

Regulation of liberalised network industries: infostructure as a missing link

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Abstract: *The aim of this paper is to evaluate how infostructure has been reformed in the liberalisation process of network industries, which has involved third party access to the network through a comparison of the electricity, railway, and civil aviation sectors in Switzerland. Our theoretical argument posits that infostructure is a missing link in the study of the regulation of liberalised network industries. Infostructure is defined as the control and command services that are necessary for monitoring the access to and optimising the uses of infrastructure. Our empirical comparison of the sectors aims at answering the principle question: What is the impact of the management of infostructure on the liberalisation process and the structure of liberalising markets? This study of the liberalisation of network industries in Switzerland highlights the potential strategic function of infostructure in the context of opening to competition and internationalising markets. Infostructure management can impact infrastructure ownership and service operation in terms of market structure and constrain access to the infrastructure and the market. Infostructure could also weaken the capacity to regulate the entire sector from regulatory agencies, particularly when self-regulatory arrangements control third party access to the network.*

KEYWORDS: aviation, electricity, railway, infostructure, liberalisation, regulation, network industries

Introduction

Since the beginning of the 1990s, political scientists have focused on studying the design and implementation process of regulatory reforms of network industries by comparing the diffusion of new regulation regimes in various European countries (Coen, 2005; Coen & Héritier, 2005; Eberlein & Grande, 2005; Moran, 2007; Thatcher, 1999, 2004; Vogel, 1996) and utility sectors (Böllhoff, 2005; Eberlein, 2000; Glachant, Dubois, & Perez, 2008; Héritier, 2005; Humphreys & Padgett, 2005; Jordana, Levi-Faur, & Puig, 2005; Varone & Bauby, 2007; Vogelsand, 2003). The depth and varieties of regulatory reforms help explain why previous literature on the topic has concentrated on the formal aspects of the reforms. These studies have shown how both formal and *de facto* independence of the regulatory authority can impact liberalisation as well as the effect of the weight of the incumbent firm on infrastructure ownership. They have mainly focused on the creation of new types of institutions but have not systematically explored the functions that these new regulatory agencies are assuming in the daily monitoring of liberalised markets. In this paper, we address the actual functioning of these new arrangements and underline the key role of a regulation function that remains on the dark side of the model of the regulation: infostructure management.

Infostructure has been defined first in the context of computer science in order to qualify the rise of an informational economy based less on material infrastructure than on knowledge and

information technology. Metaphorically speaking, whereas infrastructure is similar to hardware and includes concrete and visible constructs (transportation networks, electrical power, piped gas, water supply), infostructure can be understood in terms of software (Convery, 1998; Wong 2000). This concept was then applied to network economics (Curien, 2005) and can be defined as the control and command services necessary for monitoring access to and optimising the uses of the infrastructure. It includes key and strategic services such as dispatching for the electricity sector, paths allocation and timetabling for railways and slots allocation for the aviation sector.

In the field of network industries, infostructure management could influence the design of liberalisation and the condition of access to infrastructure for new entrants. Regulatory agencies are not systematically equipped to monitor the technical and economic conditions of access to infrastructure, and could face major information asymmetries. Moreover, infrastructure owners and incumbent firms could strategically use their historical control of access rights to limit competition.

The main research question that will be discussed in this paper is: What is the impact of the management of infostructure on the liberalisation process and the structure of liberalising markets?

We have gathered empirical evidence from the railway, electricity and aviation sectors in Switzerland by analysing both the historical management of infostructure under public monopolies – from the end of the 19th century to the 1980's – and its transformation with the liberalisation process since early 1990's. The first part of this paper aims at defining the concept of infostructure, presenting our methodology and studying how infostructure was handled in the aviation, railway and electricity sectors before the liberalisation processes in order to understand the potential strategic use of infostructure in liberalising markets. The second section will assess the nature of conflicts that can be observed around the management of infostructure during liberalisation and its impact on the access to infrastructure. The last section will be dedicated to the discussion of results.

1. Theoretical foundation and definition of infostructure

1.1. Situating the key function of infostructure in the new model of network industries regulation

In order to guarantee fair access of new entrants to the infrastructure and the market, the literature on liberalisation tended to emphasise the necessary independence of two sets of actors: the regulatory agency and the infrastructure owner, either formally or practically. The creation of a regulatory agency and the complete separation of service operation from infrastructure ownership are in principle enough to guarantee third party access. The owner of the infrastructure assumes the management of access rights and rules, and he should be autonomous, transparent and controlled by the regulatory agency. In this case, infostructure remains on the dark side of the model because the regulation of access rights and property rights on infrastructure are considered inseparable. However, under the influence of the European regulatory framework, the concrete regulation of network industries markets has seen the emergence of new intermediaries actors (slots and paths allocators, infrastructure capacity managers), besides the owner of infrastructure and the regulatory agency. The main argument of this paper is that although this third type of actor and function emerged in tandem with the liberalisation process, it remains largely understudied in the literature despite the fact that they could strategically influence the opening of competition and access to these markets. In this sub-section, we will consider the architecture of liberalisation that supported reforms in Europe and the limits of an analytical model uniquely based on the independence of the regulatory agency and the infrastructure owner.

Analytically, the new model of regulation of network industries is structured by the transition from an integrated management to an unbundled organisation of these sectors. The common point of these reforms consists, to different degrees, of the implementation of a new model of regulation (Joskow, 2006), which can be described in terms of four main lines of reforms:

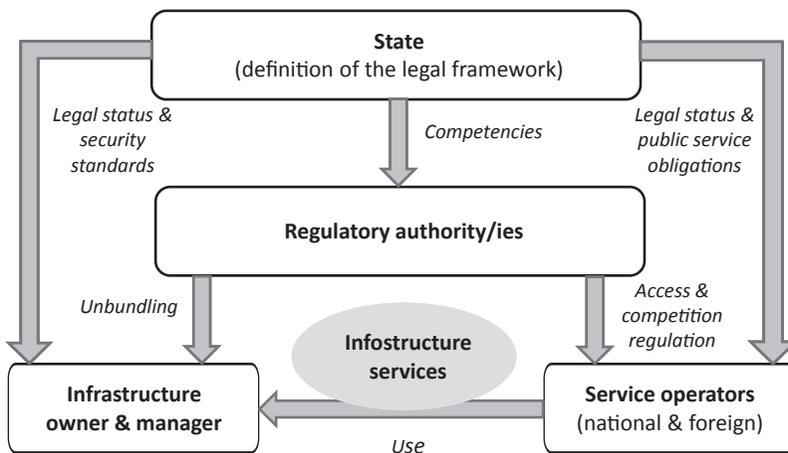
- the implementation of market competition through the opening of third party access to the network
- the creation of a new sector-specific regulatory authority to guarantee the enforcement of competition in a non-discriminatory way
- the unbundling of the incumbent firm through the formal or at least functional separation of service operation and infrastructure ownership
- the proposal of public service obligation and security standards

Figure 1 exhibits, in a simple manner, the architecture of the new model that has succeeded the former integrated model of network industries management.

This model mainly emphasises the key role of two new actors in the regulation processes, namely the independent regulatory agency and the owner of infrastructure.

In the field of network industries, and in the European context, regulatory agencies have three main functions: (1) monitoring the implementation of directives, regulations and laws defined by the State for opening competition; (2) enhancing the practical conditions of third party access to the network; and (3) in many cases, controlling the modalities of unbundling infrastructure management and service operation and of pricing access to the infrastructure in a non-discriminatory way. Agencies thus play a key role in the monitoring of infrastructure – through the control of access rights, standards and prices – but they are not suited for the concrete and practical management of this access. The issue of the independence of regulatory agencies in a context of liberalisation was certainly the main focus of recent studies on regulatory reform in the European context (Gilardi, 2002; Maggetti, 2007). This issue is related firstly to independence from elected authorities, considering that less political pressure and more stability, as well as greater expertise, will give more weight to these authorities in order to implement and arbitrate the opening up of markets. Secondly, the issue of independence is also related to *de facto* independence from regulated entities. This type of independence echoes the famous capture theory, which contends that

Figure 1: Institutional architecture of the new model of network industries regulation



regulation function tends to be captured by producers and that the content of regulation activities tends to be strongly dependent on the demand of regulation from the producers (Jordan, 1972). This theory has been strongly criticised by the economic theory of regulation, which argues that regulation could serve very different interest groups according to the veto power and leadership of both producers and consumers, and arbitrates between these interests (Stigler, 1971). In the same way, analysing the *de facto* independence of regulatory agencies in Europe, Maggetti (2007) noticed that the independence of regulatory agencies from both political control and regulated industries is possible. But Maggetti also proved that this independence is even greater as regulators are involved in pan-European and sector-specific networks of agencies. The different forums of agencies at the European scale reinforce agencies' expertise and reduce transaction costs. In the context of an incomplete unbundling of the sector between the owner of infrastructure and the old and new service providers, these information asymmetries remain strong and constitute the main concern of the daily activity of regulatory agencies. Information asymmetries are more particularly related to the conditions of access to infrastructure, and to the market. The regulation of liberalising markets implies the gathering of information and expertise related to the costs, technologies and tariffs for access to infrastructure. These information asymmetries are strongly related to infrastructure management and to the practical conditions of access to the network. Infrastructure management is thus key for the exercise of sectoral regulation and could increase information asymmetries. Based on this work on *de facto* independence, we propose to go one step further to highlight the role of infrastructure management function which could increase transaction costs' impact on *de facto* independence and render the exercise of regulation much more complex. Moreover, a deficient monitoring of infrastructure is likely to generate unfair competition between service operators, while constituting the main function of regulatory agencies.

The owner of infrastructure is the second new actor of the regulatory model of liberalised network industries. In utilities sectors, infrastructure remains at least partially governed by the principle of natural monopoly and raises the question of fair access to infrastructure in a context of competition (Künneke & Finger, 2009). Once the parameters of the natural monopoly are defined, the new regulatory model implies that reforms should be implemented to guarantee that the infrastructure owner does not limit or distort competition. The distinction between natural monopoly for infrastructure management and competition for service operation was defined early on by the US Supreme Court as an essential facility doctrine and was used during the 20th century to regulate the conditions of access in the electricity, telecommunication and railroad sectors. In 1912, the Supreme Court used the doctrine for the first time to condemn a railroad association in the St. Louis region because it was limiting access to railroad bridges and switches for other railway companies¹. If we recognise that the natural monopoly argument varies from sector to sector and according to context, then the issue of the independence of the infrastructure owner has been clearly stated in the new legal framework governing these industries – through new obligations to financially, functionally or even legally separate the provision of service from the ownership of infrastructure. However, while researchers and policymakers paid close attention to the property of infrastructure within this new architecture, the position of infrastructure, through the allocation of access rights, remains unclear both theoretically and practically. Infrastructure can stay in the hands of the incumbent firm, or be given to the infrastructure owner (if different) or to an independent public or private body. It therefore presents a good deal of room for maneuver for the incumbent firms or for national policymakers to influence the architecture of the new market. Even if the European regulatory frameworks are trying to fill this gap in and

¹ in 224 U.S. 383 - United States of America v. Terminal Railroad Association of St Louis (1912).

are defining more and more precisely the conditions for the independent management of infrastructure, we will explain below that these reforms remain highly controversial.

1.2. A definition of infostructure

The concept of infostructure focuses on services dedicated to the technical regulation of infrastructure networks. The genesis of the concept of infostructure is related to computer science and has been formalised by the new network economy (Curien, 1992, p. XIX; 2005, p. 9) which defines a network as a sum of three closely interconnected layers:

- The first and deepest is infrastructure, which is composed of nodes and lines, and by all the technical, material equipment associated with the functioning of the network (airstrips, electric pylons, railroads).
- The intermediary layer is infostructure which groups all the command, control and technical regulation services permitting access to the infrastructure for different service operators and optimising the use of infrastructure.
- The highest and most visible layer is composed of final services, which are provided by operators to end users by means of access to and use of infrastructure.

The technical and economic representation of a network as the sum of three interconnected layers is at the root of the liberalisation process worldwide. As a matter of fact, since the beginning of the 20th century, networked infrastructures and services have been considered as a whole and as the basis for network economies, or so-called natural monopolies. But during the 1980s, with the rise of the new theory of contestable markets, economists have defended the natural monopoly hypothesis, which is understood as the notion that it is too costly to duplicate the supply (Baumol, Panzar, & Willig, 1982; Viscusi, Vernon, & Harrington, 2000). The objective was to clearly identify the portion of the networked industry sector that is subadditive and characterised by a natural monopoly, i.e. the infrastructure layer which cannot be duplicated without higher costs. The identification of the natural monopoly perimeter helps in turn to define the potential fostering of competition in service operation.

At the intersection of infrastructure and service layers, infostructure is composed of a set of intermediary services and technical facilities that are auto-consumed by the network (Curien, 2005, p. 9). Within the telecommunication industry for instance, two different facilities can be identified: the infrastructure of communication transmission (lines and nodes) and the processing of information assumed by a series of digital signals to orientate and organise uses of the primary network (voice, data, video), also called the semaphore network (Curien & Gensollen, 1990).

Infostructure gathers a set of advanced services designed to monitor the use of the network. Infostructure services are characterised by software and facilities, which are less material or concrete than infrastructure but can be extremely capital intensive. They monitor access to infrastructure resources, allocate use rights, and arbitrate use rivalry and competition for the same slots or for infrastructure capacity. The infostructure layer has undergone major technological developments that have often contributed to liberalising these sectors. Infostructure services are increasingly sophisticated in optimising - in real time - the use of the infrastructure and reinforcing the efficiency of the entire network, as evidenced by the current development of smartgrid systems in the field of electricity or the progress made in traffic and congestion management for road infrastructures. In the case of telecommunications services, ISDN development during the 1980s enabled the sharing of the infrastructure between different uses and service operators. For the electricity, railway and aviation sectors, innovation in ICT helped to develop new services of

communication, dispatching, control and coordination between different service operators, and facilitated the access of new entrants.

1.3. Methodology

The aim of this paper is to study how competencies for the management of *infostructure* – for railway, electricity and aviation sectors – have evolved under the liberalisation process and what the impact of these modes of management on market regulation might be. As this paper aims at deepening the theoretical framework for the study of the regulation of network industries, the following empirical evidence will focus on the evolution of the role of *infostructure* in three sectors rather than testing theoretically based hypotheses.

We will study the case of Switzerland. Economic reforms in Switzerland are often close to European expectations and correspond, as we shall see, to a flexible and autonomous adaptation process already described by several authors (Fischer, Sciarini, & Nicolet, 2003; Fontana, 2011; Mach, Häusermann, & Papadopulos, 2003). As we will show for the aviation, railway and electricity sectors, Switzerland follows the European process and progressively implements the same liberalisation packages as its neighbour countries. We will demonstrate that the reform of *infostructure* management in Switzerland is strongly dependent on changes in the European regulation of these sectors in order to improve the level of integration of the internal market. Swiss cases are thus similar to the trends and debates that can be observed in many European countries, in the context of the liberalisation of network industries.

The three sectors offer an interesting variation for studying the role of *infostructure* in the liberalisation processes. The first difference is that the level of internationalisation and integration of markets was early and much stronger in the aviation sector than in the other two. The second difference is that the management of *infostructure* was more transnational and quite independent from the states and national companies in the aviation sector. Autonomous arrangements in the aviation sector were stronger and more able to ensure the functioning of an integrated market. Thirdly, the respective weight of infrastructure and *infostructure* in the overall functioning of the sector is variable, which allows us to study the close relationship between infrastructure and *infostructure* within the functioning of these sectors. Lastly, the three sectors were liberalised at different stages and paces. For example, the aviation sector was opened earlier and the creation of a market was more recently achieved. In the electricity sector and even more so in the railway sector, reforms are still in progress and an incomplete reform of *infostructure* management could still influence the way in which liberalisation is actually implemented. New regulatory agencies were also created by the state in the electricity and railway sectors, allowing us to assess how their intervention for the implementation of liberalisation could be constrained by *infostructure* management.

This study of the railway, civil aviation and electricity sectors in Switzerland has been built on three main types of data. First, we systematically collected and analysed the regulations and rules related to the three sectors we studied since their initial development at the end of 19th century. These historical and legal surveys propose an in-depth study of the transformation of institutional regimes and policies regulating infrastructure, *infostructure* and service management, and help to explain the impact of regime changes on actor configurations. This study is based on an historical analysis of institutional regimes of the railway (Weidmann & Rieder, 2010) and civil aviation sectors (Csikos, 2010, 2011) from 1890 to 2009. Our research is complemented by the historical analysis of electricity network regulation previously developed by Paquier and Pflieger (2008) and Pflieger, (2009). These historical screenings were primarily dedicated to an analysis of the conditions of the development of the network infrastructure. They then inserted the

transformation of the Swiss institutional context of network industries regulation in the European and international legal frameworks. This is how we have evaluated the pace and depth of the changes in infostructure management from the very first developments of these three network industries to their most recent reforms. The study of the legal framework was supplemented by a detailed documentary analysis of the recent debates and controversies over the reform of infostructure management. This analysis was based on expert and parliamentary reports published during the negotiation of the new rules and law on the liberalisation of the three sectors and on an analysis of the newspapers during the debates related to infostructure and the recent process of unbundling. Finally, the research material was complemented by qualitative interviews conducted with infostructure services for the allocation of paths and air traffic control.

1.4. Infostructure management of network industries before the liberalisation process

Historically, before liberalisation reforms, infostructure tended to be integrated within the incumbent firms activities. The Swiss case in infostructure management is illustrated below where it should be noted that the management of this function was similar in every E-U country.

For the railway sector, infostructure is mainly composed of the services of path allocation and timetabling. In Switzerland, since the founding of the national public companies SBB (1902) and BLS (1906), this regulatory function has been assumed by the integrated monopolistic firms (in charge of service operation and infrastructure maintenance) for purposes including the access of foreign trains and international railways to the infrastructure. There was strictly no legal obligation for the incumbent to authorise third party access or to give rights of use for paths (Weidman and Rieder, 2010). However, on an international scale, timetabling and access to national paths has been subject to long-term self-regulation between national railway companies from both Western and Eastern European countries, even during the Cold War. The first European Passenger Timetable Conference (CEH) and the European Freight Timetable Conference (CEM) were created in 1872 and 1918 respectively. This new infostructure service allows passengers to cross borders without change. Though this kind of self-regulatory arrangement was useful for developing international relations on the European level and for improving interoperability, there was nevertheless a clear sovereignty of national companies on their network with no domestic competition. Beyond national borders, freight trains were driven by other engines and passenger trains were organised by a close cooperation between the two or three national railway companies concerned.

For the electricity sector, infostructure is composed of transmission systems, dispatching activities and interconnection management with other transmission networks. This function is vital as it ensures a stable balance between supply and demand on the E-U level and prevents blackouts. Since 1951, this function was assumed through self-regulatory arrangements with the creation of the Union for the Coordination of Production and Transmission of Electricity (UCTE), between transmission companies from France, Germany and Switzerland. The UCTE then expanded to the 29 transmission system operators from 24 countries of Continental Europe, including Switzerland. After two mergers in 1999 and 2008, UCTE became the single association of transmission system operators on the European Union scale, plus Norway and Switzerland, currently named ENTSO-E. If the first historical aim of the Union were to ensure the technical interconnection and the exchange of electricity between countries, then the new aim of the association created in 1999 would have explicitly been to enhance competition and facilitate the creation of the internal European market for electricity in accordance with new European regulations. In Switzerland, transmission lines remained in the hands of seven regional production companies that shared a monopoly for electricity production in part of the national territory. By 1999, the first six companies delegated transmission system operation to the seventh (EGL), the main

transmission coordinator. It was not until 1999 that the seven companies decided to create a specific body to manage transmission systems (ETRANS), which rapidly revealed its inefficiency in ensuring a stable supply of electricity, as we will discuss below, and led in 2006 to the creation of the new transmission operator, Swissgrid.

In a non-integrated sector such as civil aviation, infostructure is composed of two distinct functions: (i) the air navigation services that allocate airspace time to operators (“air traffic control slots”) and manage interconnections between Swiss and foreign airspaces; (ii) the slot coordinator who plans, allocates and monitors aircraft take-off and landing times (“airport slot”) on both the main Swiss coordinated airports of Zurich and Geneva. Air navigation services (ANS) have been assumed since 1931 by a state-financed corporate firm, Radio-Suisse Ltd. In 1988, a new self-financed company fully owned by the Swiss Confederation, Swisscontrol Ltd., took over ANS activities from Radio-Suisse. Since 2001, a third new company, Skyguide Ltd., which is the result of the merger between civilian (Swisscontrol) and military air navigation services, has been in charge of the allocation of airspace under the supervision of the Federal Office of Civil Aviation (FOCA). Slot coordination at airports had been carried out by the monopolistic national carrier Swissair and its successor, Swiss International Air Lines (SWISS) until 2005. In October 2005, Slot Coordination Switzerland (SCS) was created by the Swiss Confederation. Despite the fact that SCS is called an “independent coordinator,” the airport slot allocation process has since 1947 been subject to self-regulation by international airline companies under the supervision of the International Air Transport Association (IATA), the representative body of commercial operators. This self-regulation is materialized by the IATA Schedules Conference and the set of slot allocation procedures followed by national coordinators has been defined in the IATA Worldwide Scheduling Guidelines.

1.5. The strategic position of infostructure management in the liberalisation process

Four main points will be raised according to the theoretical definition of infostructure and the preliminary historical survey presented above, which will guide our analysis of the three sectors studied in the next section.

The first point is related to the degree of internationalisation of the markets of the three sectors we studied. Under the historical model of management of networked industries, the infostructure function clearly appeared on an international level, at the intersection of different national and integrated companies. One of the chief objectives of infostructure has always been to ensure the interoperability of the network at the international level. This is particularly true in the European context where fragmented network systems still coexist, standing in sharp contrast to the United States, which is characterised by regional infrastructure networks. However, while the coordination of infostructure for the use of air lanes or runways in the aviation sector was strengthened at a transnational scale early on through the work of Air navigation services or IATA, the international coordination of railway and electricity networks were characterised by international self-regulatory arrangements for cross-border issues, though national sovereignty remained strong in these two sectors for the management of infostructure within national boundaries. It does mean that the functional scale of the aviation market was continental well before the electricity and railway networks. For the electricity and railway sectors, the question of the creation of an internal market emerged later under the influence of new European regulations in the 1990s. As observed in these sectors, new entrants often come from other European countries rather than new firms (renewable energies providers excepted). This means that the opening up of competition could be influenced by the capacity to create or enhance a single market and that infostructure constitutes a central function in that sense.

The second point is related to the nature of the regulatory arrangements governing infostructure before liberalisation reforms and their potential impact on market structure. Internationally, this function has been historically assumed by forums of national and integrated companies with their own norms and practices around the key issue of interoperability and interconnection. On a national level, however, the infostructure function was not clearly visible until recently as it was still a monopoly of the incumbent firms and hidden within their internal organisation. The fostering of competition and the unbundling of service operation and infrastructure ownership revealed this key function. The implementation of new rules and regulations on infostructure inevitably competes with existing self-regulatory arrangements as well as with the interests of incumbent firms. The weight of incumbent firms in controlling access to the network through the management of infostructure could potentially limit the access of new entrants for financial reasons (pricing and financial transparency), but also for technical reasons (standards, operation rules and capacity monitoring).

The third point is related to the respective weight of infrastructure and infostructure in the overall functioning of the sector (Table 1).

The perimeters of infostructure, infrastructure and service layers vary with different network industry sectors. For the aviation sector, the infrastructure layer is both material and immaterial, as it is composed of airports and air lanes, whereas infostructure is determined by the physical equipment of air traffic control, security facilities and airport services. Infostructure is less dependent on infrastructure, but at the same time, the weight of infostructure requires a stronger integration at a transnational scale. In contrast, for the electricity and railway sectors, the infrastructure of transport lines is much more capital intensive than the dispatching equipment of the infostructure layer, although the dispatching or path allocations functions are strategic for the safe and efficient functioning of the system as a whole. This variation is interesting for our study because in the case of the electricity and railway sectors, the capital intensity of heavy infrastructure gives its owner much more power but also many more financial and technical constraints, and could strongly impact the functioning of the market. As a consequence, the allocation of train paths or the dispatching of electrical capacity and their pricing are more technically and financially dependent on the owner of infrastructure. However, an infostructure manager who is

Table 1: The three layers of network industries

	Aviation	Railway	Electricity
Infrastructure	- Airports and air lanes	- Rails, platforms, bridges, switches, stations	- Transmission and distribution lines
Infostructure	- Airport slot coordination, air traffic control slots coordination, scheduling, congestion management, security, technical and communication standards and security systems	- Railway station control and coordination, congestion management - Timetabling, paths allocation, path control and security systems, signals, technical and communication standards, congestion management - interconnection with other railway networks	- Dispatching, control of high voltage lines charges, control of distribution lines charges - Interconnection with other transmission networks
Main services	- Passenger and freight transportation	- Passenger and freight transportation	- Light, heating, energy

not independent from the incumbent firm or any final service provider could not permit transparent third party access to infrastructure and could therefore influence the structure of liberalising markets. These two contrasting trends, between the difficulty of adopting a functional separation with the infrastructure layer and the independence required for opening up competition, could be paradoxical and hard to arbitrate concretely.

The fourth point concerns the relationship between infrastructure management and the capacity of regulation of the sector as a whole. By capacity of regulation, we mean not only the capacity to arbitrate but also to implement the opening of competition and to guarantee third-party access to new entrants. The historical integrated model was quite efficient for infrastructure management as it raises few conflicts and guarantees the security of the entire system with low coordination or transaction costs. However, in a context of incomplete unbundling (see figure 1), the management of infrastructure could strongly influence the exercise of regulation. An infrastructure manager who is not independent from the incumbent firm or any final service provider could strongly weaken the regulatory capacity of independent regulatory agencies to monitor the access to infrastructure. Moreover, as mentioned in sub-section 1.1, a lack of independence of infrastructure managers from other regulated entities could reinforce information asymmetries and increase the need for expertise in the highly technical fields of path allocation, electricity dispatching and air traffic control. The risk is not only of regulatory capture but of a regulatory failure because the agency would not be able to control the fairness of the practical, financial and technical conditions of access to infrastructure.

In keeping with the conceptual analysis of infrastructure, the next sections will contend with our main research question on the impact of the management of infrastructure on the liberalisation process and the structure of liberalising markets. Concerning the ongoing liberalisation process of network industries, infrastructure is a key independent variable that can strongly constrain the way in which liberalisation is implemented.

2. Comparative analysis of infrastructure management in liberalising markets

In this section, we will analyse how the infrastructure management function has been handled during the liberalisation process and how it has influenced it according to the explanatory factors identified in sub-section 1.5. For each sector, we will first explain the changes in infrastructure management in relation to the internationalisation of markets and to changes in the European and international legal frameworks. Then we will analyse the persistence of past modes of infrastructure management, particularly self-regulatory arrangements. Finally, the two last points will study the relative position of infrastructure management between infrastructure owners and new regulatory agencies.

2.1 The aviation sector

a. The internationalisation of markets under the auspices of the E-U

In the aviation sector, the lack of infrastructure's management capacities generated the first signs of air traffic congestion in the late 1980s in Europe with the emergence of bottlenecks at the borders of national airspaces. The congestion problem was thus a problem of coordination between airspace in a context of the progressive opening of competition and the internationalisation of markets. Since the 1970s, weak technological and staff investments in the national air navigation services (ANS) resulted in an inability on the part of the infrastructure to support the doubling of traffic volume in airspace (Eurocontrol, 2003). At that time, in a Europe involved in the liberali-

sation of civil aviation markets, about 60 air traffic control centres were still regulated by national rules within airspace defined by national borders. This raised problems for both the capacity and the interoperability of infrastructures, but also for the security of the system as a whole. As a matter of fact, two peaks of “near collisions” can be identified in conjunction with the two phases of liberalisation (1998 & 2002). In the 1998-2000 period, their number grew from 2 to 22 and in the 2002-2003 period, it grew from 13 to 19 (BEAA, 2010). After these peaks, the number of incidents has steadily declined to 3 cases in 2009 (*Ibid.*). This empirical evidence shows that liberalisation phases can generate an enormous albeit temporary pressure on infrastructure.

The European Civil Aviation Conference and Eurocontrol served as a first attempt to increase interoperability with the creation of centralised European coordination tools for airspace slot allocation such as the Central Flow Management Unit (CFMU). This technical device has enabled the management of air traffic flow on a continental scale since 1996. However, this first step for the European integration of infrastructure showed signs of weakness in 1999 with the resurgence of airspace slot shortage (Eurocontrol, 2010). This situation was the result of conflicts between service operators (airlines) and ANS around the adjustment of infrastructure’s capacity to face traffic growth and price fixing for air traffic control services. As an international practice, price fixing has been – and still is – based on a true cost accounting principle. Therefore, ANS, like Skyguide, have not been able to generate sufficient financial reserves to pre-fund an increase of their capacities (Skyguide, 2002).

Thus, the European Commission, fearing a weakening of Continental competitiveness in air transport, took charge of the problem by joining Eurocontrol and publishing in 2004 and 2009 five Regulations: (EC) Nos 549/2004 to 552/2004 and 1070/2009 for the creation of a Single European Sky (SES). By 2012, SES is supposed to divide the entire Continental airspace into functional airspace blocks defined by current national boundaries and redesigned on the basis of effective air traffic flows². Switzerland has taken part in this new institutional structure since 2006 by adopting E-U regulations.

For both air traffic and airport traffic coordination, the key issues were the problems of interoperability, capacity shortage and traffic security in a context of liberalisation. This specificity reflects a stronger international integration of the aviation sector and explains why the level of infrastructure management autonomy grew alongside the level of international integration and interoperability of national infrastructures.

b. The persistence of self-regulatory arrangements

In terms of airport traffic coordination, self-regulatory arrangements through the work of the International Air Transport Association (IATA) sustained the coordination between operators to facilitate the progressive implementation of liberalisation during the ‘90s. In order to avoid increasing delays, IATA began to recommend actions and priorities for such schedule adjustments that were formally defined in 1976 as self-regulation principles (IATA, 2011). With the liberalisation of air transport within Europe and its consequences in terms of traffic increases, in 1993 the E-U published the Council Regulation 95/93/EEC on common rules for the allocation of slots at Community airports, which was later amended in 2004 in the Regulation 793/2004/EC. The main principles of these texts were inspired by the recommendations defined by the IATA. Concretely, the Regulation aimed at separating the operator and the airport coordinator

² Interview with Mr. Marc Baumgartner (2010), Air traffic controller at Skyguide Ltd., former President of the International Federation of Air Traffic Controllers’ Associations (IFATCA), Geneva, October 26 2010.

by the creation – when needed – of an independent coordinator of schedules, and a coordination committee consisting of air carriers using the airport, the managing body of the airport, air traffic control authorities and general aviation representatives who are all allowed to make proposals and advise the coordinator.

In Switzerland, according to old IATA principles, the monopolistic national operator Swissair, and then, after its bankruptcy, SWISS, were in charge of slot allocation until 2005 in both the so-called coordinated airports of Zurich and Geneva (DETEC, 2005). Since Switzerland adopted the full E-U air transport's law since 2002, the Swiss government announced in 2005 the adoption of a decree establishing Slot Coordination Switzerland (SCS) as the independent coordinator for airport slots in Zurich and Geneva. This new structure has been incorporated as a non-profit association whose members are both Zurich and Geneva airports and the main Swiss airlines. SCS has been placed under the supervision of the Federal Office of Civil Aviation.

Despite this new structure, nothing has really changed, as SCS follows allocation rules defined by the IATA (DETEC, 2005; SCS, 2011). Concretely, SCS adopted the main principles of IATA procedure such as “grandfather rights” which allocate slots to a carrier that had previously operated them. The coordinator then identifies periods in which requested slots exceed declared airport capacities (IATA, 2011: 13) and discuss with operators minor changes in their initial plan (e.g. change of aircraft type, abandonment of unused slots, etc.), on the condition that there would be no impact on capacity or if capacity were returned. Finally, SCS procedures are linked to the IATA Schedules Conferences organised twice a year to gather stakeholders to adjust their schedules by way of meetings between coordinators and carriers or the exchange of slots between carriers (IATA, 2011). Thus, IATA Worldwide Scheduling Guidelines furnishes all stakeholders (i.e. governments, airport managing bodies, coordinators, and operators) with a detailed outline of recommended procedures for slot allocation and conflict resolution. In particular, it assigns to the coordinator the role of resolving “[...] problems arising from conflicting requirements in such a way as to avoid any need for external intervention” (IATA, 2011: 13). It urges stakeholders to make efforts “to resolve such problems in an atmosphere of mutual co-operation and goodwill.” It is clear that the philosophy behind IATA principles is to enable the self-regulated resolution of potential conflicts between operators. In order to justify its central position in the definition of the negotiation process, the IATA notes that “there is a process in place today, which has been singularly successful in maintaining a high degree of coherence and stability in the international air transport system” (IATA, 2011: V).

The last change in infostructure management shows that the IATA's self-regulation principles have been institutionalised by the Swiss Confederation by their integration into their corpus of laws. In the aviation sector (coordination of airports), the IATA model of self-regulation has been simply downloaded by the Swiss regulation. Newly entering companies (such as low-cost carriers) have adopted the historical airport slot allocation process under the umbrella of the IATA. The airport slots allocation procedures in the Swiss civil aviation sector do not raise major conflicts between operators thanks to the efficient coordinated play between users within IATA structured procedures.

c. The structural weight of infostructure over infrastructure

In the aviation sector, infostructure “creates” airport slots and air lanes, which are immaterial. It means that infostructure is less dependent on a material infrastructure for its functioning (the airports excepted) and that its autonomy could result in fewer conflicts or coordination costs with the infrastructure owners than in the railway and electricity sectors. However, this does not mean that the reform of infostructure is not controversial, particularly in the context of defining airspace

blocks at the European scale. Since 2006, Skyguide Ltd., the Swiss Confederation owned ANS, has been involved in a European-wide negotiation process in order to create, along with other foreign ANS such as Belgium, France, Germany, Luxembourg, and the Netherlands, a functional airspace block (FAB Europe Central-FABEC³). Thus, SES is supposed to optimise airspace capacity from 2016-2018 by minimising restrictions related to current fragmented air traffic control management. Although service operators (air carriers) have broadly supported the creation of the SES project, as they have been asking for such integration since the 1980s, the conflicts with ANS around price definition and the adjustment of capabilities around effective traffic growth have not been resolved. On the contrary, the functional airspace block adds new constraints to the infostructure such as yardstick competition (Shleifer, 1985) between national air navigation services, especially in the realm of cost/performance. Moreover, as the collection of fees to service operators remains the sole source of funding for a ANS like Skyguide, the competition between them to attract traffic in their activity area within the functional airspace block will remain valid. The need for the supranational coordination of air traffic management under the umbrella of the E-U led to growing pressure on the infostructure both in terms of performance and cost cutting. In this case, infostructure tends to be considered as a quasi-market with competition rules between air navigation services, without any possibility for them to set their prices freely.

d. Regulation without agency

In the case of the aviation sector, no regulatory agency has been created mainly because self-regulatory arrangements for the access of service providers have been downloaded by Swiss and E-U regulations. For airport traffic coordination, even non-IATA members, such as low-cost carriers, have accepted IATA's rules and are invited to the Schedules Conferences. In this self-regulation system, operators have, by way of IATA, full control on the slot allocation procedures and have no interest in publicising conflicts, so as not to risk the transfer of the regulation to a state-controlled or state-regulated institution. Thus, in this case, the autonomy and expertise of the infostructure manager IATA are such that the creation of a regulatory agency is not required.

2.2 The railway sector

a. The slow integration of the European market

From 1991 to 2001, the E-U published two main Directives to separate infrastructure management and service operation in the railway sector. The Council Directive 91/440/EEC of 1991 on the development of the Community's railways aimed at the functional separation of infrastructure management and railway services, at least in accounting. Ten years later, the Directive 2001/12/EC was obliged to create a separate entity for the management of infrastructure. Article 14 clearly states that "where the infrastructure manager, in its legal form, organization or decision-making functions is not independent of any railway undertaking, the functions referred to in paragraph 1 [i.e. the capacity allocation] (...) shall be performed by an allocation body that is independent in its legal form, organization and decision-making from any railway undertaking". In 2004⁴, the European Commission announced to the Swiss government that the existing sys-

³ FABEC represents an area of 1.7 million km², equalling 9% of the surface area of the European continent. It will manage about 5.5 million flights per year, equating to 55% of all European air traffic (FABEC 2011).

⁴ Interview with Mr. Thomas Isenmann, managing director of Swiss Train Path Limited, Bern, September 13 2010.

tem of path allocation organised by the three railway companies themselves was not operating in accordance with the obligation that infrastructure management be independent of the Directive. The main argument of the Commission was that non-discriminatory open access to infrastructure for foreign or new service providers was not guaranteed because of the lack of independence of the allocation body. But SBB, the main historical incumbent firm, refused to functionally separate infrastructure management and service operation.

In Switzerland, the legal status of the path manager and the potential extension of its responsibilities to timetabling are still subject to debate between incumbent firms, the Swiss government, and the European Commission. It is considered by the Commission as a crucial issue for the strengthening of liberalisation and the interoperability of the new internal market against the position of vertically integrated Swiss railway companies. On the European scale, few cases of conflict have recently occurred. In 2010, the Italian incumbent firm, Trenitalia, applied for and obtained better train paths than its German and Austrian competitors DB and ÖBB. Both companies expressed their intention to go before the European Commission if an agreement was not reached with the path manager⁵.

b. The strategy of railways companies to set self-regulatory arrangements

Since 2006, the incumbent firms have been allocating an important part of infrastructure management to the new entity Swiss Train Paths Ltd (STP), a subsidiary of the three main incumbents for standard-gauge railways in Switzerland and the Swiss Union of Public Transport Companies. This decision was a reaction to the risk of creating a new publicly owned independent corporation to assume complete responsibility over infrastructure management: path allocation; path pricing; timetabling; and congestion management. As a matter of fact, in its message on the second stage of railway reform in 2005⁶, the Swiss government announced its intention to create a new public body to assume these functions, but the decision was ultimately postponed. The three railway companies took the initiative without any legal basis and created a private subsidiary to allocate paths (STP) in 2006. The strategy of the three incumbent firms was to keep the responsibility for path allocation in their hands and to ratify it by law (Isenmann, 2010). Nevertheless, after five years of consultation with the main stakeholders of the sector, no agreement was reached and the second step of the railway reform was delayed until 2010⁷.

c. The weight of infrastructure owners

The incumbent firm SBB was opposed to the creation of a holding company heading separate entities for infrastructure and service operation, arguing that this would generate transaction costs. SBB posited⁸ that it was risky for the security of the entire system to separate the design of the timetable and its implementation through the allocation of paths. It defended its position that timetabling should remain the responsibility of the infrastructure manager. The argument around the security of passenger traffic and the importance of coherence between timetabling and path management has thus been a key point in the opposition to the unbundling of the integrated firm. As a consequence, the path manager's main responsibilities are: the study of applica-

⁵ "Le difficile passage des Alpes des trains austro-allemands", *Ville et transports magazine*, 16 December 2010

⁶ Message of the Federal Council, February 23 2005, "message sur la réforme des chemins de fer 2".

⁷ Press release of the Federal Office of Transport "Réforme des chemins de fer 2: le Parlement va traiter l'interopérabilité et l'appel d'offre en trafic voyageurs - l'attribution des sillons suivra", June 11 2010, Bern.

⁸ Interview with Mr. Thomas Isenmann, op cit.

tions to paths; the verification and approval of the timetable produced by the national timetabling conference; and the resolution of claims or possible conflicts between service operators. However, STP does not cover the entire process of path allocation, as the central function of timetabling remains in the hands of the incumbent firm.

However, the access to railway infrastructures did not ultimately raise much conflict. STP dealt with only around 120 conflicts per year from 2006 to 2009 – for a total of 12,500 train paths allocated per year – all of which were resolved by agreement (Swiss Train Paths, 2007, 2008, 2009). Around 100 of these 120 conflicts were simply resolved by finding a solution to supply the path with the infrastructure manager via technical arrangements (e.g. a change of track) or by applying the priority rules that are partly defined by law⁹. As in the aviation sector, the managing director of STP¹⁰ explains this easy resolution of conflicts by way of the iterated prisoner's dilemma: companies are strongly encouraged to cooperate and find a solution around a conflict over paths; the resolution of a conflict around one path between two companies will in return help find a solution for future path conflicts.

Thus, path allocation procedures in the Swiss railway sector do not raise major conflicts between operators thanks to efficient coordinated play amongst service operators and as a consequence of the high administrative cost of complaint.

d. The structural weakness of the regulatory commission

Railway companies are encouraged to cooperate because other modes of conflict resolution of the regulatory agency through the *ex post* regulation are costly. If firms are unable to find any agreement and complain, the case is transferred to the Regulatory Commission (RACO). But, according to the STP managing director¹¹, as the RACO lacks the means for proper investigations, the first case of conflict between two railway companies lasted two years before its resolution, and for the two other cases that have arisen, the firms involved withdrew their complaints since the parties made agreements during the investigation procedure. RACO thus lacks the means of investigation, reinforcing the position of self-regulatory arrangements for incumbent firms to monitor the access to infrastructure. Another explanation for the low number of conflicts is that the liberalisation process is not yet mature enough in Switzerland (the competition is open only for freight services) and rivalries for access to the network are still weak.

2.3 The electricity sector

a. The issue of interoperability at the European scale

On September 28, 2003, the failure of the Lukmanier and San Bernardino transmission lines in Switzerland provoked cascading effects and a blackout in Italy. Investigations proved that the blackout was mainly due to a lack of coordination between the different systems operators in Switzerland (SFOE, 2003). This event showed that a failure of management in infrastructure and a weakness of interoperability between transmission grids could strongly impact on the stability and security of the entire European system.

⁹ According to the Swiss federal law on railways (art. 9a), priority rules are as follows: scheduled national and international passenger lines; scheduled regional passenger lines; international and transit freight lines; national freight lines.

¹⁰ Interview with Mr. Thomas Isenmann, op cit.

¹¹ Interview with Mr. Thomas Isenmann, op cit.

On the European scale, the debate around infrastructure management in the electricity sector is strongly related to the controversies surrounding the unbundling of transmission infrastructure ownership, transmission systems operation, and electricity production and distribution. After the first directive of 1996¹², which opened up competition in the electricity and gas sectors, the European Commission decided in early the 2000s that further measures were required to reinforce interoperability within the internal market. The main objective was to encourage the unbundling of transmission systems operation (TSO) and electricity generation. According to the 2003 Directive¹³, the TSO would ensure the balance between supply and demand, guarantee the security of supply and the interconnection between other transmission systems, and allow indiscriminate access to the network in a context of liberalisation. While the Directive states that infrastructure should be managed independently, it is not explicitly obliged to completely unbundle transmission system operation, infrastructure ownership (grid) and electricity generation activities. The vagueness of the 2003 Directive has led to great complexity in transmission system operation. In this context, from 2007 to 2009, the European Commission, the Parliament, the States and the main stakeholders of the electricity sector fought once again over the status of the TSO and the transmission grid owner. After two years of debate and strong opposition from France and Germany, the new 2009 Directive¹⁴ finally kept the question of transmission grid ownership open.

The promotion by member states of alternative and more integrated models of transmission operation (rather than the strict unbundled model initially proposed by the Commission) shows that changes in transmission infrastructure ownership and transmission systems management are a sensitive issue in Europe. The recent negotiation of the 2009 EC Directive raised the strong opposition of states against the intention of the European Commission to ask for the creation of strictly independent transmission system operators. Consequently, the European legal framework leaves a good deal of room for maneuver to the States for the choice of one transmission system operation model or another, which could impact the liberalisation process.

b. The implementation of self-regulatory arrangements by the electricity producers

As for the railway sector, the incumbent firms decided to create an infrastructure manager without any legal basis and to anticipate the Federal electricity supply act that was adopted by Parliament in 2007. The creation of an autonomous transmission system operator (TSO), called Swissgrid Ltd., dates back to 2005. Swissgrid is in the hands of the seven regional electricity producers, operating the transmission system, ensuring interconnection and guaranteeing non-discriminatory third-party access. It does not own the grid but has its own legal autonomy, personnel, accounting and corporate identity. The aim of the seven historical electricity producers was to comply with the 2003 EC Directive and to increase coordination amongst the electricity transmission lines owners to prevent blackouts.

However, the problem of Swissgrid autonomy in terms of decision-making has raised a lot of conflicts with regulatory authorities in the past five years. Since the seven companies owned the vast majority of energy production facilities, the whole transmission network, and the newly

¹² Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity.

¹³ Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC.

¹⁴ Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC.

created Swissgrid operator, the Competition Commission (Comco) had to give its agreement. The Comco¹⁵ stated that the new firm benefited from a dominant position in the market for the transmission of electricity and imposed four conditions: third-party access should be guaranteed in a context of liberalisation; tariffs should be published; a separate accounting should be produced; and members of the board should not be members of the board of electricity production companies that owned 100% of Swissgrid's shares.

c. The issue of grid ownership

Infostructure management in the electricity sector is a major issue for the implementation of liberalisation. The operation of the transmission system impacts both the security and the interoperability of the grid (as the 2005 blackout has shown) and the access of new entrants to infrastructure. The reform of the modes of management of infostructure and the governance of Swissgrid has been extremely controversial since the start of liberalisation in 2007. Since 2007, Swissgrid has been legally obligated¹⁶ to include members of its executive board who do not occupy any executive position in an electricity company. This condition caused major conflicts between the electricity companies owning Swissgrid and the competition commission before the Federal Court¹⁷. Swissgrid never complied with the obligation. In 2010, 6 of the 13 executive board members remained electricity producers. Moreover, the 2007 law also asked for a transfer of assets and ownership of transmission lines from the electricity producers to Swissgrid. The transfer of assets will be achieved only by the end of 2012, because the financing scheme still needs to be clarified. The estimated value of assets has been raised from €1.1 to €2 billions. As the former Energy Minister stated in 2009¹⁸, the Confederation did not have the financial means to buy the transmission lines from the electricity producers. As a matter of fact, the incumbent firms still strongly oppose a complete unbundling of the property of the transmission network and the electricity production facilities.

d. The exercise of regulation challenge by the lack of independence of the infostructure manager

The debate around the governance of Swissgrid and its executive board disrupted the first steps of the liberalisation process in 2008 and 2009. In 2008, six months before the opening of competition, Swissgrid, electricity producers and distributors announced an increase of electricity prices ranging from 23% to 40%¹⁹. Swissgrid alone was responsible for 10% of the rate increase. Two weeks after the publication of the new tariffs, representatives of industries and large and small consumers (such as Economiesuisse and Consumer associations) asked for a decrease of the toll applied by Swissgrid, arguing that the costs of buying reserve capacities had been overestimated. The Competition Commission (Comco) stated in October that the new tariffs of Swissgrid were illegal, arguing that the weak autonomy of the system operator – with experts and members of the executive boards coming from electricity generation companies – were influencing the calculation of reserve capacity costs. The newly created Electricity commission (EL-

¹⁵ Decision of the competition commission authorising the creation of Swissgrid, 7 March 2005

¹⁶ Federal electricity supply act, March 2007.

¹⁷ Decision of the Federal Court to cancel the decision of the Competition commission, 13 February 2007.

¹⁸ "Il faudra du temps pour que la concurrence joue dans l'électricité". Le conseiller fédéral Moritz Leuenberger va étudier un changement de la loi. *Le Temps*, 14 January 2009.

¹⁹ "Le Conseil fédéral veut réviser la loi sur le marché de l'électricité", *Le Temps*, 18 November 2009.

com) received more than 1,700 complaints regarding the Swissgrid toll. In 2009²⁰, the regulatory agency simply reduced the price paid by final users to Swissgrid, which incited heavy conflict between the infostructure manager and the regulatory agency. The origin of the conflict on electricity pricing was the lack of independence of Swissgrid experts vis-à-vis electricity producers while tariffs for the access to the network were being defined. In 2010, the Federal Administrative Court²¹ decided to rule against the decision of the Elcom and authorise Swissgrid to raise its tariffs. Beyond this case, a new Act on electricity supply is currently being discussed to strengthen the autonomy of Swissgrid and to control the conditions of the transfer of assets (transmission lines) from the electricity producers. The recent conflicts between the regulatory agency Elcom and the infostructure manager Swissgrid exemplify the difficulty in exercising regulatory power when infostructure is not independent from electricity producers.

3. Results and discussion

The main objective of this article was to evaluate how infostructure management evolved under the liberalisation process of network industries and to what extent it could impact the functioning and structure of liberalising markets. The main result is that infostructure appears to be the missing link in the study of the regulation of liberalised network industries. In the next section, we will discuss the results of our study following the four lines of analysis presented in section 1.4. Table 2 synthesises the main recent changes in infostructure management for the three network industries we studied.

The first result is that infostructure management could strongly constrain the implementation of liberalisation according to its key role in the implementation of the internal European market. In terms of access, infostructure ensures the technical and operational integration of the networks at the continental level. Therefore, one of the main aims of the new European regulation frameworks for infostructure management is to significantly improve the interoperability of air navigation services, electric transmission lines and railroad management. The reform process strongly varies between the aviation sector on the one hand and the two other sectors on the other. In the aviation sector (coordination of airports), the IATA model of self-regulation has been simply downloaded and institutionalised by the European regulation. By contrast, in the railway and electricity sectors, this kind of international self-regulation existed for the transboundary issues but was not able to facilitate the creation of the internal market. The reinforcement of the European internal market therefore required an increase in the capacity of foreign service operators to access national networks. European institutions were not able to download existing self-regulations guaranteeing a fair and autonomous allocation process. For the European Commission, this lack of autonomy raises the problem of third party access but also limits the potential integration of the internal market. For the railway and electricity sectors, the changes progressively required by the E-U were much deeper than they were in the aviation sector and required the creation of an independent infostructure manager separated from the incumbent firm. These reforms generated new conflicts between the European Commission, the Swiss Confederation and the incumbent firms. The main factor explaining the resistance of states and incumbent firms is that infostructure (dispatching, timetabling, path allocation, surveillance) was considered as a strategic or sovereign function. The creation of a new infostructure manager by incumbent firms themselves (such as Swiss Train Path or Swissgrid) appeared to be a palliative measure to avoid the

²⁰ Decision of the electricity commission, 6 March 2009.

²¹ Decision of the Federal Administrative Court, 8 July 2010.

Table 2: : A comparison of change in infrastructure manager status and potential conflicts

Network industry sector	Infrastructure manager ownership	Controversies around the legal status of infrastructure management	Conflicts over third-party access and market structure
Railway	Swiss Train Path (STP) owned by three vertically integrated incumbents	<ul style="list-style-type: none"> - Controversies around the ownership of infrastructure - Controversies around the decision-making autonomy - Controversies around the extension of the STP competencies and the potential inclusion of timetabling 	None because of strong self-regulation and cooperation
Electricity	Swissgrid owned by the seven vertically integrated incumbents	<ul style="list-style-type: none"> - Controversies around the ownership of infrastructure and transfer of assets (transmission lines) to a separated entity - Controversies around the decision-making autonomy of Swissgrid (related to its executive board) vis-à-vis vertically integrated electricity producers 	Conflict with regulatory authorities and consumer representatives over market power risks and pricing transparency
Aviation	<p>Air traffic coordination: Swiss Confederation own 99% of the capital of Skyguide Ltd. Airport traffic coordination: Six non-vertically integrated incumbents (2 infrastructure providers (airports) and 4 service operators (carriers)). IATA controls the slot allocation procedure.</p>	<ul style="list-style-type: none"> - Air traffic coordination: No controversies, legal status of infrastructure remains unchanged (private law company owned by the Swiss Confederation). - Airport traffic coordination: No controversies because the new legal status of infrastructure management is based on IATA historical self-regulation rules. 	<p>Air traffic coordination: Conflict with service operators (airlines) over pricing and capacity monitoring Emergence of yardstick competition between national air navigation services Airport traffic coordination: None because of strong self-regulation (IATA)</p>

complete unbundling of the sector and to comply with the obligation to open access to the network.

The second result is that the maintenance of self-regulatory arrangements for infostructure management could impact market structure and limit third party access to the network. In the three sectors we studied, infostructure management has been historically handled either by the incumbent firms or by self-regulation processes. Moreover, the room for maneuver in the management of infostructure implies that the reform process is still in conflict over the allocation of this strategic function. In the aviation sector, self-regulation was able to efficiently manage competition between companies, but in the electricity and railway sectors, infostructure management is still strongly dependent – at least legally – on incumbents firms. Clear consequences of infostructure management on the market structure were observed for the electricity sector in Switzerland. In the railway sector, however, there is no evidence of a limited access to infrastructure due to the weight of the incumbent firms on infostructure management. Competition is still not completely open and service operators and incumbent firms play a cooperative role in solving their conflicts.

Thirdly, the cases of the railway and electricity sectors also allow us to underline the particular weight of infrastructure owners and the difficulty to achieve a complete unbundling of them. In the two sectors, infrastructure owners are still opposed to a delegation of infostructure management to an independent entity mainly for technical and strategic reasons, citing as a reason the higher costs of coordination that this separation would generate. It shows that the central issue for the functional unbundling of infrastructure and service is to arbitrate where the management of infostructure will be located in the new framework and what its level of independence from service provision should be. Until now, the new model of regulation of network industries considered that an unbundling of infrastructure and service provision was sufficient for guaranteeing fair access to infrastructure, but it should be noted here that this unbundling will take into account priority infostructure management functions and the processes of allocation of access and use rights. Unbundling is therefore not only a matter of separating property rights on infrastructure and service operation, but a matter of guaranteeing the independence of the allocator of use rights: the infostructure manager.

Finally, these results allow us to discuss the impact of infostructure on the regulation of liberalising network industries in general. As we discussed in the first section, the central assumption of the political science literature in the field of network industries and market regulation is that the implementation of fair competition strongly depends on the capacity to delegate power to an independent regulatory agency. However, our results question whether *de facto* independence could even be sufficient for establishing a full capacity of regulation. By capacity of regulation, we mean not only the capacity to arbitrate but also to implement the opening of competition and guaranteeing third-party access to new entrants. This capacity depends on highly technical and precise expertise in the conditions of access and use of infrastructure, which are in the hands of the infostructure manager. The capture of infostructure by the incumbent firm increases information asymmetries around the technical, financial and practical conditions of access to the network. In the electricity and railway sectors, the capacity of regulation of the two agencies is still weak. The weak independence of infostructure management and the lack of investigation capacity of regulatory agencies are conjunctly weakening the capacity to regulate the entire sector.

In conclusion, the study of the liberalisation of network industries in Switzerland highlights the potential strategic function of infostructure in a context of opening to competition and internationalising markets. Infostructure management can impact infrastructure ownership and service operation layers in terms of market structure and constraint access to the infrastructure and the market. Infostructure could also weaken the capacity of regulatory agencies to regulate the entire

sector, particularly when self-regulatory arrangements control third party access to the network. However, we should stress that infostructure is not simply an independent variable, which impacts liberalisation reciprocally, and as we have demonstrated, liberalisation reforms were partly dedicated to deeply modifying the management of infostructure. The strategic position of infostructure underlined in this paper explains why reforming this function is still so conflict-laden. However, the implementation of fair competition is also related to other complementary variables that were identified early on in the literature and were discussed in this paper: the potential impact of an incomplete unbundling of infrastructure and service provision; the expertise and capacity of regulating agencies in relation to the risk of capture; and the role of past self-regulatory arrangements that governed access to infrastructure for decades. Our argument is not mono-causal. On the contrary, we urge a more careful assessment of the position of the infostructure manager as a key intermediary actor, in addition to the roles of regulatory agencies and infrastructure owners.

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Regulation (EC) No 1070/2009 of the European Parliament and of the Council of 21 October 2009 amending Regulations (EC) No 549/2004, (EC) No 550/2004, (EC) No 551/2004 and (EC) No 552/2004 in order to improve the performance and sustainability of the European aviation system.

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