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Multi-Dimensional Performance Approach to Reforming Network Industries: An Application to Reforming the Chinese Railway Sector

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Multi-dimensional Performance Approach to Reforming Network Industries: An Application to the Chinese Railway Sector

Marc Laperrouza[1]

ABSTRACT: *The creation of markets in network industries has more often than not been driven solely by an economic performance rationale. While increasingly included, other variables such as social values (e.g., public service and affordability) or environmental values usually rank as lower priorities, running the risk of achieving short-term economic goals at the expense of longer-term social acceptance.*

Building on the technology-institution coherence framework, this paper seeks to determine the role played by international government organizations (IGOs) in ensuring a broad definition of performance in the network industries. Specifically it proposes to discuss the involvement of two majors IGOs (namely the World Bank and the Asian Development Bank) in the Chinese railway sector. It also reflects on the "disconnect" between the factors that enter in the construction of railway lines (e.g., resettlement plans, environmental impact, etc.) and those used in managing the network.

The first section provides a brief overview of the major reforms undertaken in the Chinese railway sector during the past decades. It identifies what objectives underpinned the creation of the Chinese railway market. The second section analyses the IGOs' support in reforming the Chinese railway sector and shows how their involvement changed over time. Particular importance is given to identifying whether and how various performance objectives (e.g. economic, technical, social or environmental) evolved. The third section presents the technology-institution coherence framework and introduces the concept of multi-performance objectives when reforming network industries and creating markets. It proposes five performance objectives to ensure that the creation of markets is not limited to economic performance objectives.

Introduction

Until recently the railway sector remained the "parent pauvre" of China's infrastructure development projects. Likewise, and contrary to other network industries such as energy and telecommunications, it remained largely shielded from pressures to reform and to liberalise. For more than a decade the powerful Ministry of Railways (MOR) managed to keep the reforms to a minimum despite the involvement of multi-lateral lending agencies (e.g., the World Bank or the Asian Development Bank) and country donors (e.g., the Japan Bank for International Cooperation or the Agence Française de Développement) early on.

This is not to say that the railway sector remained devoid of activity. For instance, the World Bank funded several infrastructure building projects with loans each above

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USD 200 million during the 1980s. In parallel, the Bank pursued its efforts to bring reforms to the sector with advice as to promoting competition or exiting non-core railway activities. Similarly, the Asian Development has been actively advising and funding the development of China's railway network since 1989.

In fact, with time the Chinese government and MOR have warmed up to the idea of in-depth reform of the railway sector. In line with reforms conducted in other network industries, management of the railways was strengthened and decentralised. By 2004, the assessment of the World Bank was the following: "The railways modernization program and investment directions are clear […] Moving to sector lending to support defined objectives, bringing value added in high technology transfer, and informal advice on best practices would be key priorities together with a scaled-up investment program. Bank interventions should also be used to leverage additional financing, including financing from the private sector" (World Bank, 2004). Despite a lot of goodwill and close to three decades of multi-lateral lending agencies involvement as well as several attempts at reforming the sector, much of the Chinese railway market remains yet to be created[2].

Overview of reforms undertaken in the Chinese railway sector in the past 15 years

Attempts to reform the Chinese railway sector started early but did not lead to the same type of liberalisation witnessed in other network industries. In fact the case for the reform of the Chinese railway sector has been widely discussed over the past decades, including by multi-lateral lending agencies. For instance the World Bank was already making recommendations as how to conduct reforms on matters like management finance or regulation at the beginning of the 1980s (World Bank, 1993). The Ministry of Railways has undertaken many reforms over the past decade-and-a-half to facilitate structural and organizational reforms, including the separation of non-core units, the separation of the accounting of the passenger transport business, granting concessions to some 100 branch lines, the establishment of regulations to permit foreign investment, and the establishment of special-purpose subsidiaries (World Bank, 2007).

According to the World Bank the Chinese government has pursued two key objectives in the railway sector: 1) reforming the industry to become more responsive to the *market economy* and 2) achieving an innovative and step change in the *capacity and quality of infrastructure and services* (World Bank, 2009a). As with other infrastructure development, the government has used Five-Year Plans (FYP) to map out the railway sector's development. The plan aims to provide a balance between 5 elements: (i) rural and urban development, (ii) interior and coastal development, (iii) economic and social development, (iv) people and nature, and (v) domestic and international development (Parkash, 2008a). As shown in Table 1, plans to extend the Chinese railway network are extremely ambitious.

Table 1: Medium Long Term Railway Development Plan and Five-Year Plan Targets (km)

	End 2007 Actual	2010 11th FYP	2020 MLTDP	
			2004 Original	2008 Revised
Total length of track	78'000	92'000	100'000	120'000
Double track	27'000	41'400	50'000	60'000

[2] There is no competition taking place at the operations' level. Regarding construction, there is a duopoly with China Railway Construction Corp. and China Railway Group.

Electrified	25'500	41'400	50'000	72'000
Passenger dedicate lines	405	5'000	10'000	12'000

Source: World Bank

A brief history of the reforms

A large literature exists on the introduction of reforms in the Chinese railway sector (OECD, 2003; R. Pittman, 2004; Rong & Bouf, 2005; Wu & Nash, 2000). It is complemented by several reports published by multi-lateral lending agencies (ADB, 2003; Parkash, 2007, 2008a, 2008b; World Bank, 2009b) as to the advancement and direction of the reforms.

Railway reform in China started in 1994 and stemmed from the general economic reform policy, lack of network capacity and investment, low level of service, increasing competition from other modes, and losses incurred by the sector. At the time, the major instruments of change can be summarized as decentralisation and deregulation (Wu & Nash, 2000) although the latter instrument has been applied in a restricted manner. According to the World Bank (Churchill & Thum, 2005, p. 30) "the reform program of China's railways is broadly consistent with lessons learned from railway reform in developed market economies", including the separation between government and market-driven activities, financial transparence and tariffing. The Government has adopted a step-by-step approach, concentrating on reforms within the existing framework rather than breaking up China Railways (CR) itself. These reforms have included:

Separation of non-core activities (construction, manufacture, telecom, design, education and social activities) and reduction of working staff;

New industry participants through the establishment of new joint-venture railways owned by national and provincial governments and private investors[3];

Commercialisation by making managers of regional railways administrations accountable for returns on capital, output, profitability and safety;

Management restructuring through consolidation and introduction of responsibility and accountability at the regional level;

Flexibility in fares for passenger services and creation of freight specialist companies;

Introduction of traffic management information system and improvement of train operations through upgrading of routes and higher axle loads.

Mainline railways in China are now moving towards a new era, with the renewal of old lines and the construction of new express passenger lines. This development is geared at separating passenger services from freight ones and providing high-speed networks for passenger services (Chen, Ho, & Mao, 2010).

The situation started to change after 2003 with massive spending in railway infrastructure spending. Since 2004, the Chinese government has funded the upgrade of conventional railway lines and launched into the construction of tens of thousands of kilometers of high-speed passenger lines. After completion of the major rail lines in 2020, it is bound become the largest, fastest and most technologically advanced high-speed railway system in the world.

[3] The Government expanded this approach to finance new high-speed dedicated passenger lines that would free up freight capacity on existing lines. It is intended that all new investment will be made using this model.

Funding of the massive build-out comes from various sources, including a construction surcharge (80% on freight tariff), the China Development Bank, commercial Banks as well as international development banks (e.g., the Asian Development Bank and the World Bank). It is also important to note that, despite their importance[4], loans made by multi-lateral lending agencies only represent a small amount of the total sources of MOR for construction. That said on a given project (see

Table 4), the World Bank's commitment usually lies between 25-30% of the total project cost.

Table 2: Sources of MOR Capital Construction Investment Funds, 1990-2007 (CNY billions)

Period	**Total funding**	**Foreign loans**	**As a % of total funding**
1991-1995	108.1	3.6	3.33 %
1996-2000	211.1	6.5	3.08%
2001-2005	281.9	11.6	4.11%

Source: Adapted from World Bank (2009b).

Where does China stand on some of the key market issues in the railway sector?

China's railways have undergone massive structural reforms during the past two decades. Among the most prominent changes has been restructuring the tariff schedules to reflect full cost recovery and generate enough revenue to repay loans (ADB, 2007a). While the strategic goals for the national railway system have become more attuned to market needs (Luger, 2008) the government has taken a "very gradualist, risk-averse strategy for restructuring the railways in China" (Russell Pittman, 2011). Earlier restructuring proposal have been turned down by the State Council in 2002 – the planned structure after reform included a railway network company, five to seven passenger transport companies, three to five cargo transport companies as well as two to three specialty companies – and was replaced by much more limited reform steps focusing on the expansion of the system instead that on its restructuring (OECD, 2003; R. Pittman, 2004; Rong & Bouf, 2005).

As regards separation of regulatory and operating functions, the PRC has been considering the option of separating governmental regulatory functions from rail operations, with the possibility that MOR would back away from direct management of operations and remain at arm's length, transferring autonomy to the national railway. In 2005, MOR also examined the policy environment required to attract private investment in China's railway sector leading to the creation a several joint ventures at the provincial level (Amos & Bullock, 2006)[5].

[4] For instance between 1984 and 2002, loans from the World Bank for railway construction in China amounted to USD 2.345 billion.

[5] In April 2011 the Chinese government has renewed its intention to separate government from business functions in the next five years and to attract more investors in the railway sector.

Further to the infrastructure renewal and construction, the mainline railways in China also began to enhance its management and operations in 2005. So far, the reforms have not taken place to the same extent as those reforms in western countries. Instead, they are similar to the early stage of the western railways revitalisations (i.e., characterised by hardware upgrade and organisational restructuring). In addition there have been some attempts at open access over the years but these are more local experiments than a true opening to competition of service provision[6].

Most key strategy, policy and high-level planning decisions about China's rail infrastructure and operations have been made and continue to be made by MOR. The Ministry faces a twin-challenge: scaling up the capacity and quality of infrastructure to meet growing demand and reforming the industry to become more responsive to the market economy (World Bank, 2009b). In fact China finds itself in an (almost) unprecedented situation in which it has the needs and the means to create, or at least significantly develop, its railway sector. While large, its resources are not unlimited. Important choices have to be made, such as giving a preference to passenger or freight, maximising social utility or economic profitability.

In spite of the notable developments that occurred in the past decade, the overall level of railway service remains relatively poor. Except for the new high-speed lines connecting major urban centers (e.g., Beijing, Tianjin, Shanghai, etc.), connections are poor, local trains lose money and interfere with long distance passenger and freight trains. After careful deliberation and analysis of international experience, the PRC government has adopted strategic goals for the national railway system, aiming to make it more responsive to market needs. The railway is spinning off non-transport subsidiaries as independent companies, and in certain regions has initiated pilot operations where passenger services are set up as profit centers separate from freight. That said, overall system development has been given priority over structural change (World Bank, 2009b).

From network build-out to market creation

While connected, there is a difference between building the railway *infrastructure* (i.e. either constructing a new line or refurbishing an existing one) and creating a railway *market*[7]. A number of lessons can be derived from Europe's liberalisation of the railway sector in the attempt to create the single European railway *market*. First, it is a lengthy and cumbersome process. While the initial reform impulse goes back to the end of the 1980s, most European countries are still in the midst of the reform process. The two countries that pioneered reforms (Sweden and the United Kingdom) have experienced multiple set-backs and reversals "along the line". Second, the multiplication of actors and their changing roles creates new issues. For instance, the unbundling of train operations from track management brings more transparency to the system (e.g., cross-subsidies). At the same time, separation induces higher transaction costs[8]. Third, the introduction of competition (in particular "on the tracks") remains very challenging. While a healthy competition seems to be developing in the freight segment much

6 See for instance (Chen, et al., 2010).

7 The latter can of course not take place without the former but, as witnessed in most European countries, markets don't necessarily fall into place once tracks have been laid nor when substantial reforms have been conducted.

8 There is a growing literature looking at efficiency gains after unbundling but the evidence is not clear yet. See for instance (Growitsch & Wetzel, 2009; Rico Merkert, Smith, & Nash, 2010).

remains to be achieved in the passenger segment. Except in very few cases (e.g., in the United Kingdom) incumbent train operators are able to maintain a strong dominance on their respective/historical markets. The potential for discrimination remains extremely important to the point that most European countries had to introduce an independent railway regulator to establish a level playing field. In many countries this measure has not yet borne fruits and many regulators are struggling to achieve meaningful results when it comes to reigning in the dominance of the incumbent railway company. The different business models for the multiple types of services offered in the passenger segments (e.g., regional, long-distance, high-speed) require time to reach maturity. Last but not least, the question of profitability of the overall sector – infrastructure management and service provisioning – is under question. In summary, the creation of European railway markets seems to require much more than the sole introduction of competition[9].

After two decades of liberalisation in Europe a new paradigm is starting to emerge. It now focuses rather on the *management* of markets and of competition. This is not to say that institutional issues related to market creation have disappeared. Member-state heterogeneity, tensions between the European Commission and Member-states, as well as tensions between liberalisation and integration objectives all dictate on-going policy adjustments, influencing both the direction and the pace of liberalisation.

The Chinese railway market lags behind Europe when it comes to market creation. Unbundling has yet to take place (if it does) and the policy measures towards market creation remain few. For instance the current policy framework has not encouraged proactive determination of market pricing[10]. The inability of Chinese railways to raise or vary tariffs as easily as other modes can is a serious constraint to establishing meaningful passenger and freight marketing, to managing customer relations, to making its presence felt in logistics services, and to developing new products in a competitive transport environment. It prevents optimising internal surpluses for investment and inhibits raising private sector participation to higher levels through enhanced revenue streams (Parkash, 2008b).

Involvement of multi-lateral lenders in the Chinese railway sector

Both the World Bank and the Asian Development Bank have played an important role in developing the Chinese railway system over the past two decades through the financing of railway projects (see

Table 3and

Table 4). Generally speaking, the major objective of the World Bank's China Country Assistance Strategy since the 1980s was to alleviate infrastructure bottlenecks, providing financial resources and promoting sector reforms in China (Churchill & Thum, 2005).

[9] In fact, competition is too often looked at as end in itself whereas it should be considered as a means to achieve an objective.

[10] Only local railways can establish their own rates under NDRC guidelines and with approval from local governments.

Table 3: Railway projects financed by ADB (1989-2011)

Name of project	**Duration**	**Loan (USD million)**	**% of total cost**
Shanxi–Xiaoliu Railway	1989-?	39.7	n.a.
Yaogu–Maoming Railway	1991-?	67.5	n.a.
Guang–Mei–Shan Railway	1992-1997	200 [c]	27.30%
Hefei–Jiujiang Railway	1993.1997	110	29.10%
Jing–Jiu Railway Technical Enhancement	1994-1997	200	37.59%
Dazhou–Wanzhou Railway	1996	100	n.a.
Shenmu–Yanan Railway	1997	200	n.a.
Guizhou-Shuibai Railway [d]	1998-2004	140	36.75%
Hefei-Xi'an Railway	2000-2007	300	10.58%
Ganzhou-Longyan Railway	2001-2008	200	25.81%
Yichang-Wanzhou Railway	2003-2010	500	21.16%
Dali-Lijiang Railway [b]	2004-2010	180	32.85%
Zhengzhou–Xi'an Railway	2005-2012	400	9.68%
Taiyuan–Zhongwei Railway	2006-2012 [a]	300	7.99%
Chongqing-Lichuan Railway Development	2006-2014 [a]	150	4.88%
Multi-tranche financing facility	2009-2016 [a]	1000	30.88%
Lanzhou-Chongqing	2009-2016 [a]	300	3.48%

Source: Compiled by author from ADB website.
Note: [a] estimated; [b] AFD finances USD 40 miilion; [c] actual cost; [d] project assessed as successful.

In addition to the World Bank and to ADB, two other agencies have lent funds for the construction of the Chinese railway system: the Agence Française de Développement (AFD) and the Japan Bank for International Cooperation have (for an amount of JPY 577'826 miilion) between 1980 and 1997[11].

ADB's involvement in the Chinese railway sector

The Asian Development Bank (ADB) has provided 14 loans in the sector since 1989 covering 15 provinces for a total of about USD 3.0 billion. ADB's strategy for the railway sector has focused on helping: (i) expand the railway system by constructing new lines in un-served, less developed areas; (ii) modernise railways, enhance safety, and increase capacity to improve efficiency on key routes of the national railway system; (iii) commercialise railway operations to sustain efficient operations; (iv) promote energy conservation and environmental sustainability; and (v) increase railway competitiveness in the transport sector through restructuring and reform.

[11] AFD's involvement is limited to the electrification of a railway line.

Table 4: Railway projects financed by World Bank (1984-2011)

Name of project	**Duration**	**Loan (USD million)** [a]	**% of total project cost**	**Outcome**	
				Sustainability	**Institutional development**
Railway I	1984-1991	220	27.74%	Likely	Medium
Railway II	1985-1995	235	41.29%	Likely	Negative
Railway III	1986-1995	230 [b]	39.83%	Likely	Medium
Railway IV	1988-1998	200	33.33%	Likely	Substantial
Inner Mongolia Local Railway	1989-1996	150 [b]	42.87%	Likely	Substantial
Railway V	1992-1998	330	32.81%	Likely	Substantial
Railway VI	1993-1999	420	35.43%	Likely	Substantial
Railway VII	1995-2002	400	22.89%	Likely	Substantial
National Railway	2002-2008	160	12.29%	Likely	Substantial
Shijiazhuang-Zhengzhou Railway	2008-	300	4.62%	n.a.	n.a.
Nanning-Guangzhou Railway [c]	2009-	300	5.01%	n.a.	n.a.
Guiyang-Guangzhou Railway	2009-	300	2.39%	n.a.	n.a.
Harbin-Jiamusi Railway[12]	2010-	300	4.24%	n.a.	n.a.

Source: Compiled by author from World Bank website.
Notes: [a] Appraisal costs and not actual costs of projects; [b] Includes IBRD and IDA; [c] This project, and the previous two Bank-financed projects, the ShiZheng Railway project and the GuiGuang Railway project, differ from previous Bank-financed railway projects in China in that a project company will be formed and MOR will transfer the assets created by the project to the project company.

[12] With this 14th loan to MOR, the Bank will have lent USD 3.65 billion in support of China Railway development over the last twenty years. While ADB provided seven loans for railways during the 1995-2002, the World Bank support for railways was rather dormant. After providing eight railway loans from 1984 to 1995, a period of 6.5 years passed with no new railway lending (ADB, 2007c).

ADB has developed a number of key initiatives for managing railway development including setting up effective institutional structures (e.g., establishment of steering groups at different administrative levels) consulting and involving stakeholders and local government agencies (e.g., through railway construction support offices), and developing an effective project performance management system that closely monitors indicators (in relation to project goals, purposes, outputs, and conditions). They include: i) economic development and socioeconomic indicators, (ii) costs and times for passenger and freight services, (iii) services offered and charges, (iv) accident rates, (v) financial sustainability, (vi) county and village incomes, (vii) access to social services, and (viii) jobs created in construction and maintenance (Parkash, 2008a). ADB conducts an annual review of all railway projects, covering any institutional, administrative, organisational, technical, environmental, social, poverty reduction, resettlement, economic, financial, and other aspects that may impact on the performance of the projects and their continuing viability.

Table 5: Project monitoring

Performance indicators for the NanGuang Railway Project
Average number of pairs of express passenger trains of a maximum speed of 200 km/h operated per day between Sanyanqiao and Litang West; Average number of pairs of freight trains operated per day between Sanyanqiao and Guigang; Average travel time of express passenger trains having a maximum speed of 200 km/h between Sanyanqiao and Litang West

Source: ADB website

In addition to providing loans to build lines, ADB has provided technical assistance since 1989 on subjects such as institutional strengthening, strengthening of business and commercial practices, policy support, passenger and freight policy reform, efficiency and emergency management (ADB, 2007b). The technical assistance that accompanies the larger loans often mentions the necessity to increase the market orientation of MOR.

World Bank's involvement in the Chinese railway sector

Over the past 20 years, the World Bank has lent USD 3.65 billion in support of China Railway development. The World Bank's first railway project with China was completed in 1990. In 2004, while preparing the Second National Railway Project, the Bank, MOR, and the national Development and Reform Commission (NDRC) launched a dual-track approach that reflected the differing responsibilities of NDRC and MOR and the different modes of engagement necessary. Support for sector-wide reform was separated from project development and lending.

Table 6: Evolution of World Bank's involvement in China's railway sector (1983-2005)

Phase	**Description**
Initiation (1983-1988)	Reintegration of China into the global economy with focus on removing bottlenecks and on institutional development
Transition (1991-93)	Consolidation of earlier assistance with emphasis on exposition to new technology and efficiency
Heavy lending & intensified dialogue (1994-1998)	Strong emphasis on project lending commitments

Portfolio constraints, shift to the West and continued Dialogue (1999-2002)	Policy dialogue in railways is starting with the reform decisions of the Central Government in 1999

Source: Adapted from Churchill & Thurn (2005).

How are the two multi-lateral lending agencies involved in market creation?

It appears that while a lot of the work conducted by the World Bank and the ADB explicitly integrates multi-performance objectives in the project appraisal phase, it is not all that clear how much the actual provision of services (i.e., running trains on the tracks once the line has been built) incorporates performance objectives.

Both agencies have described at length the issues faced by the Chinese railway sector when it comes to moving towards more of a market orientation (ADB, 2003; Parkash, 2007, 2008b; World Bank, 2009b). In fact, according to the ADB (2007a, p. 9), "Four special project features were pursued by all ADB railways projects. These were (i) use of full cost tariffs on project railways, (ii) support for commercial practices in railway companies, (iii) new technology to improve efficiency, and (iv) development of link roads and stations to extend the impacts of railways."

Both agencies are involved in the creation of a railway market in China in a number of indirect ways. For instance during the 1997-2005 period the ADB has included covenants requiring full-cost tariffs for the project lines (ADB, 2007d, p. 15). In addition ADB considers that it has played "a useful confidence-building role in supporting the concept of separate corridors" for passenger and freight traffic as well as "encouraged private investors" to take part in railway projects. At the same time it notes that the Chinese railway sector is "insular and most comfortable carrying traditional traffic streams such as low cost bulk goods and long distance passengers. The organisation is production driven and not customer centric and business oriented" (ADB, 2008, p. 3).

ADB has assessed its involvement in the Chinese railway sector along the twin criteria of outcome (in terms of effectiveness, efficiency and sustainability) and impact (in terms of economic development, poverty reduction, social and environmental impact, regional cooperation, anti-corruption and financial performance). In addition ADB has been conducting bottom-up assessments of its performance.

Table 7: Value-added by ADB projects compared with domestically financed projects (railway)

	Value added		
ADB project feature	**At time of feature introduction**	**By end of study period**	**Comment**
Finance mobilisation	Significant	Moderate	Value added for local railways, not national railways
Full cost tariff	Moderate	-	This requirement initially useful, now widely adopted
Commercialisation	Moderate	-	Some initial value, now widespread
New technology for rail operations	Significant	Moderate	Some ADB contribution but could add more value

Rail safety	Moderate	-	ADB initially helped MOR to access the latest technology
Private sector participation	Moderate	Moderate	Introduced recently, full potential still to be realised
Separate passenger corridors	-	Moderate	ADB has encouraged this useful initiative of MOR

Source: Adapted from (ADB, 2007d)

Table 8: Bottom-up assessment of ADB performance in the Chinese railway sector

Relevance (scale 0-3)	**Effectiveness (scale 0-6)**	**Efficiency (scale 0-3)**	**Sustainability (scale 0-6)**	**Impact (scale 0-6)**	**Overall**	**Rating description**
2.6	4.0	1.8	4.0	4.0	16.4	Successful

Source: ADB (2007d)

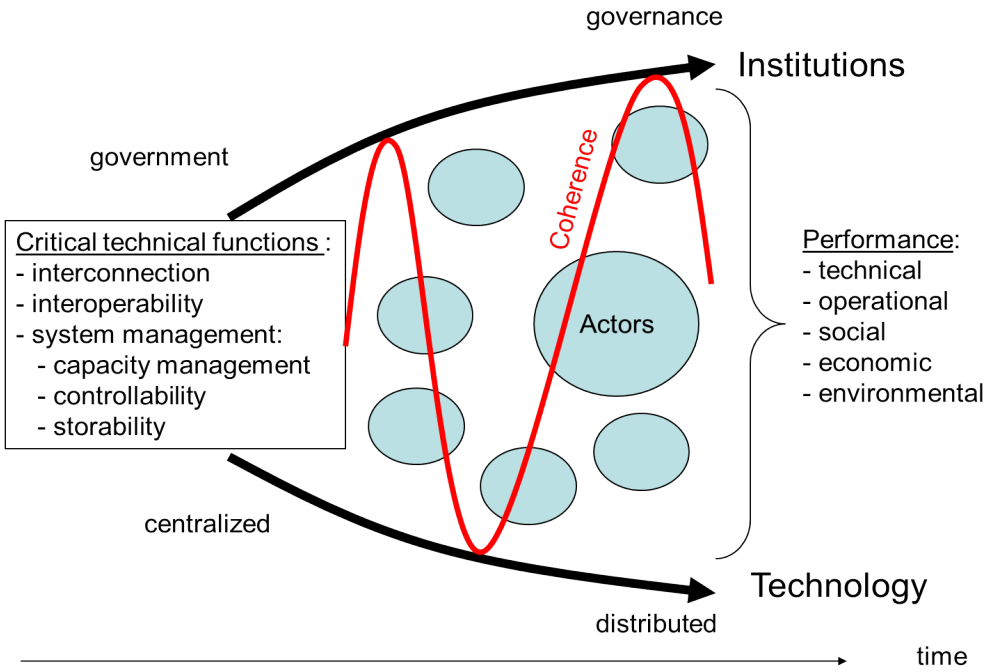
Theoretical framework on co-evolution of technologies and institutions[13]

The coherence framework aims to link the degree of coherence between institutions and technologies and the performance of a network industry infrastructure. It contains a way to compare and match institutions to technologies (Groenewegen, 2005; Künneke & Finger, 2007; Künneke, Groenewegen, & Ménard, 2008; Kunneke, 2008). The framework is usually applied in network industries where institutions and technologies heavily condition performance.

The framework postulates that (co-)evolution is related to the development of markets, as the emergence/creation of markets constitutes the very purpose of liberalisation: more concretely, as technologies evolve from centralised to de-centralised technologies and institutions evolve from government to governance, the size/value of the market increases, market opportunities open up, the logic of the market (as opposed to the logic of government) expands, and, in principle, more market actors emerge. According to this framework, markets in the infrastructures are basically constrained between the state of technology at any given time and the institutional conditions at any given time. In other words, markets in infrastructures are bounded both by technology and institutions, yet nevertheless continue to grow. A number of configurations can describe this evolution (Crettenand, et al., 2010).

Figure 1: Technology-institutions coherence framework (2010)

[13] This section draws on (Crettenand, Laperrouza, Finger, & Duthaler, 2010) and (Finger, Crettenand, Duthaler, Künneke, & Laperrouza, 2010).



Source: (Finger, Crettenand, Laperrouza, & Künneke, 2010)

The first configuration is the traditional *public monopoly*, whereby a given infrastructure is owned by the State and managed either by a public administration or a public enterprise; this stage characterises the infrastructures before liberalisation, i.e. before the creation of the market[14]. In the second configuration the liberalised (i.e., unbundled infrastructure) service providers are competing on top of a monopolistic infrastructure (network); governance at this stage is ensured by way of independent regulatory authorities. In a third stage infrastructures become much more fragmented and decentralised, characterised by the competition of loosely coupled networks[15]. The framework postulates that these configurations – and the coherence between institutions and technology – impact the performance of the network industry.

Performance of network industries and market creation

One important element of the reform process of the railway sector has been the drive to increase its efficiency[16]. A large strand of literature has looked at railway performance including some testing influence of exogenous factors like regulatory policies (Cantos & Maudos, 2001; Caves & Christensen, 1980), public policies (Oum & Yu, 1994), administrative autonomy (Gathon & Pestieau, 1995) and technical efficiency (Cowie, 1999). For instance, after measuring railway performance with adjustment of environmental effects, data noise and slacks Lan and Lin (2005) conclude that important policy implications and amelioration strategies for operating railways derive from

[14] There can be certain variation of this configuration, namely when the infrastructures are owned by the public authorities, yet managed by private operators in so-called public-private partnerships (PPPs)

[15] This configuration currently characterizes the telecommunication infrastructures, as well as the postal services and the airlines in mature markets (but not the railway sector).

[16] Measuring efficiency/performance in the railway sector is made more complex since the firms operate without private producers, either because of the particular market structure or because of non-commercial objectives which are assigned to them (Perelman & Pestieau, 1988).

broadening the scope. That said, there is no consensus on performance of network industries (Karlsson, 2007, p. 2). This is partly due to unresolved problems in how to define and measure it in network industries. According to Karlsson et al. (2007, p. 2) *"an analysis of sector efficiency that considers the hierarchical characteristic of many systems, specifically the efficiency effects that a subsystem imposes overall, has not been adequately addressed."* Each network industry has its specific technical features which need to be taken into account, but there are similarities across the network industries as well.
Rodriguez et al. (2007) identify a number of performance measures, including commercial efficiency, technical efficiency, financial performance, capital expenditures and cost of capital. In many cases, the government and regulator seem to address all these objectives at the same time with no particular priority. This is not particularly surprising since different stakeholders, private and public, with different scope of action (e.g. competition authority or national safety authority) are in charge of a given task which influences performance.

As noted, Finger, Groenewegen & Künneke (2005) have postulated that the performance of the network industries is related to the *degree* of coherence between institutions and technology[17]. With the liberalisation of network industries (and ensuing creation of markets) considerations about performance have changed. Performance does not matter solely from a macroeconomic perspective: with the appearance of multiple actors (often private) performance has become a concern at the firm-level as well (Table 9 lists the performance indicators for the British infrastructure manager).

Table 9: Network Rail's performance criteria

Indicator	**Criteria**
Network availability	Possession disruption index Freight disruption index
Train performance	Public performance measure (total, long-distance, regional) Cancellations and significant lateness (total, long-distance, regional) Delay minutes (passenger, freight)
Infrastructure	Number of asset failures
Customer satisfaction	Level of satisfaction
Finance	Network Rail (IM) efficiency index Expenditure (operations, maintenance, renewals, enhancements)

Source: Office of Railway Regulation (ORR)

In the initial framework (Finger, et al., 2005) performance is defined by way of three parameters: the economic performance, the public value and the integrity of the technical system. The economic performance concerns the static, dynamic and system efficiency. The public value is defined by the quality, accessibility, affordability and reliability of the service, as well as the environmental aspects. Performance criteria of the technical system integrity include resilience and robustness.

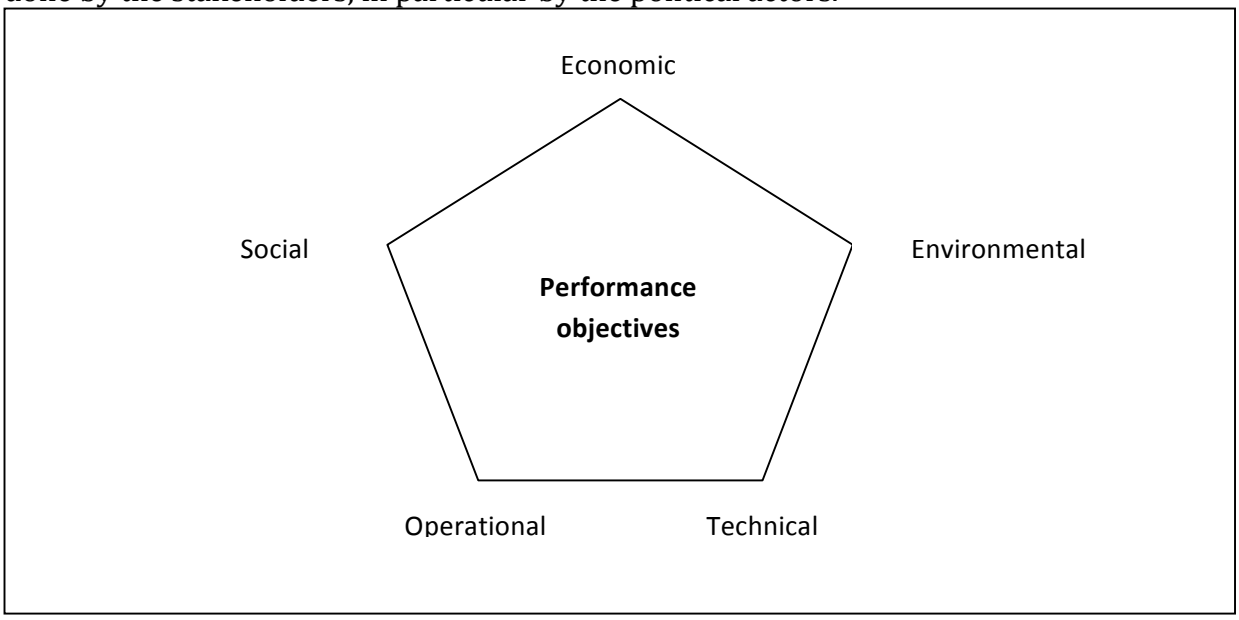
[17] Their claim stemmed from the observation that liberalization (as an institutional change) has introduced a certain incoherence between the new liberalized institutions on the one hand and the current state of the technology on the other hand.

A simple governance mechanism

A number of authors have proposed typologies for the governance in network industries (Finger & Varone, 2006; Thatcher & Coen, 2008). Stern and Holder (1999) make a clear distinction between the objectives of infrastructure regulation (i.e. its purposes and functions) and the specific institutional framework for regulation in any given country. Merkert (2007) notes that it may be efficient to have different governance structures for different rail tasks as well as for different types of train operation and infrastructure provision.

The focus of many studies on a single category of performance fails to achieve comparative evaluation along several dimensions (Ménard & Ghertman, 2009, p. 170). Because the above mentioned institutional changes involve economic, social and environmental dimension, and because it is possible that there are trade-offs between these different dimension, studies need to use multiple categories. As noted by Steenhuisen & van Eeten (2008) "realising multiple public values in a large scale technological system (such as railways) requires a myriad of trade-offs because realising one value can directly affect, postpone or thwart the realisation of other values". Governance should address questions of ownership, organisational form, methods of regulator or market design but also take into consideration the technical aspect of railways[18]. At the same time, it is important to recognise that no framework will be able to fully satisfy the governance needs of an evolving sector. It is also important to keep in mind that incremental policies at the national level may be more effective than grand designs.

Based on Finger et al. (2005), five performance categories are defined as represented in the following figure. The initial economic and technical performances are kept, the public value is divided in social and environmental performance, and the operational dimension is added. The categories have to be so large that they can be declined in every sector. Ultimately, the choice and weight of each category is a choice done by the stakeholders, in particular by the political actors.



Source: (Laperrouza & Finger, 2009)

[18] Bauer & Schneider (2008) make a distinction between the social and the technical subsystem and include 4 layers of design issues: embeddedness, institutional environment, governance and resource allocation.

Examples of indicators per category are: 1) economic (e.g., subsidies per pass-km in railways or production costs), 2) social (e.g., consumer satisfaction, accessibility, affordability, quality of service), 3) operational (e.g., reliability and use of the network, congestion), 4) technical (e.g., availability), 5) environmental (e.g., GHG emissions per pass-km, noise).

Improving performance will be the combined result of technological and institutional evolution. This is both a push and a pull relationship. It is "pull" because some of the performance indicators cannot be set by the market, because they are either externalities (e.g., environmental and social performance), or because the market is not fully functioning (yet). Where the market is functioning, there may be push factors such as in the case of price, service quality, innovation, i.e., static and to a lesser extent dynamic efficiency.

One of the two dimensions of the governance of the dynamics thus must consist of promoting market based solutions to infrastructure provision wherever possible. This means that the different configurations (where a certain coherence exists between technology and institutions) should evolve to include ever more market-based or network-based modes of governance of the three critical technical functions, rather than hierarchy-based ones. And where a hierarchy mode of governance prevails, static or cost-based regulations should be replaced by dynamic or incentive-based regulations. Similarly, the technological evolution in the areas of the five critical technical functions should be such that market-based modes of governance become viable. Such technological evolution can again be incentivised by appropriate regulations (e.g., incentives for technological innovation). If this is not the case, i.e., if an incoherence between technology and institutions is introduced in the co-evolution between technology and institutions the performance of the infrastructure systems will suffer (Crettenand, et al., 2010).

Conclusion

Not only do freer markets require more rules (Vogel, 1996) but finding an equilibrium between competitive and non-competitive elements often requires a delicate act of political, financial and organisational balancing – in most network industries at least one element of the value chain still retains its natural monopoly characteristic. Financing and managing this element – along with ensuring the functioning of the entire infrastructure system – often causes severe headaches for governments.[19]

When the European Commission started the process of liberalisation its goal was the *creation* of markets. In many network industries, including the railway sector there were often no market to speak about at all. The entire value chain was monopolistic and in many countries the firms providing the services were owned and operated by the respective nation-states. Contrary to expectations, the creation of markets caused additional institutional problems (e.g., interplay between competition law vs. sector-specific regulation, non-discriminatory market access). In other words whereas the market solved efficiency and productivity issues in certain segments (e.g., those open to competition) the entire system became much more complex to manage. It is interesting to note the shift from the belief that the creation of markets would solve most problems in the railway sector. Policy-makers have rapidly realised that the creation of markets

[19] For instance in railways the infrastructure can't be profitable unless the full costs are passed onto the train operators. If that were the case, passengers or shippers would put more cars and trucks on the roads.

does not solve all issues and, in certain cases, that they have to co-exist with the layer of public policy they were supposed to replace. Two decades of experience in liberalising the European railway sector have shown that markets far from solve all the 'wicked' public policy issues. They actually create additional issues, such as question of non-discriminatory access, competition and regulatory policy, etc[20]. As summarised in the ADB's report (Duncan, 2007) "the introduction of competition is fraught with grievous risks".

Many of the issues faced by policy-makers, including corporatisation, financing, tariffing, competition or public service tend to be treated in a piecemeal manner and with little interconnection. The sequential approach to reforming railways leads to focusing on one aspect rather than considering the railway system globally. This paper advocated that the creation of markets in the railway sector should include a discussion on the performance that is sought from the system. In fact the framework for reforming the Chinese railway sector need to be informed by a decision on performance objectives – instead of being the result of a given institutional set-up should rather be at the base of the institutional setting. The creation of a market in the Chinese railway sector also needs to take into considerations the particular characteristics of railways, including the aspect of natural monopoly for the infrastructure portion. Interestingly enough, most Chinese railway infrastructure projects funded by multi-lateral donor agencies include a broader notion than "simply" economic performance, including environmental and social factors. It seems however that there is a "gap" between the "building" of a railway network and the "operations".

As with many reforms undertaken in China since the 1980s delivering on the "hardware" part – in this case the network construction – has been relatively easy. The "software" part – developing an institutional framework that accommodates a market – tends to be much more difficult. This task is made even more complex since few other countries have succeeded in creating sustainable railway markets. In fact if there is one lesson to learn from the liberalisation of European railway markets it is that there is no one-size-fits-all model of market creation. Most countries are experimenting with market creation and making changes "as they go".

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[20] The latest European white paper on transport (European Commission, 2011) mentions that "the area where bottlenecks are still most evident is the internal market for rail services, which must be completed as a priority in order to achieve a Single European Railway Area. This includes the abolishment of technical, administrative and legal obstacles which still impede entry to national railway markets."

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