

Epilogue...

Economics of Infrastructures: The Ultimate Challenge?

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CHALLENGE

William H. Melody is the founder of the Economics of Infrastructures Programme of the Delft University of Technology, established in September 1997. He saw the Economics of Infrastructures as a new academic discipline that is distinct from traditional Public Utility Economics. His long and rich experience in this field, both as an academic and as a practitioner, is reflected in his innovative approach. Not surprisingly, many of the aspects of Melody's life work celebrated in this *festschrift* are evident in the design of the programme at Delft. The distinctive features of Melody's approach to the Economics of Infrastructures are:

- His generic approach to infrastructures. Traditionally infrastructures have been approached as distinct industrial sectors with fundamentally different technological and economic characteristics. Conversely, Melody puts emphasis on the commonalities with respect to regulatory regimes, network economics, industrial structures, consumer needs, national interests and public service obligations.
- His wish to contribute to solving real-world problems. The liberalisation processes of various infrastructures poses a broad range of policy challenges, including long-term dynamic efficiency, sustainable competitive market structures, the position of residential customers, and economic equity in a globalising economy.
- His wish to look beyond the traditional technologically determined infrastructures exemplified by physical networks of wires, pipelines, roads, waterways and others. In his view, information based networks with distinctive economic features constitute the infrastructures of the 21st century. Virtual networks replace physical networks.
- His aversion to traditional neoclassical economics. As Trebing, his academic mentor, remarks in this collection: 'Throughout his work he never hesitated to

examine the shortcomings and abuses inherent in the application of neo-classical economics to the problems facing society'. Instead, Melody relies on Institutional Economics, which is much closer to the complexity of real world problems.

- His strong belief in interdisciplinary approaches. Economic allocation processes in infrastructures are influenced by technological design, regulation and market-related processes. Hence, understanding the economics of infrastructures requires an interdisciplinary approach that includes technology, law, policy and economics. The qualifications of the staff of the Economics of Infrastructures Section are reflective of this approach: they have backgrounds in physics, law, political science, and of course, economics.
- His inclination to contribute to the diffusion of knowledge, beyond his students in Delft. In this vein, he has developed courses for telecom regulators, with a specific focus on the problems and needs of developing countries; served as editor of the well-known journal *Telecommunications Policy*; and established LIRNE.NET an Internet based initiative to enable and stimulate the exchange of knowledge of the regulation of liberalised infrastructure industries.

Melody also established a tradition of annual international conferences on aspects of economics of infrastructures at Delft. Their themes, summarised in the remainder of this contribution, reflect the major research interests of the Economics of Infrastructure Programme.

INFRASTRUCTURES OF THE 21ST CENTURY

The ongoing process of world-wide infrastructure reform is the result of complex interrelations between changing technologies, market structures and institutional arrangements. In addition to the contributions of the individual elements, interrelations among them create innovative functions and even new infrastructures, enhancing socio-economic performance and creating new regulatory requirements.

Advances in information and communication technologies (ICTs) are an important driver of technological change in infrastructure industries. Traditional infrastructures such as transportation and energy now rely heavily on ICTs, among other reasons to improve system performances, enable individual pricing, allow for service based costing, and introduce new services such as road pricing and virtual utilities. Virtual utilities are small-scale power producers that combine their facilities using ICTs, enabling a more significant market position. The ICT infrastructure itself, which

includes telephony and Internet, has proven to be very innovative in terms of new technologies (for example, wireless technologies) and customer services. But even beyond that, it has engendered an entirely new infrastructure: the information infrastructure. Information, or 'anything that can be digitised – encoded as a stream of bits' (Varian and Shapiro 1998: 3), is distributed through ICT infrastructures, and it is processed into knowledge by formal and informal institutions such as universities, research and development departments of firms or informal networks of researchers. Hence information infrastructures consist of technological and institutional networks that generate knowledge-based products and services that often have public-goods characteristics. For this reason regulation of these new infrastructures is desirable.

Rapidly changing market structures are another source of infrastructure reform. Adjacent to network-based regulated activities, there exist a wide range of commercial activities subject to market provision. Traditional infrastructure products such as electricity, gas, telecom and rail transport are supplemented or improved by newly developed services that contribute to a higher customer satisfaction. Vertically integrated infrastructure firms are forced to unbundle, and are looking for new synergies. Possible new business strategies include horizontal integration with comparable activities in other infrastructures (the multi-utility approach), or globalisation. But there are also opportunities for newcomers with technical expertise (for example, maintenance, metering, billing) or leveraging an existing customer base (for example, petrol stations selling electricity). The new market structures and customers' needs yield different technical and regulatory requirements for future infrastructures.

TELEMATICS AND THE ECONOMY OF INFORMATION SOCIETIES

The key ambition is to understand the characteristics of the evolving new telematics-based networked economy and to assess implications for policy and strategy. These implications become visible in emerging flexible networked organisations, their linkages with electronic marketplaces, and in the new 'rules of the game' for competition and collaboration arising within chains of supply and demand. One starting point is the evolving new electronic marketplace, new trading relations and their implications. In the new economy the limits of markets are extended and the structure of markets and the conduct of trade are changing. The development of telematics networks has many economic aspects, such as viability and critical mass, market and industry structure, market attractiveness, and the potential for radical innovation in services and production. These and other influences will strongly affect firm strategies and government policies concerning investment in infrastructure, R&D priorities, innovation in new products and services, organisational choice and the quality of life.

CONVERGENCE

The sharp delineation between infrastructures was often thought of as a ‘natural’ consequence of the highly specific network structures in these sectors. Electricity cables could be used for one purpose alone, that is, the transmission of electrical energy. Correspondingly, electric or telecom wires, water and gas pipes, or railroad tracks determined the services the operators of these networks were able to offer. Technology seemed to be the decisive factor characterising these sectors. The economics of these infrastructures had common characteristics in that they were associated with various kinds of market failures, for instance, natural monopoly and positive externalities. Consequently, there was no room for competition or rivalry. For this reason distinctive institutional structures were established for each of these infrastructures. Institutions supported distinct technologies; the technologies justified distinct institutions.

The liberalisation of infrastructures has made the demarcations appear less rigid than commonly assumed. As one of its constituting features, liberalisation separates the operation of facility networks from other activities such as the provision of services. Generally the facility networks remain regulated monopolies whereas other activities in the value chain may develop into competitive markets. This offers new business opportunities. Although the technology remains more or less the same, railroad companies can become telecom operators, water companies can sell electricity, energy firms can not only combine gas and electricity, but also engage in activities such as insurance or banking services. Unexpected new suppliers such as environmental organisations, supermarkets, petrol stations or even churches may emerge. This blurring of the boundaries of different infrastructure services is referred to as ‘convergence of infrastructures’. There are three specific fields of interest under this rubric:

- *The nature of convergence:* In addition to physical networks, there are newly developing virtual network economies, both on the demand and supply side. Therefore, it is expected that convergence will be part of a fundamental turning point in the technical and institutional development of infrastructure industries.
- *New business approaches:* Based on synergies attributed to convergence, new business approaches are being developed. Traditional infrastructure industries are disintegrating, but, at the same time, new opportunities for reintegration are emerging beyond the traditional business. For example, grocery stores, environmental organisations and trade unions are offering utility services, whereas traditional infrastructure firms are engaging in new activities such as credit cards, insurance, or shoe sales.

- *Regulatory challenges:* Government policies and regulation have to adapt to the changing conditions. Is there still a need for sector specific regulation or should there be regulatory convergence? What are the consequences for the effectiveness of regulation or for the scope of competition policy?

BEYOND THE MARKET

By definition, infrastructure industries are important for the economy, polity and society. They are generally understood to be network industries, characterised by high capital cost facilities with long life spans, the existence of some bottleneck features and network externalities. These characteristics have been used historically to justify the need for public planning. However, the traditional public or private monopoly model for provision of infrastructure services has failed to yield sufficiently wide penetration or adequate service quality in many parts of the world. Even in countries such as The Netherlands where high penetration and good reliability were achieved, the sector is thought to have fallen short on innovation. During the current period of transition from monopoly to liberalisation, public planning has become the neglected factor. The recent crises of infrastructure – accidents in the railroad system in the United Kingdom and electricity shortages in California – constitute evidence that not all in the old order needs to be abandoned. In particular, there may be justification for focused public planning that does not distort market forces, but instead complements them.

The function of public planning is twofold in the new market-centric environment. On the one hand, it concerns the design of markets and, on the other, the design of safeguards for special cases of market failure that cannot be addressed by the basic design of markets. The latter is the more controversial aspect of public planning. The public interest is often associated with objectives such as universal service, reliability, safety and fair pricing. In this respect, two fundamental questions need to be considered: 1) *To what degree is regulatory involvement required to guarantee the supply of these services?* For example, fair pricing might be the result of competition, and reliability can be understood to be a precondition for competitiveness in a well functioning market. 2) *Does liberalisation necessarily engender a need for redefinition of the public interest?* In the electricity sector, for example, the provision of reactive energy has been only very recently discovered to be an important service that large-scale production facilities used to provide without much attention. However, in largely decentralised systems, reactive energy is more difficult and costly to realise. There is also some discussion as to whether the availability of sufficient network capacity can be achieved by market processes alone. There also may be further tensions between the public interest as nationally defined and as seen from European Union or global perspectives.

What are the appropriate mechanisms to address the public interest in infrastructure industries? To what degree will public planning be both appropriate and necessary for the 21st century and what will the appropriate policy instruments look like? There is a broad spectrum of possibilities ranging from government provision of infrastructure services to loose government supervision of private sector activities. Although these policies are not new, they must be readapted to the changing regulatory and market regimes of liberalised infrastructure sectors. Ideally, the policy instruments will support competition without providing opportunities for private investors to shift risks to the public sector. A final complicating factor is that public planning has shown a tendency to preserve the economic and technical status quo. Allowing for dynamic efficiency requires a flexible system capable of generating new solutions for old planning problems. In this vein, we might optimistically anticipate the obsolescence of the need for public planning as new infrastructure concepts are developed and deployed.

REGULATION AND INNOVATION

Liberalisation affects the economic, organisational and technical performance of network industries. Changes in the institutional set-up of infrastructure markets modify economic incentives with respect to the design and management of infrastructures. Changes in economic parameters have repercussions for the choice of the hardware and the technical organisation of complex systems. Network components have to serve new or different purposes and it may be necessary to develop new network concepts. New and incumbent firms spend large amounts of money to demonstrate that they have become sensitive to customers' preferences and, thus, seek to enhance the quality of their services and the choice available to their customers.

Under these changing conditions, the safeguarding of the technical integrity, the public interest, and the coordination and planning of the long-term transition of existing infrastructures to systems that adequately meet future demand poses new challenges. The ambitions for sustainable development are another area of attention. In some cases, the consequences of these shifts are evaluated positively. Yet, elsewhere, the results of real world deregulation are giving rise to doubts about the chosen means and ends.

There is insufficient understanding of these processes of change. There is a need to reassess the role and functions of regulation to shape markets in liberalised infrastructures in order to improve the socio-economic performance of these industries. Regulation must contribute to technical and institutional innovation in these vital sectors. Three aspects require attention:

- *Networks and Imperfect Markets*: Networks generally give rise to various kinds of market failures and market imperfections that demand regulatory intervention or coordination of activities. What are the consequences of liberalisation for the technical functioning of infrastructures and innovation in governance and technology? How do they influence their performance?
- *Networks and Externalities*: Network based infrastructures are of fundamental importance to facilitate activity in the future society. The questions here include issues such as the economic, social and technological requirements for next generation infrastructures; the needs of an information economy; the requirements for sustainable development; the need to develop adequate performance indicators, and the consequences of ongoing globalisation for infrastructure design.
- *The Limits of Regulation*: What are the prospects for a different scope of regulation, including sector specific regulation, general infrastructure regulation for converged utilities, or even competition policy alone that is based on commodified infrastructure goods and services? How do these regulatory approaches relate to the performance of sectors?

The applicability of various regulatory paradigms must be assessed in order to provide policy makers, regulators and the regulated industries with sets of lenses to *identify* and *select* the technical, organisational, economic and regulatory elements of the supply system that are relevant to their operation. This includes performance indicators such as quality, security, convenience, standards for market behaviour, routines for solving problems and the selection of technologies, procedures and rules for training people and advertising campaigns, etc. In contrast to the limited neoclassical paradigm of regulation, these approaches open up new possibilities for management and policy intervention, and for the interpretation and influencing of the behaviour of firms and customers in a regulated network sector.

CONCLUSION

From my vantage point as his close associate, it appears that the establishment of the programme at Delft was Melody's ultimate challenge to contribute to the basic needs of society through well functioning infrastructures. Under his leadership, the Economics of Infrastructures became a solid and essential element of the research and teaching programme of the Faculty of Technology, Policy and Management of the Delft University of Technology. But his scope of knowledge diffusion was much broader than the university itself. His many international publications were

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not the sole vehicle. His genuine concern for the problems of developing, as well as industrialised, countries in reforming their infrastructure industries caused him to engage in extensive travel to make presentations at numerous conferences, workshops, seminars and training programmes. Even in his post-Delft period, it is certain that he will continue to pursue his research and teaching objectives with great success.