telecommunications regulatory agency, Oftel, and formed Ofcom with powers to oversee a broader array of converging information communications technology (ICT) services. Sometimes institutions and technologies can become misaligned, with potentially disastrous results, such as the energy crisis in California (Borenstein 2002). Proper alignment between institutions and technologies is

called coherence (Künneke 2008).¹

Recent trends in the internationalization of infrastructure raise the issue of whether the sectors are undergoing fundamental changes that imply a need to realign regulatory institutions. There are several examples of internationalization of infrastructure: telecommunications is an increasingly global business, as was evident from the ripple effects that the 1984 breakup of AT&T had across the world (Carpentier et al. 1992: vii) and from the expansion of the European telecommunications companies Telefonica, France Telecom, and Vodafone across the globe. Electricity crosses national boundaries, as Canadians and American citizens learned during a grid failure in the northern US, and as the countries neighboring South Africa are learning as they deal with Eskom. Environmental issues related to infrastructure, most recently climate change, also seem not to respect national boundaries.

Infrastructure internationalizes through interconnections that cross national borders. The physical cross-border interconnections create or result from interdependencies and spillovers, sometimes provide economies of scale, and sometimes involve network effects. In addition to the physical network interconnections, there are financial interconnections: some utilities in the UK ran into financial difficulties because of unproductive international investments (*The Independent* 1997). Gazprom has demonstrated that strategies cross national boundaries and sometimes blur the business-political boundary (*Hoovers Online* 2009; *Spiegel Online International* 2006).

This internationalization of infrastructure raises the issue: are existing infrastructure regulatory institutions capable of dealing with these changes or do we need realignment? This is the issue I examine, although limiting my attention to traditional utility sectors of electricity, natural gas, telecommunications, and water. I find that current regulatory institutions appear adequate to address the issues raised by internationalization of infrastructure; but that the dynamic changes occurring in infrastructure call for experimentation with alternative institutional arrangements.

I reach these conclusions by first revisiting the purposes of regulation and the design of regulatory institutions. I then examine the internationalization of infrastructure. I find that while internationalization appears to be growing in magni-

1. Künneke's concept is technical coherence, which focuses on aligning regulatory institutions with technologies so that, in instances where technology was controlled by a single decision making system, a regulatory institution would encapsulate the entire control system. There appear to be at least three other forms of coherence that might be relevant. Effect coherence involves ensuring that the regulatory institution's geographic and legal reach are sufficient to accomplish the purposes of regulation. Capacity coherence refers to the information and expertise of the regulatory institution. Array coherence refers to the number and types of operators with which the regulatory agency engages.

tude, there are no new features of internationalization that would seem to require new forms of regulatory intervention. Finally, I develop a framework for adaptive learning in regulatory institutional design.²

Regulatory institutions: purposes and structure

Purposes of regulation

Regulation of infrastructure developed for several reasons, including controlling market power, ensuring industry stability, redistributing wealth, extracting rents from service providers, limiting opportunism, and overcoming information asymmetries. I describe these in this section to lay a foundation for analyzing how internationalization of infrastructure may impact them.

The first two reasons for regulation that I will address—controlling market power and ensuring stable supply—have their roots in the public interest theory advanced by institutional economists such as Martin Glaeser and Harry Trebing.³ The central idea is that infrastructure industries are affected with the public interest in that the effects of inefficiencies and instabilities in infrastructure have unusually disproportionate, cascading effects throughout the rest of the economy (Glaeser 1927: 170–71; Phillips 1993: 1–2, 83–121). Utility sectors were thought to be unstable because the high fixed costs led to destructive competition (Sharkey 1982: 24–8). Although as I will describe below, some people are skeptical that regulation developed primarily to serve the public good. There is evidence that infrastructure industries are affected with the public interest as defined by the institutionalists. Empirical research has consistently supported the idea that advancing telecommu-

2. To elaborate on this point, there is reason to be skeptical that a researcher has sufficient institutional and systems knowledge to observe all of the relevant information, interpret the situation, and appropriately intervene by instructing people on what should be done. It naturally follows that any conclusions by a researcher on this topic should be considered as tentative. Observation–interpretation–intervention, which is our scientific approach, is a complex process that is often done with an end in mind. I do not believe I have ever encountered an analysis that was not guilty to some degree of this sequence of thought: anticipation of prescription; gathering of data consistent with the *ex ante* prescription; interpretation of data as anticipated or nearly so; and arrival at or near the anticipated prescription. I do not mean to imply that this approach is inherently wrong or inappropriately biased. Indeed, Conklin (2006: 14) argues that the above four-step sequence is appropriate and must be repeated often for organizational learning to occur. Indeed, we should be doubtful of anyone who claims to begin an investigation without bias as such a person would by definition begin with a blank slate, meaning that the person would have no discernable motivation for launching an investigation, no basis for knowing which data might be appropriate for the investigation, and no framework for organizing the data into a logical story. This implies that it is not our biases that distort our conclusions, but our learning process if the process excludes new understandings of how the world does and should work.

3. See, for example, Glaeser (1927) and Trebing (1984, 1987).

nications infrastructure is important for economic development.⁴ Furthermore, the rapid growth of the economies of China and India provides evidence that such economic expansion goes hand in hand with utility infrastructure growth.

There is also substantial support for the notion that infrastructure industries tend to be characterized by market power. For example, governments generally grant exclusive licenses for electricity and gas distribution. There are also situations where infrastructure markets that are open to competition nonetheless are marked by dominant firms. For example, broadband markets in the US generally have two dominant players, a fixed line provider and a cable television provider (FCC 2008). But this is not always the case: Ward (1995) finds that the degree of market concentration in the US telecommunications long distance market in the early 1990s was comparable to that in most areas of the economy.

The evidence supporting the notion that infrastructure markets are sufficiently unstable to warrant government intervention and that regulation improves stability is out-of-date at least for the US because regulation has been in place for such a long time. Perhaps it is time to experiment again to see if this idea remains true.

The notions of rent seeking and taxation by regulation come from neoclassical economics (Posner 1971; Peltzman 1976). These theories are not normative notions of why we should regulate, but are positive theories trying to explain how the self-interest of government actors, such as politicians, might motivate the formation of regulatory institutions. These ideas hold that regulation occurs because of its distributive effects, namely its ability to transfer wealth from less politically powerful stakeholders to more politically powerful ones. There would seem to be very few who would argue that such transfers do not happen through regulation. Although there are exceptions, it seems to be a rule that rural areas dependably benefit from cross subsidies effected through regulation, that regulated entities are frequently protected from competition, and that labor unions benefit by sharing in the monopoly rents made possible by market protection. Studies of developing countries consistently show that it is the wealthy, not the poor, who benefit most from universal service subsidies (Estache 2006), and this would appear to hold true for the US.⁵

Another reason for regulation, namely to limit political opportunism, has substantial empirical support. Spiller (2005) explains that utility industries are especially vulnerable to opportunism because the technologies are characterized by large, sunk investments that are specific to the purpose of providing the utility service, the technologies often have economies of scale and scope, and their services

4. See, for example, Van Ark and Inklaar (2005), Röller and Waverman (2001), Waverman et al. (2005), and Crandall et al. (2007).

5. See Hazlett (2006) and Holt and Jamison (2007) for extensive critiques.

are consumed by large portions of the population. Regulation by what we call independent regulatory agencies helps effect a system of checks and balances that limit politicians' abilities to expropriate at least some of the value of sunk infrastructure investment for short-term political gain. Empirical research has consistently supported this notion, finding that infrastructure providers—both privately owned and publically owned—make more investment when there is a strong, independent regulator, and that customers benefit because the additional investment leads to more service, which customers willingly purchase.⁶

Another reason for developing expert regulatory agencies is to address the problem of information asymmetry. This line of reasoning holds that infrastructure providers have private information, such as their innate abilities and unobservable efforts, and that expert agencies have better skills than politicians for observing at least some of the private information and for establishing economic incentive mechanisms, such as price cap regulation, that can reward service providers for using their private information in a way that benefits customers (Sappington and Weisman 1996: 2–4). Although this theory is generally associated with neoclassical economics and Austrian economics, it can be found in Martin Glaeser's 1927 institutionalist book on public utility economics (Glaeser 1927: 714–24).

Structure of regulatory institutions

Having addressed the issues of why we have regulation and regulatory institutions, I now turn my attention to the determinants of the scope of authority of regulatory institutions: Why are there both state and federal regulators in the US and Brazil, but not in most other countries? What explains the scarcity of regulation by cities? Why are there instances of supranational regulators?

As one would expect, institutional design generally falls directly from regulatory purpose because, in essence, institutional design is a component of the technology of human work. To keep this analysis manageable, I will focus on the scope of authority of the agency and not on the internal processes. Also, because I have limited my study to utility regulation, I am addressing regulatory organizations with coercive power, that is, the authority to punish someone or some organization for violating regulatory rules.⁷ This omits from my consideration institutions that

6. See for example Spiller (2005), Henisz and Zelner (2001a, 2001b), and Gutiérrez (2003).

7. There are many possible regulatory institutional frameworks. Within a sovereign jurisdiction, there can be regulatory agencies with varying degrees of independence, coercive power, and flexibility. Above the sovereign level, there are other possible frameworks, including regulatory associations and extra-jurisdictional committees that serve to allow regulators to share information, engage in joint planning, and learn through interactions and sponsored training courses. Such cooperation can also occur without a formal structure, such as the World Forum on Energy Regulation. Competition regulators from multiple countries will sometimes form committees of their key staff

are somewhat voluntary in nature or serve primarily as forums for resolving issues. The aspects of regulatory authority that I will address include say-so over prices, financing, decision making, and particular issues, as well as the number and range of service providers.

Because two of the leading drivers of regulation are control of market power and industry stability, it is almost always the case that regulatory institutions have rate-making authority and often have authority to require a uniform system of accounts and financial reporting. In some jurisdictions, the agency can impose financial quality on a utility, such as requirements for liquidity, maintenance of performance bonds, capital structure, and ring fencing. When these cannot be directly imposed, a regulator might be able to encourage financial quality through rewards or penalties provided through the ratemaking process, such as the adoption of penalties or rewards on the allowed rate of return. Some regulators even have authority to approve or deny the issuance of debt, which helps limit utility exposure to extra-jurisdictional ventures.

The regulator's authority to make decisions is affected by the regulator's independence, which simply means that the regulatory agency operates under laws rather than decrees; manages its own budget, subject to legal limits imposed by law; and makes decisions that are reviewable only by an independent judiciary and not by ministries, parliament, or the government. Furthermore, decision makers such as commissioners serve fixed terms that do not coincide with political terms; decisions makers cannot be removed from office except for cause, such as a violation of ethical rules; and decision makers do not engage in anything that might be a conflict of interest, such as seeking employment with a regulated utility, having a financial stake in a utility, or having financial or other ties to other stakeholders. Independence limits opportunism and regulatory capture.

The regulator can affect its degree of independence by choices it makes regarding transparency, credibility, and legitimacy. Transparency affects independence because participation in regulatory processes and seeing how regulators reach decisions give the public confidence that the regulator can be trusted to be a legitimate

for purposes of coordinating cases, discussing emerging issues, or simply maintaining knowledge of what is happening in each others' countries. There are limits on what can be done through associations and committees because some regulatory laws have specific process and evidence requirements that cannot be met through such cooperative endeavors. Furthermore, some international organizations can become debating societies with their own bureaucracies far from the stakeholders most affected by their influences. But nonetheless, these regulatory communities have become important in addressing cross-border regulatory issues. Treaties and other formal agreements can create formal multilateral bodies that perform regulatory functions. The Eastern Caribbean Telecommunications Authority (ECTEL) in the Caribbean performs regulatory work for the member states, but it is up to the individual countries to act on what ECTEL recommends. The European Union has a supranational competition regulator, and there has been work on supranational telecommunications and energy regulators.

overseer of the operators and not captured by them. Transparency also limits opportunities for favoritism and corruption because such activities often melt when exposed to sunshine. Credibility, which relates to the regulator's authority and dependability from the operator's perspective, impacts independence because it influences whether the operator will cooperate with the regulator or seek to use the political process to constrain the regulator.

Agency authority is also defined in terms of the types of issues that the regulator resolves versus those that the political bodies solve. In effect, this is a division of labor between politicians and bureaucrats (Alesina and Tabellini 2007). The underlying theory holds that the Darwinian process for politicians results in political representatives who benefit those stakeholders who can and do keep those representatives in power. This is not a new thought: it was raised by de Tocqueville in the nineteenth century and has been highlighted by libertarians as a flaw of government. What Alesina and Tabellini add to our understanding is that politicians may find it efficient for some government functions to be performed by expert bureaucratic institutions who are rewarded not for redistributing wealth, but for facilitating the creation of wealth.

The reach of a regulatory institution, in terms of geography and service providers, is determined by need for coordination, concerns with capture, economies of scale for the regulatory institution, and correspondence of control. The International Telecommunications Union (ITU) is an example of a regulatory institution whose jurisdiction is determined in part by the desire for wireless infrastructure that crosses international boundaries to have some common standards. The ITU works through collaboration and negotiations among the members, but can enforce some of the agreements. The ITU's deliberative processes are sometimes criticized for being slow and lacking teeth, but regulatory agencies with greater powers can also be very slow, such as the US Federal Communications Commission's (FCC) long delays in licensing radio spectrum for cellular phones.

The evolution of US regulatory agencies serves as an illustration of the importance of institutional design to avoid capture, exploit scale economies, and effect a correspondence of control. In the US, cities were the initial regulators of utility services, but in the early 1900s, most states elected to move regulation to the state level. There were three reasons for this. First, there were instances of corruption with municipal regulation because a single operator would serve the entire city and so would have a strong interest in developing non-transparent relationships with the city government officials. Some city officials were willing participants in such arrangements, because of opportunities to advance political careers or gain personal wealth. Second, a reason was to gain scale economies in regulation so that staff expertise could be strengthened. Third, state agencies were formed because

sometimes utilities were able to engage in activities, such as affiliate transactions and the creation of service bottlenecks that were beyond the jurisdiction of cities. Cities did not have jurisdiction perhaps because states did not delegate the authority to cities and perhaps because city charters did not grant city governments such authority. This is the correspondence of control issue, namely, that the regulatory agency should have authority to protect ratepayers from adverse decisions made by the utility, its affiliates, or its allied organizations. For example, if a utility makes or participates in a decision that affects costs or market structure within a regulator's jurisdiction, then the regulator should have authority to disallow the ratepayer impacts of that decision.

Federal regulation of utilities in the US formed in part because of this correspondence issue. In some instances, utilities engaged in transactions that were beyond the jurisdiction of the states, such as the selling of electricity or gas across state boundaries. States are explicitly prohibited from regulating interstate commerce, so federal regulators were needed.

More recently, federal jurisdiction has expanded to limit stakeholder influence, such as the not-in-my-back-yard issues, where a decision that might be suboptimal for any one state to make on its own might be optimal as a joint decision, especially if there are side payments. Federal jurisdiction has also expanded when it was perceived as easier by advocates of some policies, such as certain environmental issues, to obtain federal legislation than to convince state legislatures that such policies were needed.

I do not claim to be an expert or even well informed on European regulation, but my impression has been that supranational competition regulation formed to ensure that the concept of a single European market was steadily enforced in competition law. I think there was some skepticism at one time that some member states would have difficulty giving up national champions and thus frustrate the European Union (EU) intentions. With respect to infrastructure regulation, the expert regulatory working groups in Europe appear to have provided for consistent policy analysis across the union, which has helped harmonize regulators' compliance with EU directives.

Dominica, Grenada, St. Christopher (Kitts) and Nevis, St. Lucia, and St. Vincent formed a supranational regulator the Eastern Caribbean Telecommunications Authority (ECTEL) for scale economy reasons. Each member state was very small and so lacked resources that could be devoted to telecommunications regulation. The formation of ECTEL allowed the countries to share work.⁸ Furthermore, the countries all regulated Cable & Wireless, a British company, and believed that they

8. The country populations are Dominica 73,000; Grenada 91,000; St. Christopher (Kitts) and Nevis 41,000; St. Lucia 160,000; and St. Vincent 105,000.

could be more effective together than apart in dealing with such a large, multinational corporation. The Economic Community of West African States (ECOWAS) secretariat is another example of regional cooperation where a network of sovereign states in Africa gave a supranational institution coercive power to oversee the development and operation of a regional transmission grid (Berg and Horra 2008).

The processes that led to the development of these regulatory institutions were not without their errors and evolutions: experimentation with municipal regulation provided lessons that led to the formation of state regulation in the US, and the shortcomings of state regulation led to the formation of federal regulation. Municipal regulation was largely dissolved; but state regulation continues, and its boundaries are a constant concern of state and federal regulators. The successes of telecommunications regulation by ECTEL has led to an interest in regional electricity regulation. I explore this experimentation and learning process more thoroughly below.

Internationalization of infrastructure

I now turn my attention to the internationalization of infrastructure and, based on the preceding discussion about regulatory purposes, draw conclusions about needs for institutional reform. Internationalization of infrastructure occurs through interconnections or links that cause interaction among infrastructures. These interconnections take many forms.

Physical interconnections

Physical interconnections are those we are most familiar with and include telecommunications traffic, electricity transmission, natural gas pipelines, and liquefied natural gas shipping, and the like. Here the cross-border issues include agreements on technical standards, geographic locations, payment amounts, payment systems, transmission rights and obligations, and enforcement of contracts or other agreements. The value of the infrastructure service on one side of the border depends on actions taken at the border or on the other side. For example, electricity generation in one Central American country sometimes powers load in neighboring countries. The transmission lines that make this possible depend upon agreements between the government officials, private sector representatives, or both in the countries involved in the construction of the lines, technical standards, availability of load, payment obligations, dispute resolution, and the like. These international interconnections occur for many of the usual reasons, including issues of comparative advantage, where one country may be in a better position to produce natural gas or

generate electricity than another; scale economies, where the market size needed to permit economic viability of service provision may be larger than a single country; and network effects, where the opportunity to communicate across borders increases the value of the network service. International interconnections have given rise to international regulatory institutions to address issues of control coherence. ECOWAS in Africa, the Nordic Power Pool, and the ITU are examples.

Logical interconnections

Logical interconnections go hand in hand with physical interconnections and are those related to the intelligence and controls across the system. Telecommunications numbering and internet naming conventions would fall into this category and result in institutions such as the Internet Corporation for Assigned Names and Numbers (ICANN).

Financial interconnections

Financial interconnections include those where a multinational infrastructure firm's performance in one country is affected by its ventures in another country, where firms seek to hide or double report costs or revenues through transactions with international affiliates, and perhaps where there are scale economies in financing operations. Here the cross-border issues include ring fencing the finances of domestic operations (including rules on debt guarantees and property rights claims on cash flows), regulatory access to and use of financial and accounting information, and constraints on regulators' behaving opportunistically by effectively, although perhaps not deliberately, excluding certain costs from recovery or counting more than once revenues from supra-jurisdictional operations.

Financial interconnections raise effect, control, and capacity coherence issues. Effect coherence can be accomplished by governments giving their regulatory agencies sufficient powers to obtain information, disallow costs, ring fence, and the like. Control coherence might be required if multinational operators, for example, develop relationships that limit regulators' access to information central to the regulators' tasks.

Strategic interconnections

Strategic interconnections are those where decisions across jurisdictions are strategically interrelated. Natural gas pipelines and supply across Eastern Europe provide recent examples where contract decisions appear to have been tactics in larger economic and geopolitical strategies. Infrastructure regulation appears to be inadequate to the task of addressing such a problem regardless of the regulator's in-

ternational scope. At one level, the challenge with natural gas supply in this region could appear to result from limited jurisdiction because transactions and agreements outside of the Republic of Georgia, for example, for a period of time limited the country's energy regulator's ability to limit retail prices. But at another level, it appears that governments were intimately involved in setting up the situation, with the result that political negotiations have been needed to resolve supply and price restrictions. So the issues have not been beyond government control, but have been beyond the jurisdiction allowed the regulator. Another strategic interaction would be multimarket contact by infrastructure providers, with the resultant incentives and opportunities to avoid price competition or to divide markets. Here national competition regulators can step in, if they have authority, to penalize collusive conduct even if some of the anticompetitive agreements involve other jurisdictions.

Strategic interconnections are related to control, effect, and array coherence. Often the issues appear beyond the scope of the utility regulator's job, meaning that control coherence cannot be achieved. When the interconnections are not part of a larger set of international engagements among countries, regulators might need authority over contracts and supply acquisition, as well as cost disallowance.

Policy interconnections

Policy interconnections include spillovers of jurisdictional decisions. Intense price competition and costly, protracted regulatory proceedings in the US appear to have contributed to the decisions of many US telecommunications firms to withdraw from non-US markets in the late 1990s. Prior to that, however, liberalization of telecommunications in Western economies led to the creation of multiple global telecommunications firms that desired to interconnect with networks in non-liberalized markets, contributing to the eventual effective collapse of the international interconnection and settlement regime and to the opening up of markets in other countries. Telecommunications liberalization led to technology changes that changed the economics and customer expectations in non-reformed countries, again pressuring policymakers in those countries to liberalize. The creation of a company like Enron, created in part because of utility reforms in the US, impacted utility services and policies in many countries where Enron negotiated supply contracts.

International regulatory associations play an important role in addressing the capacity coherence issues raised by policy interconnections. At one level, these associations provide avenues for information sharing and dialogue on issues. At another level, they provide opportunities for capacity building (Berg and Horrall 2008).

Internationalization of customers

Internationalization of customers led to changes in infrastructure companies. MCI, for example, coined the term local-to-global-to-local strategy, which summarized a strategy for the company to secure local networking in countries where MCI's multinational customers had operations and to interconnect those local networks through MCI's global network (Jamison 2001). Some multinational energy customers contract with third parties to obtain supply and price guarantees. The resulting issues appear to be largely related to effects and capacity coherence and can be addressed by giving national and state regulators adequate authority over information gathering and cost disallowance.

Environmental interconnections

Environmental interconnections are largely spillovers and externalities related to environmental impacts of infrastructure decisions. Examples of concerns would include acid rain, greenhouse gases, and water extraction. The emerging approach to addressing such issues is to develop international treaties. However, there is interest in giving multinational organizations, such as the United Nations, coercive power over countries that might choose not to follow guidelines preferred by a majority of other nations.

These many forms of interconnection—physical, logical, financial, strategic, policy, customer, and environmental—are all growing. But as can be seen from the examples, these are not new and, as of yet, do not appear to create regulatory issues that are fundamentally different in nature from issues that are addressed by existing institutions.

Systems learning

Above I concluded that internationalization of infrastructure does not create a need for new internationalization efforts for regulatory institutions. However, I could be wrong because my knowledge and comprehension of the myriad of situations are limited. And while others may have more expansive knowledge than I possess, I think it is fair to say that no one possesses all of the knowledge needed to prescribe with accuracy the types of regulatory institutions we need across the globe. Indeed it is fair to say that we can achieve better results using our collective knowledge than simply relying upon individual knowledge. How can we provide a system where people grow in knowledge together so that the learning embedded in institutions and the system of institutions is consistently greater than individual knowledge and is able to adapt when circumstances change?

The appropriate answer to this question is to create or allow a system of experiments in institutional design and regulatory rules that test assumptions and conclusions, and that examine new ways of addressing known problems. Such a system is needed for adaptive learning, which I define as creating new mental and institutional frameworks that narrow the gap between existing beliefs and reality, by exploring the meaning and implications of novel experiences that expose the people and organizations to conflicts between beliefs and reality (Heifetz 1994: 244–5; North 2005: 66–7).

For example, Chile and Argentina led the world in electricity reforms, but made mistakes that several European countries learned from and, for the most part, avoided repeating. The US learned as well, but as evidenced by the California electricity crisis, did not learn well enough and created a new set of mistakes that others observed and learned from. Likewise the evolution of regulatory institutions in the US provided lessons regarding ratemaking authority and independence, the initial understaffing of UK electricity regulator provided lessons on developing agency expertise to avoid significant information asymmetries, and New Zealand's attempt to rely solely on competition law illustrated the importance of expert regulatory agencies and *ex ante* regulation of markets with powerful incumbents.

As these examples illustrate, adaptive learning occurs through experiencing and analyzing the results of decisions that run against existing beliefs. For example, at one time public ownership was favored around the world. But then privatization was tested, and the results were positive. Consequently, the public ownership paradigm gave way rather rapidly in the 1980s and 1990s to a preference for private ownership. After it became clear that equity markets would not finance all of the infrastructure that multilateral institutions such as the World Bank believed was needed, and after it became clear that privatization was only a piece of a larger system of reform efforts and that multiple tasks had to be performed well for sector performance to improve, many countries began developing and testing various forms of public-private partnerships. Of course, the key test of which types of ownership and market structure arrangements are most appropriate is the performance of the sector. Thus, some form of benchmarking can be an important instrument of adaptive learning.

Adaptive learning can result from choices made by oneself or by one's organization, but also by being exposed to the consequences of others' experiments. The state of California is an example of a government learning from its own experiment. The US liberalization of telecommunications in the 1970s and 1980s provided opportunities for adaptive learning by other countries. The US telecommunications reform decisions had cascading effects that exposed people in many countries to novel experiences that became their opportunities for adaptive learning.

The coevolution that results from institutions interacting and adapting, being terminated, and being created is called systems learning. Systems learning is the sum of adaptive learning within organizations and the adaptations that occur in how organizations interact. Changes in markets and supply chains are examples of systems learning because the knowledge is embedded in agreements (both formal and informal) on how organizations will interact. Mergers, divestitures, and business closures are also examples of systems learning.

For a regulatory system—that is to say, the regulatory and government institutions, service providers, customers, and supporting institutions such as think tanks—to engage in effective adaptive learning, both for organizations and systems, the system needs the following properties.

Decentralized control. Formal rules that encompass significant portions of a system are costly to change and reinforce the status quo, making it difficult to engage in adaptive experiments. With extensive formal rules, the burden of proof falls on the entity advocating change. Furthermore, casualties—those organizations that must come to an end for adequate progress to be made—can gain bargaining power if there is centralized control and thus make change costly.

Multiple moving parts. Concepts of static efficiency often imply that industrial organization should emphasize scale economies and transaction costs. However, opportunities for adaptive learning are greater with greater numbers of decision making units, implying that there are times when production economies should be sacrificed for potential dynamic gains.

Differing treatment. Asymmetric treatment of service providers allows for learning about how service is affected by regulatory rules.

Deliberate experiments. The system should make it easy to suspend rules or establish temporary rules with formalized processes for information gathering and analysis.

Information sharing. Regulatory associations should devote time to discussions about how jurisdictions differ, how they are the same, and how regulatory decisions affect sector performance.

This is far from a complete list of attributes needed for optimal systems and organizational learning, but it does point to the importance of limiting the geographic reach of regulatory institutions and of using markets and competition when possible.

Conclusion

I have concluded in this chapter that there is no pressing need to reform regulatory institutions to address the increasingly international nature of infrastructure.

I have also concluded that experiments and learning with regulatory structures are important both to test my conclusion and to ensure that service providers and regulatory institutions can innovate and adapt with low costs.

It seems that there are several opportunities for adaptive learning in utilities regulation, not all of which are driven primarily by internationalization of infrastructure. Broadband development and measurement are two examples. Some countries are holding onto traditional subsidies and regulatory schemes, even those that have been unproductive in the past, rather than trying policies with less centralized control. Smart grid represents another opportunity to experiment with new business models, economic incentive schemes, and regulatory jurisdiction.

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Exploring the coherence between institutions and technologies in liberalized infrastructures

Rolf Künneke

Infrastructures are complex systems in which technology, economics and institutions are closely related. It is of importance that changes in the different elements cohere, that is, that changes in the technology correspond with supporting changes in the institutions and vice versa. Changes in the economy like the scale of production are facilitated by supporting changes in the technology. Likewise, when government decides about changes in the institutions (by introducing competition, laws, regulations, and new modes of governance) it is vital that the coherence with the technological elements of the system are taken into account. The restructuring of various infrastructures (such as telecommunication, energy, water, rail transport) is often solely perceived as a matter of institutional change, ignoring the relationships with the other elements of the infrastructures as a complex system. Parts of the activities in the respective value chains are exposed to competition and are treated as commodities that are exchanged on anonymous markets.

Networks are typically regulated since they often inhibit characteristics of natural monopolies. New regulatory frameworks are established including independent system operators and regulators, and stronger private sector involvement. Up to now, the possible relations of these profound institutional changes with the technological features of infrastructures were not addressed as a potential disturbing matter. Supporters of the deregulation process (or at least the mainstream economists supporting it) believed—and still believe—that introducing market-based trading in infrastructure industries would per se create or reinforce the incentives for technological innovation, and hence readjustment in accordance to the novel institutional frameworks. Thus, the coherence between technology and institutions would be re-established as a consequence of the newly evolving market-driven allocation processes. The issue of incoherence between institutional change and the technological status quo was overlooked or, at least, underestimated (Künneke

2008).

However in the past years, significant unexpected side effects appeared such as large scale electricity black outs and deadly train accidents that pinpoint to insufficient institutional safeguards to guarantee the proper technical functioning of these complex systems. Besides, there is an increasing concern about the long term security of supply and the technical reliability of infrastructure systems. Firms operating on competitive markets are experiencing other incentives as compared to regulated monopolies. Among others, they are facing regulatory and commercial risks that influence their economic behavior, for instance with respect to innovations, investments, and maintenance. This has repercussions for the technical functioning of infrastructures.

This chapter shortly summarizes some important features of the coherence theory, which focuses on some interrelations between institutions and technology. It draws strongly on the work of Matthias Finger, John Groenewegen, Claude Ménard and Rolf Künneke. A section provides a brief overview on the coherence framework. Another summarized the issues for future research. The chapter provides an important input for the research to come.

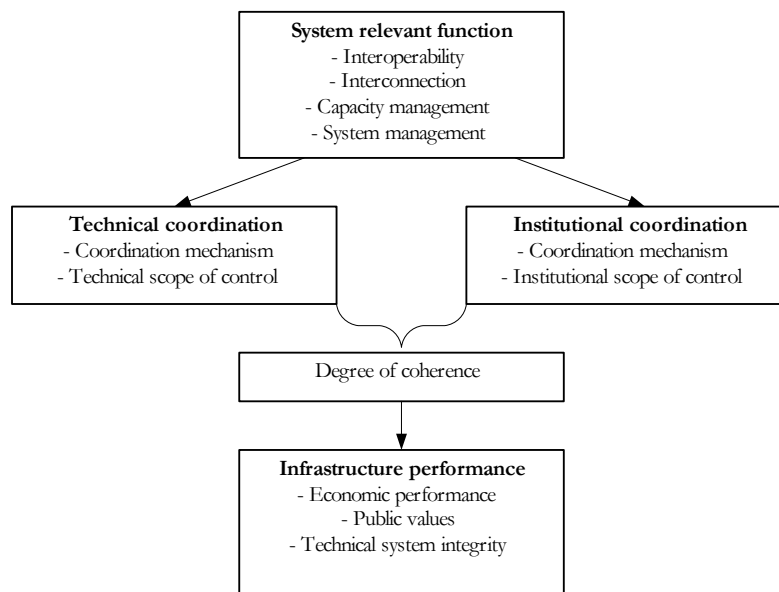


Figure 19.1: The relationship between technology, institutions and performance of infrastructures (*Source:* Finger et al. 2005)

The coherence framework

Four system relevant functions are identified that are essential in order to support the expected performance of infrastructures (see Fig. 19.1). These essential functions need to be supported technically as well as institutionally (Finger et al. 2005). Interconnection addresses the physical linkages of different networks that perform similar or complementary tasks (Economides 1996). Typical examples include the interconnection of different telecommunication networks, railroad tracks or electricity systems. Interconnection occurs sometimes even beyond the limited boundaries of specific infrastructures. For instance, recharging electric cars on the electricity network offers new opportunities for electricity storage as the batteries can be used to temporarily buffer the production and consumption of power. This is the concept of the mobile mart grid. In this case, there would be an interconnection between the road transport system and the electricity infrastructure. Interoperability is realized if mutual interactions between network elements are enabled in order to facilitate systems' complementarity. For example, in the railroad sector, the specification of the tracks needs to be aligned with the needs of the locomotives. In the aviation sector, airlines rely on specific navigation systems that guide planes to their destination without accidents. Interoperability ensures that the elements of the network are combinable. Capacity management is necessary because networks are scarce resources as the capacity of nodes and links is limited. Capacity management deals with the allocation of this scarce network capacity to certain users or appliances. The electricity sector is a very illustrative example in this respect. Since electricity storage is only possible on a very limited scale and at very high costs, power production and consumption has to be balanced nearly instantaneously (that is, load balancing).

The technical and institutional coordination of these essential functions can be accommodated in different ways. Finger et al. (2005) refer to three basic coordination mechanisms: top down centralized hierarchy, bottom up decentralized coordination or peer to peer control. These coordination mechanisms can be further specified in terms of the scope of control they allow. According to these criteria, coherence would be realized if the technical and institutional coordination of essential functions is based on similar coordination mechanisms with a comparable scope of control. If there are deviations, this would result in a system performance that does not meet expectations. There is a trade off between the different categories of infrastructure performance. For instance, in certain infrastructures might have resulted in improved economic performance, at the expense of social or technical performance. Finger et al. (2005) focus on the technical performance of infrastructures.

Issues to be addressed

The coherence approach seems to be intuitive and promising, but in a theoretical perspective it certainly needs further specification and clarification.

Methodological issues

Among others, the underlying assumptions have to be specified. What are the relevant variables? Which of them are exogenous or endogenous? What behavioral assumptions are made with respect to individual actors? This last question has been subject to debate. What is the role of individual actors in coherence theory? Is this theory based on methodological individualism, collectivism or interactionism. It seems as if the latter, interactionism, is the case; but this needs to be more elaborated in detail. In Finger et al. (2005) the role of actors is largely neglected. However, actor behavior can be very important for the alignment between institutions and technology. For instance, vested interests and/or dominant economic positions can create opportunities or barriers for certain technical or institutional changes.

A closely related topic that demands clarification is the unit of analysis. Is this the actor, like in many economic theories, or the transaction, like in transaction cost economics? The critical function might also be considered as a unit of analysis. This would be a very novel approach that could potentially further substantiate coherence theory as a different conceptualization of the interrelation between technology and institutions.

These methodological issues, which are only summarized here very briefly, are of a very fundamental nature and hence demand a thorough consideration and clarification in the research to come.

Operationalization and conceptualization

The concept of coherence is presented as a heuristic approach, which demands for further specification and operationalization of important dimensions. Especially the notion of coherence asks for further attention in this respect. Up to now it is only translated into different modes of organization on a very high level of abstraction. There are some attempts to go a little bit into more detail (Künneke and Finger 2007); but still this is only an interesting starting point. If we were able to describe coherence, the next step would be to determine or even measure the degree of coherence. What is a high or low degree of coherence? Are there different dimensions to be taken care of? If yes, how to compare them?

Given it would be possible to answer these questions, we would end up in a more normative discussion whether coherence would be desirable or not, and what

the right degree of coherence might be. A certain degree of incoherence might be a driver for institutional or technological change, which might stimulate innovation and hence dynamic efficiency. However, a very high degree of incoherence, associated with path dependencies, lock-in or strong vested interests, could end up in a worst-case scenario of persistently bad performing infrastructures. Some urban drinking water systems might serve as empirical examples in this respect (Shirley 2002).

The dynamics of coherence is a related point. In its present stage, coherence theory is static or, at best, comparative static of nature. The processes of institutional and technological change are not addressed; but only a certain status at a specific point of time. To what degree is it possible to capture the dynamics of coherence with the present approach? Or does this require a different methodological approach that is outside the present framework?

Practical applicability

As an important practical question, the applicability of this approach for recent policy issues needs to be addressed. Apparently there are certain critical functions that need to be pertained, technically as well as institutionally, in order to safeguard the proper technical functioning of infrastructure systems in their evolving international context. What can policy and industry do about this? To what degree can these processes leading to (in)coherence be purposefully be influenced or designed? Or is this the result of autonomous and spontaneous processes that are outside the control governmental policy? Is it only up to government to take an active role in this respect, or what is the role of other stakeholders? At the present stage of research, coherence theory at least provides a new perspective on the restructuring of infrastructure systems. It seems to be advisable not only to be concerned with institutional changes, but also to take a more active role in stimulating certain technological changes. This goes further than only providing some financial incentives in favor of certain technologies, such as clean energy technologies. The industrial policy vis-à-vis certain infrastructure sectors would need to be reconsidered. In energy, for instance, the regulatory institutional systems emerged to support the centralized energy provision. In order to stimulate a more decentralized energy infrastructure this institutional structure would have to be fundamentally reconsidered. The specification of these needs for institutional and technological restructuring of infrastructure systems is an important challenge for the further development of the coherence approach. This ultimately determines whether this theory is useful or not.

Conclusions

This discussion chapter reflects on the coherence approach which aims to further substantiate the interrelations between institutions and technology related to the ongoing restructuring of various infrastructure systems, including energy, electronic communication, transport and urban water system. It provides a short summary of the basic ideas of this approach and some issues to be addressed in future research. These are quite fundamental issues related to the research methodology, operationalization, conceptualization and practical applicability. It summarizes some results of a workshop on coherence held at the conference.

The coherence approach provides an interesting and novel view on the ongoing process of the re-regulation of infrastructures; but quite some research has to be conducted in order to develop this toward a thorough theoretical framework.

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