Multimodal Infrastructure Investment Decision Making: An Institutional and Funding Perspective

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This paper presents a case analysis of multimodalism in transportation investment decision making as it relates to other policy decisions, including infrastructure ownership structures, geographic scales, and revenue sources. This allows a more complete understanding of multimodalism's benefits, drawbacks, and opportunities. Private infrastructure developers are more likely to evaluate and select investments in a multimodal fashion than either the public sector or public-private partnerships. Decentralized, municipal decision making tends to reduce barriers to multimodalism, although with reduced capacity for large-scale project implementation. Experience suggests that the source of transportation revenues is a less important influence on multimodalism than the organizations collecting them.

INTRODUCTION

In transportation, *multimodalism* refers to a variety of concepts, ranging from the strategic to the operational. Meyer and Miller (2001) define multimodal planning as "the process of defining problems, identifying alternatives, evaluating potential solutions and selecting preferred actions that meet community goals in a manner that includes all feasible transportation modes." The alternate approach, unimodalism, involves budget-setting, analysis, and project selection for highways, mass transit, railroads, and other transportation investments in isolation from one another. On an operational level, multimodalism refers to journeys in which passenger or freight use multiple modes of transport under a single fare or contract (i.e., intermodal). This paper focuses on the strategic level, investigating the prospects for and consequences of multimodalism in transportation infrastructure investment analysis and decision making. In this context, multimodalism can be defined as the integrated evaluation and selection of projects and programs, funded from a single budget, with competition across modes for resources.

A multimodal approach to investment decisions is of ongoing interest in the transportation community. Broadly speaking, the potential benefits include more effective, efficient investments characterized by a reduction in the level of public resources necessary for transportation infrastructure while maintaining or improving the level of service of the transportation system as a whole. Still, multimodalism faces a number of institutional barriers: implementation in practice is sparse, attributable to the inertia of legacy decision-making processes, reluctance to compete across modes for resources, and lack of effective tools for conducting multimodal evaluations. As a result, in many places, modally-oriented agencies continue to receive independent budgets and conduct project evaluations to decide investments for only their mode.

The purpose of this paper is to examine the current status of and prospects for multimodalism in infrastructure investment decision making, using Portugal as the case context. Although the conclusions are tempered in recognition of the limited applicability of a single case, Portugal nonetheless offers a range of experiences (and experiments) that inform the analysis. Specifically, multimodalism is considered in combination with three other dimensions of the framework within which transportation infrastructure investment strategies are developed: ownership structures, geographic scales, and revenue sources.

This paper begins with a review of the literature and current multimodal practices. Next, a multidimensional strategy development framework is presented, within which multimodalism can be considered, along with a summary of the state-of-the practice of transportation infrastructure

investment decision making in Portugal. Next, the relationships between multimodalism and three other dimensions of the strategy development framework are analyzed. Finally, based on this multidimensional analysis, a more complete assessment is presented of the benefits of, barriers to, and prospects for increasing multimodalism.

LITERATURE REVIEW

Literature to date presents both the benefits of and barriers to multimodalism in transportation infrastructure investment decision-making processes. Transportation planners have conjectured that there are benefits to integration not just across modes but also across sectors in the development of investment strategies. For example, Hatzopoulou and Miller (2008) identify multi-sectoral policies whose "impacts extend beyond the transport sector itself to other sectors such as environment, health, and education" as a "common denominator" among sustainable transportation plans at the metropolitan and regional scales. By identifying a broader range of policy objectives outside of transportation that are related to transportation investments, decisions will not only be more efficient, but they will also more closely reflect the collective preferences of the population of infrastructure customers. Kanafani (2008) succinctly summarizes the key potential cost of unimodalism—"many actors are each optimizing their own objectives with no one looking after the whole system"—implying that multimodalism is equivalent to system-wide optimization of resource allocation.

However, integration of modes (and sectors) for investment decision making is not without its costs. Stough and Rietveld (1997) argue that the theoretical benefits of greater integration are counteracted by the reality that broader participation also brings more conflict to the decision-making process, in turn slowing the process and increasing its costs. Many contemporary transportation institutions reflect the rigid, centralized character of organizations following the "Fordist" model of industrial growth characterized by specialization and standardization of internal processes and mass production. Consequently, institutions are averse to change and competition. In response, Stough and Rietveld (1997) advocate a research agenda that focuses on improving the decision tools that reduce the costs of integration.

Another consequence of integration is greater competition. If multiple, previously un-integrated unimodal transportation organizations and other government agencies are asked to compete for funds from a single source, representatives of each organization must respond by developing and presenting compelling cases for each individual project or program, leading to greater competition across all modes for limited resources. Jones and Lucas (2000), for example, describe just such a "single capital pot" scheme operating on a pilot basis in Scotland, in which the central government grants resources to local authorities to spend as they see fit. The scheme "has led to a sharp drop in transport expenditures in some areas. Hence, transport schemes will need to demonstrate (and so be designed to achieve) wider social and economic benefits, if they are to compete successfully for limited resources." The benefits of such integration for the public could be substantial: greater competition among uses of public resources could lead to more efficient allocation decisions. However, transportation industry stakeholders advocating for integrated strategy development, such as those in the Scotland case, would likely not ex-ante expect, and they certainly would not ex-post favor, such a decline in transportation spending.

Kanafani (2008) concedes that although "transportation planners have always accepted the integration of modes as a sound principle… daunting challenges prevent its realization." The U.S. Government Accountability Office (GAO 2004) cited unimodal institutional structures as a key barrier to the potential for more multimodal strategy development: "There are relatively few instances in which decisions involve trade-offs among the various transportation modes to meet passenger and freight mobility needs." GAO (2004) points to the conflict between the language of federal legislation which "emphasizes the goal" of intermodal planning and the "reality of federal funding structures," which are oriented uni-modally.

In the following sections, a framework is presented for more deeply examining multimodalism, focusing on its relationship with other dimensions of strategy development. Next, the Portuguese transportation sector is characterized and used as the basis for an analysis of multimodalism. Finally, the ways in which multimodalism relates to other dimensions of strategy development are identified, offering a more complete picture of the potential benefits of and barriers to multimodalism. This explicit linkage to other dimensions of strategy development expands the analysis of multimodalism typically seen in transportation literature.

STRATEGY DEVELOPMENT FRAMEWORK

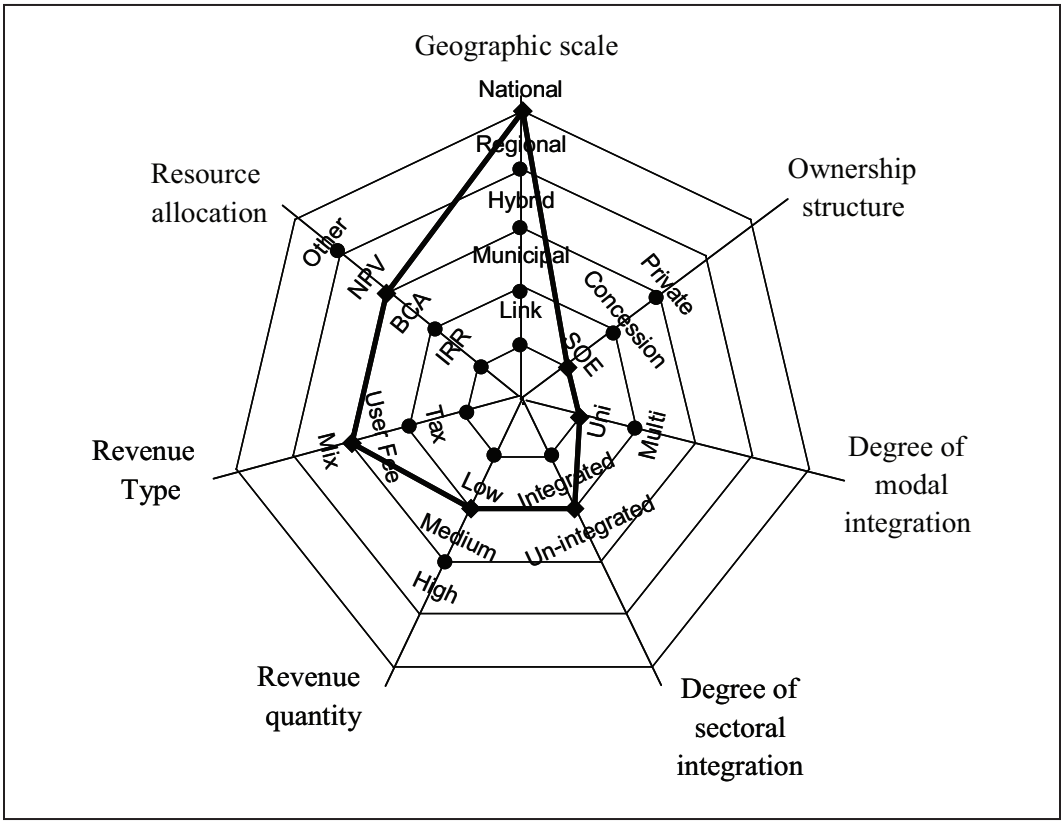
The lens adopted for this analysis is the multi-dimensional *strategy development framework* developed by Dunn (2010). Table 1 lists and provides examples of seven of those dimensions: ownership structure, degree of modal integration, degree of sectoral integration, revenue type, revenue quantity, resource allocation technique, and geographic scale. These dimensions are used to characterize the way a set of organizations in a defined context strategically manages a transportation infrastructure system. Note that "*degree of modal integration*" is just one of seven dimensions used to characterize a strategy development framework.

Table 1: Dimensions of a Strategy Development Framework

Dimensions of Strategy Development Framework		**Examples**
Institutional Architecture	**Ownership Structure**	Government agencies or state-owned enterprises
		Public-private partnerships for infrastructure delivery
		Private infrastructure companies or cooperatives
	Degree of Modal Integration	*Uni-modal state-owned enterprises (e.g., independent highway and rail companies)*
		Multimodal agencies with integrated funding sources
	Degree of Sectoral Integration	Uni-sectoral agencies with autonomy
		Multi-sectoral agencies or highly collaborative uni-sectoral agencies
Decision-making Process	**Revenue Type**	Direct user fees (e.g., tolls, fares, parking fees)
		Indirect user fees (e.g., fuel taxes, vehicle sales & ownership taxes, licensing fees)
		Beneficiary fees (e.g., land-value capture taxes)
		General taxes (e.g., sales, income, and property taxes)
	Revenue Quantity	High vs. medium vs. low tax and/or toll rates
	Resource Allocation	Political negotiation, e.g., within deliberative legislative bodies or executive administrations
		Information-driven ranking of projects via benefit-cost analysis and net present value analysis.
		Formula-based allocations (e.g., based on population, income, travel demand)
Geographic Scale of Control		National
		State
		Metropolitan
		Local/Municipal

One way to illustrate the strategy development framework for a particular context is with a radar chart, as illustrated in Figure 1. The analyst selects values or combinations of values along each dimension to characterize a particular transportation context. For example, the strategy development framework for Portugal's system of highways could be characterized as a combination of nationally-scaled state-owned enterprises and concessions (managed and operated by private consortia under long-term contracts with the state) that makes investment decisions unimodally using a mixture of user fees and general tax revenue of medium quantity, allocated largely on the basis of net present value analysis. Of course many of the discrete values selected along the dimensions are simplifications, but the purpose of this exercise is to characterize *in combination* various dimensions of the investment strategy development framework. Next, the existing strategy development framework for Portugal is discussed, with particular emphasis on the degree of multimodalism.

Figure 1: Example Representation of a Strategy Development Framework[1]



STATE OF THE PRACTICE IN PORTUGAL[2]

Portugal's transportation system includes an extensive highway network; a conventional rail network providing regional (commuter), long-distance intercity, and international passenger service as well as freight service; urban public transit systems, including bus, light rail, subway, and ferry; several airports, including a major international hub in Lisbon; container ports in Lisbon and Sines; and a proposed high-speed rail (HSR) network that will first connect Lisbon with Madrid and, later, Lisbon with Porto (see Figure 2 for reference map of Portugal).

Figure 2: Reference Map of Portugal[3]

Figure 3 illustrates the institutional architecture that currently oversees Portugal's transportation infrastructure as a four-level hierarchy. The levels, from top to bottom, are:

- The central government, including the Council of Ministers, Ministry of Public Works & Transportation and Communications (MOPTC), and the MOPTC's constituent Secretariats of State
- Regulatory entities
- State-owned enterprises (SOEs)
- Private concessionaires

Not represented are municipal governments, which own and operate local transportation infrastructure (e.g., streets and sidewalks) and, in the case of some smaller municipalities, bus transit systems. Regional authorities are also omitted, whose powers to date are not clearly defined.

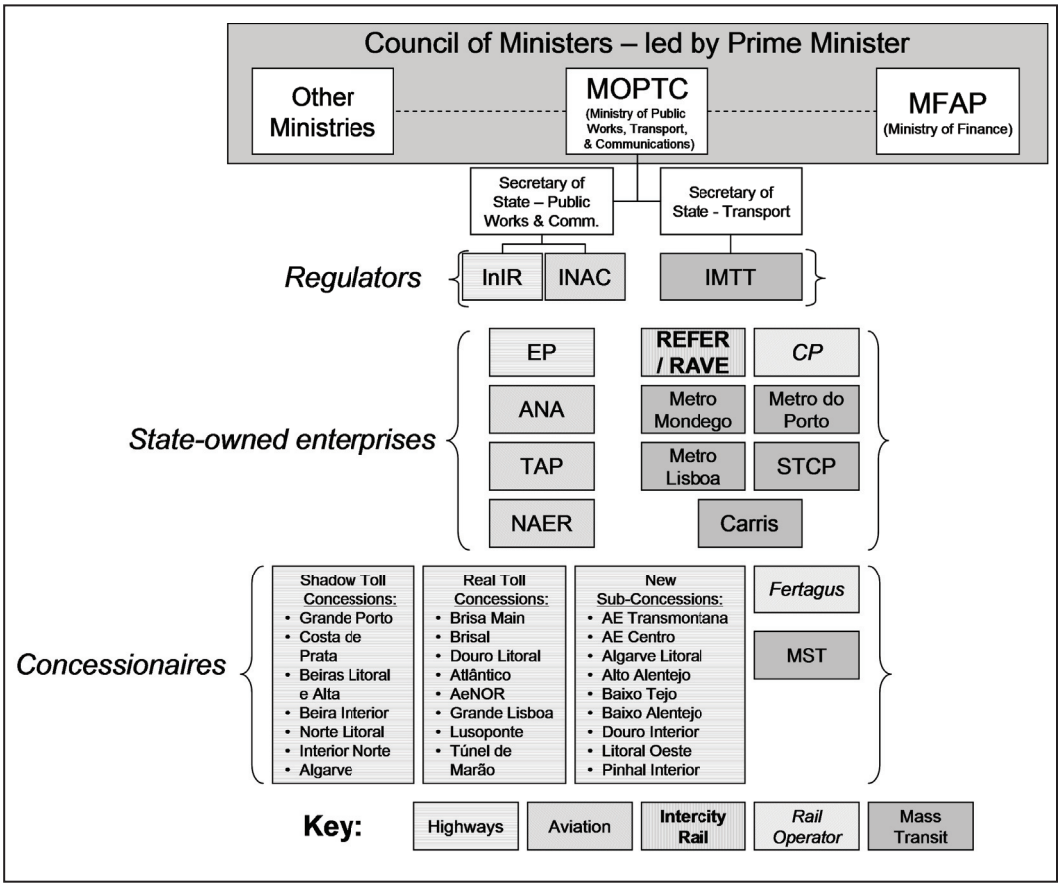
Most transportation infrastructure investments are developed and decided at the highest levels of government (within the legislative National Assembly and the Council of Ministers, which is the cabinet of the executive branch) and within the MOPTC itself, while independent agencies develop and enforce service, economic, and safety regulations for each transportation mode. Resource allocation decisions result from negotiations within the government; these negotiations serve as a de facto multimodal investment allocation mechanism, but are based on preservation of existing budgets and needs assessments, which are formulated independently by stakeholders within each mode.

The MOPTC itself is bifurcated, with one secretary of state for highways and aviation and another for railways and urban public transit.[5] The SOEs acting on behalf of the government to deliver transportation infrastructure investments are unimodal in character, with few formal connections to one another. For example, the 2000 National Road Plan (Plano Rodoviária Nacional, or PRN 2000) was developed by the principal highway agency Estradas de Portugal (EP), while the planned HSR network was developed by the HSR company Rede de Alta Velocidade (RAVE) (EP 2000 and RAVE 2008). There were no explicitly multimodal considerations either in the decision to develop the plans or in the ongoing execution of the plans.

Strategic Orientations (Orientações Estratégicas) were produced by the MOPTC, with one document corresponding to each mode: rail, road, airports, and ports/logistics (MOPTC 2006a; EP 2000; MOPTC 2006b; MOPTC 2007, respectively). The Strategic Orientation for rail characterizes highways largely as a competitor and refers to policies that promote highway use as a "threat." Instead, the rail sector endorses policies that favor rail over road-based travel, including pricing as a means of improving the attractiveness of rail to customers. For its part, the PRN 2000, which serves as the Strategic Orientation for highways, does not even mention rail.

The best prospects for consideration of multimodal tradeoffs in infrastructure investment decision making under the current framework are within the very highest levels of government and through informal connections of the unimodal organizations. Even these opportunities have, in many cases, disappeared due to the severing of ties, for financial reasons, between the government and the modally-oriented SOEs. In late 2007, for instance, EP was converted into an autonomous company and empowered to fulfill its public objective of building road infrastructure through concession

Figure 3: Institutional Architecture of Portuguese Transportation System[4]



agreements with private companies and through borrowing (with the implicit backing of the state). Likewise, Rede Ferroviária Nacional (REFER), Portugal's state-owned railway infrastructure company, fulfills its obligations to maintain rail infrastructure largely through borrowing instead of direct grants from the state.

There are several consequences of the unimodal nature of the current strategy development framework. First, SOEs lack a formal venue for multimodal planning or analysis of investment tradeoffs. Policy objectives, sometimes including specific investments, are dictated to the SOEs by the government; however, because many of the SOEs now operate "off budget," they can pursue investments free from state-imposed budget constraints, which removes restraints on borrowing and spending. Deficits are funded by further loans, with the underlying asset values and implicit state backing as collateral. Another consequence is that SOEs will compete for the same traffic. For example, the motorways and the HSR network will connect many of the same points. With little population growth and a variety of options for intercity travelers, it may be difficult for demand to meet expectations, at least in the short- and medium-term, that could become problematic for repayment of funds borrowed for construction. Moreover, with investments pursued unimodally, there are limitations on the physical integration of infrastructure which could, in some contexts, provide not only for more efficient multimodal trip opportunities for customers but also more efficient, less costly network designs. Finally, by sending uncoordinated signals about infrastructure investment to the market, land development patterns will likely respond in unintended and difficult-to-predict ways, compounding the challenge for design of policy in other areas such as environmental protection, land use, and economic development.

A program of multimodal strategy development in Portugal would likely result in lower levels of investment in infrastructure. Instead of unimodal Strategic Orientations referring to the various other modes as competitors, multimodal strategy development would focus on opportunities for synergy and efficiency in the design of a multimodal network for passengers and freight. Intercity infrastructures would be less likely to compete for trips among modes, but instead would complement one another. The quantity of infrastructure developed and proposed would likely be reduced if for no other reason than the realization that redundant systems would be unable to draw sufficient traffic in order to be justified financially.

The prospects for more explicit and extensive multimodalism in the development of transportation infrastructure strategies for Portugal remain dim. Within the existing institutional architecture, the strongest prospects for multimodalism are within the government (the "top layer" of Figure 2). MOPTC, for example, has a strategic planning unit that produced a national, multimodal Strategic Transportation Plan (Plano Estratégico de Transporte, or PET) (MOPTC 2009). However, the plan is descriptive rather than prescriptive, indicating there is little opportunity within the planning unit to influence infrastructure investment decisions by the government in a multimodal direction. The other layers offer even fewer opportunities for modal integration: SOEs (e.g., EP and REFER) and regulatory agencies (e.g., InIR for highways and IMTT for railways and urban public transit) each have substantial institutional inertia and entrenched industry interests focused on a particular mode.

ANALYSIS OF MULTIMODALISM AS PART OF A MULTIDIMENSIONAL STRATEGY DEVELOPMENT FRAMEWORK

The focus of this section is to analyze benefits of and barriers to multimodalism in a multidimensional context, characterized by the strategy development framework presented in Figure 1. Of particular interest is the relationship between multimodalism and three of the other dimensions: ownership structure, geographic scale, and revenue sources. The benefits of and barriers to multimodalism vary depending upon how these other dimensions are defined.

Dimension 1: Ownership Structure

In the current framework of largely public ownership of infrastructure, in Portugal and beyond, multimodalism fares poorly. Public transit agencies invest in transit lines, highway agencies invest in highways, and rail agencies invest in rail, each typically using distinct revenue sources and budgeting mechanisms. However, involvement of the private sector has been notable at times throughout history—dating at least as far back as ancient Rome, whose imperial highways were maintained by private contractors (Laurence 1999). Involvement of private contractors remains common, but the spectrum of private involvement also includes relatively less common approaches such as:

- Fully private contracts, whereby a private infrastructure owner (supplier) provides a facility to private customers.
- Concession agreements, whereby a public owner leases a facility or right-of-way to a private builder for a defined period of time. The private builder finances, builds, and/or operates the facility in exchange for a revenue stream such as tolls or transfer payments based on traffic volumes, infrastructure availability, or other performance metrics.

The prospects for multimodalism under private ownership and under a concession approach to infrastructure development are discussed in the following paragraphs.

Private Ownership. A study of the long history of transportation reveals many attempts to provide infrastructure privately. Purely private efforts date as far back as the 18th and 19th century turnpikes of Great Britain and North America (Wood 1919). Railroads in the United States were also built as private ventures in the 19th century and largely remain private for freight, although it should be

noted that government land grants spurred their early development. Other contemporary examples of private infrastructure include the 1995 Dulles Greenway in Virginia, the 2000 Camino Columbia Toll Road in Texas, and the 2004 Las Vegas Monorail. Such examples, however, remain rare, and there are no examples of large-scale, purely private transportation infrastructure in Portugal.

The most prolific example of contemporary private infrastructure is the U.S. system of freight railroads. Although the bulk of railroad companies' capital investments are devoted to rail-related facilities, substantial investments have been made in intermodal facilities. With over 21% of revenues derived from intermodal traffic (AAR 2010), freight railroads partner with logistics providers to deliver intermodal services for their customers, capitalizing on jointly-financed improvements to intermodal facilities. A recent example is the opening of the $370 million Union Pacific Intermodal Terminal in Joliet, Illinois (UP 2009).

Concessions. The concession approach represents an attempt at finding a public-private middle ground that can, in theory, maximize the benefits of both approaches while attempting to avoid the disadvantages of each. The basic structure is for the government to grant exclusive rights to a private entity to finance, build, and/or operate a portion of an infrastructure network for a fixed period of time and to collect tolls or other user fees from the facility. In exchange, the public sector sometimes receives an upfront payment for the lease of those rights or simply enjoys the delivery of infrastructure without drawing heavily on public budgets. Concessions have been in use for centuries, but recent examples abound in Western Europe, Asia, and Latin America. Portugal's road concessions to private operators have grown substantially since the early 1990s. While Portuguese concession agreements in the rail sector have traditionally been with state-owned enterprises, the new HSR system will be concessioned to a private consortium.

Portuguese concessions vary by size and type of concession contract. The largest road contract is with Estradas de Portugal (EP), which until recently was the highway agency of the national government, but now is an SOE.[6] Other than EP, there are 15 concession agreements in Portugal: eight "real toll" concessions and seven "shadow toll" concessions (in which the government, rather than motorists, compensates the concessionaire, as a function of traffic).[7] In the rail sector, the government maintains a concession contract with state-owned REFER to manage the conventional rail infrastructure network, while private consortia are bidding to develop HSR. Information about select Portuguese concessions is summarized in Table 2.

Multimodalism and Ownership Structure. The experience of private ownership from the turnpike era, the railroads, and the modern era as well as of the recent concessions awarded in Portugal serves as the basis for judgment of multimodalism's prospects.

There is little evidence that a concession-based approach would lead to more multimodalism than under public ownership. As demonstrated by the Portuguese case, concessions are being pursued independently for highways and rail, administered and financed independently by public partners, absent coordination across institutional boundaries. The private parties in concession agreements likewise see little incentive for multimodalism in their participation, especially since the public parties are likewise unimodal. Given that concessions are pursued largely as a means of financing projects that are planned and advocated by the public sector, with government retaining many of the downside revenue risks of investment, this result is not surprising.

By contrast, the prospects for multimodalism with privately provided infrastructure are mixed. Although devolving all transportation infrastructure matters to the private sector is unrealistic, private investors have historically pursued investments across modes, from toll roads to passenger and freight railroads to transit systems. Today, private multimodalism is perhaps best exemplified by the manner in which railroads interface with other modes, without bias, to support the shipment of goods for their customers. The private sector faces fewer political processes which allocate resources in a unimodal fashion, and it avoids altogether the complexity of assessing economic and social benefits of diverse projects across modes, focusing instead on a single metric: profitability.

Thus, one of the lessons to transfer from private experiences to the public sector and to concessions is that multimodalism is easier to implement when there is no modal bias, supported by a clear, simple evaluation framework for projects.

Table 2: Public-Private Partnerships in Portugal[8]

Type of Concession	Name of Concession	Length (km)	Year Granted
Highways - Real Toll	Brisa	1,093	1972
	Brisal	93	2004
	Douro Litoral	53	2004
	Atlântico	170	1998
	AENOR	174	1998
	Grande Lisboa	64	2004
	Lusoponte	24	1998
	Túnel de Marão[9]	30	2008
Highways - Shadow Toll	Grande Porto	64	1998
	Costa da Prata	108	1998
	Beiras Litoral e Alta	174	1998
	Beira Interior	178	1998
	Norte Litoral	119	1999
	Interior Norte	158	1998
	Algarve	134	1998
Highways – Other	Estradas de Portugal (state-owned)	13,000	2007
Conventional Rail	REFER (state-owned)	2,841	2008
High-Speed Rail	TBD (private)	600 (planned)	TBD

Dimension 2: Geographic Scale

Transportation infrastructure providers exist for a range of geographic scales, regardless of ownership structure. For example, U.S. freight railroads of varying sizes abound, from short lines to Class I companies. Concessions likewise range in size, for example, within Portugal from the 50-km Douro Litoral highway concession to the nearly 1,100-km Brisa highway concession. Public entities likewise exhibit a broad range of scales; consider, for example, the diversity of sizes and populations just among the 50 states. Identifying cases that reflect either "local" or "global" approaches to infrastructure provision is an exercise in relativity. In this section, the contrasting approaches of the European Union (EU), Portugal, and municipal governments are presented.

EU. To guide its investments in Portugal and other member countries, EU planners developed an explicitly multimodal Trans-European Transportation Network (TEN-T) as early as 1994 for consideration by the member states. The TEN-T comprises priority long-distance, cross-border axes and projects, including roads, rails, inland waterways, sea lanes, airports, ports, and a global navigation satellite system (GNSS) known as Galileo (EC 2005, EC 2003, EC 2001).[10]

One of the EU's most effective tools for multimodal investment analysis and decision making is the European Investment Bank (EIB), Europe's infrastructure bank. The EIB makes loans to a diverse portfolio of transportation and other infrastructure projects throughout the continent, basing all of its lending decisions on a streamlined process for project evaluation that incorporates technical,

social, economic, and environmental aspects, all considered similarly regardless of the project's mode (e.g., EIB 2005). Although separate detailed guidelines exist for each mode, in recognition of the unique technical characteristics, the overall process is the same, resulting in multimodal lending decisions. For example, since 2005, the EIB has loaned the following to the Portuguese transport sector (EIB 2010):

- Highways: €2,269 million
- Conventional rail: €705 million
- High-speed rail: €600 million
- Aviation: €109 million
- Urban transit: €90 million

Despite its multimodal approach, the TEN-T faces several challenges. First, preferred investments at the EU scale do not necessarily align with domestic preferences. Portugal's HSR network is one example: emphasizing transnational connections, the EU's influence has led to prioritization of the Lisbon-Madrid HSR link over the domestic Lisbon-Porto link, despite the fact that Lisbon-Porto has an estimated IRR of 10.8%, compared with 5.9% for Lisbon-Madrid (RAVE 2008). In addition, planners have been asked to balance a broad range of conflicting objectives in their development of a European-wide network for priority investment, including transportation efficiency, environmental protection, geographic fairness, and economic growth. As the geographic scale expands, incorporation of such diverse views from other sectors slows the process of planning and investing. Finally, member states are still free to make purely domestic investments that are not necessarily aligned with TEN-T. For example, along with high levels of EU investment in rail and highway projects, Portugal has continued a parallel program of similar domestic investments, of which debt service and operational requirements are now contributing to the country's fiscal crisis.

Portugal. As discussed previously, Portugal's domestic transportation infrastructure strategy is developed largely by the central government in a unimodal fashion. Examples of documents reflecting the central government's deliberate strategy include the National Road Plan and the Strategic Orientations for the rail sector. The objective of each of these strategies is to improve the competitiveness of Portugal within the EU by creating better internal linkages and improving the quality of links that facilitate international trade, but they are not coordinated.

The machinations of domestic Portuguese politics dominate infrastructure strategy development, pitting forces within the central government against one another in a negotiation that results in familiar compromises about amounts of investments in transit, highway, rail, and other modes. However, these negotiations, which occur at the highest levels of government, begin with the previous year's budget as the baseline for negotiation, with little meaningful consideration of appropriate budget levels *across* modes.

Municipal. Municipalities in Portugal are responsible for small-scale, local infrastructure, including streets, sidewalks, and in some cases local bus transit systems (in Lisbon and Porto, the municipalities at the center of the two largest metropolitan areas, bus and rail transit are provided by state-owned enterprises). The budgets for public works at the municipal scale are more flexible relative to the national budget, with municipalities making public works investments in a variety of modes, including transit, based on the level of need estimated by their technical staff, availability of revenues, and preferences of the local populations. Although the prospects of multimodalism are strong under this approach, the vast majority of municipal governments have very modest resources at their disposal and little capacity to invest broadly in, for example, multimodal intercity infrastructure.

Multimodalism and Geographic Scale. The prospects for effective multimodal investment in the Portuguese context are highest at the municipal level. This conforms with the observations of Stough and Reitveld (1997) that there are fewer barriers to integrated decision making within

smaller organizations (and, by extension, at smaller geographic scales). Interestingly, the EU also offers strong evidence of multimodal planning and decision making, bolstered by an infrastructure bank that uses a consistent methodology to support its lending decisions across modes.

Despite the potential benefits available of such multimodal decision making at both the local and supranational scales, the national government remains the dominant planner and investor of infrastructure in Portugal, with an institutional structure that is highly unimodal. Devolving authority and resources to local governments to make investment decisions may result in more multimodal decision making, but it may also result in the diversion of resources away from transportation. By the same token, ceding more authority to the EU for infrastructure decisions may result in more multimodalism, but risks allocating more resources to transnational projects that are of lesser benefit for Portugal itself.

Dimension 3: Revenue Sources

The final dimension to consider is revenues sources. Two types of revenues are described, categorized broadly as general taxes, which are paid by all members of society, and user fees, which are charged either directly or indirectly to transportation customers roughly in proportion to their usage.

General Taxes. Due to the broad array of general tax mechanisms in use by governments, it is impossible to identify a convincing linkage between any particular taxation approach and multimodalism (or lack thereof). In Portugal, a diverse array of general taxes is collected by municipal governments and by the national government, including taxes on income, sales, fuel, and property. Many of these taxes accrue to the general budget, which is used to support a variety of infrastructure projects through the largely unimodal processes outlined above.

Nonetheless, there are many counter examples of multimodal investment decision processes that use general tax-derived revenues, including the EU and municipal governments that were described in the previous section. EU revenues consist of taxes on commodities such as sugar, EU-wide value-added taxes, and contributions from each member state, while municipal governments in Portugal derive their budgets from general taxes on income and property.

User Fees. In Portugal, as in many other countries, much of the revenue available for transportation investment is derived from user fees, both direct and indirect. Below, the user fees and their ultimate uses are summarized.

- Road tolls. Portuguese motorists pay tolls for use of many of the country's motorways, with revenues devoted to the highway sector. Specifically, revenues are allocated to concession operators in order to cover their operational costs, debt service, and re-investment in the highway system.
- Rail fares. As with highway tolls, fares paid by rail users in Portugal are devoted to the operators who collect them. The vast majority of passenger service is operated by Comboios de Portugal (CP), a state-owned enterprise, with a few smaller private participants.
- Rail access fees. Rail operators such as CP and the private passenger and freight operators must pay fees to access the track to the infrastructure manager REFER. These revenues are devoted entirely to REFER for management of, maintenance for, and capital investment in the rail infrastructure system.
- Transit fares. As with rail fares, collections from passengers are devoted fully to the transit operators.
- Fuel taxes. Approximately 1/6 of fuel tax revenues are remitted to Estradas de Portugal in exchange for its maintenance of the highway system. The remainder accrues to the general budget.

Generally speaking, user fees are "ring-fenced" to the mode from which they are collected, not only in Portugal but around the world. The U.S. Highway Trust Fund is another example; although a

small percentage is devoted to transit projects, the vast majority of highway user fees are reinvested in highways. A notable exception is London, where a substantial share of congestion-charging revenues are devoted to transit improvements.

Multimodalism and Revenue Sources. Although logic suggests that general tax revenues should be easier to apportion than user fees in a multimodal fashion, examples and counter examples of multimodalism exist for transportation budgets composed of both user fees and general tax revenues. Consequently, the question of *how* revenues are collected becomes less important than *who* collects them. Modally-oriented agencies or companies are unlikely to share their user-fee proceeds with others, resulting in modal silos. Similarly, general fund revenues that are apportioned to modally oriented agencies according to formulas or historical budget shares, without serious cross-modal analyses, likewise lose the potential benefits of true multimodalism.

CONCLUSIONS

The theoretical impacts of multimodalism include benefits for providers and customers of transportation infrastructure alike, including passengers and freight. From the point of view of providers, more efficient investments are possible, while for customers more efficient travel options become available. These benefits (competition and more efficient allocation of resources) are, paradoxically, also barriers to integration. The involvement of greater numbers of stakeholders leads to competition for scarce resources, which is generally perceived as a threat by existing organizations. Advocates for multimodalism risk losing the support of constituent modal interests, which could result in further setbacks for the multimodalism objective. Moreover, the potential exists in this environment not only for competition across modes but also across sectors, leading to a potential decline in resources made available for transportation overall. Even if successfully implemented, integrated multimodal decision making entails higher costs of coordination.

Given these barriers, multimodalism can be more deeply examined and carefully pursued in parallel with other dimensions of strategy development. For example, along the dimension of ownership structure, more private involvement in infrastructure development could lead to more multimodal decision-making approaches. Because private developers are interested in the financial performance of investments, regardless of mode, they are more likely to consider trade-offs across modes before investing. This is not often the case in the public sector, where the relatively simple decision metric of profit is unavailable. That said, attempts to involve the private sector through concession agreements (i.e., public-private partnerships) will not necessarily lead to higher levels of multimodalism, because concessions are largely used as financing tools for investments that are already planned and decided unimodally by the public sector. Instead, the multimodal experiences observed in the private sector suggest the need for development of integrated, multimodal evaluation tools for the public sector (along the lines of those that use profit as a decision metric) that can serve as clear, simple, convincing inputs to the decision-making process, thereby eliminating modal bias.

Along the dimension of geographic scale, in Portugal, multimodalism is more feasible and more likely to deliver benefits at geographic scales *other than* the national scale. Decentralization has the effect of reducing the number of participants, thereby reducing the potential points of conflict and competition for resources. Interestingly, at the same time, the EU's pursuit of multimodal planning and investment along with the EIB's multimodal investment appraisal processes offer another avenue for greater multimodalism in Portugal at the supranational scale. However, allowing greater control by the EU risks overlooking important domestic needs, while local governments if given greater authority, may lack the ability to assess large-scale projects, especially at an intercity scale.

Finally, along the dimension of revenue sources, although multimodalism requires a single budget from which to make investment decisions, experience suggests the source of those funds (general tax revenue vs. user fee revenues) does not necessarily influence the degree of multimodalism. As observed in Portugal and elsewhere, the "user pay" principle remains strong:

revenues collected from users of a particular mode tend to be reinvested in that same mode, whether for highways, transit, or rail. Nevertheless, all forms of passenger transportation (and many forms of freight transport) receive subsidies from general revenues. As a result, the relative influx of funds from a particular mode is ultimately less relevant for multimodalism than the design of multimodal funding mechanisms for distributing revenues, regardless of source, that are used to subsidize all modes.

The conclusions presented here are based on the observations of multimodal planning and investment decision making in Portugal and within the EU, supported by Portugal's experience with concession agreements, multi-level planning and investing, and various types of transportation revenue, with reference to other historical cases and examples where appropriate. Although the case of Portugal is admittedly limited, it offers a rich platform to consider the relationship between multimodalism and other dimensions of transportation infrastructure strategy development. Transportation stakeholders advocating for greater multimodalism in project evaluation and decision making should not view multimodalism as a topic in isolation, but rather as one dimension among many others in the strategy development framework that governs their transportation system. By examining the other dimensions, including the three discussed here (ownership structure, geographic scale, and revenue sources), diagnoses of barriers to multimodalism become more precise, while prescriptions for implementing multimodalism are better informed by recognizing the complexity of strategy development more broadly.

Endnotes

1. Abbreviations: Net present value (NPV), benefit-cost analysis (BCA), internal rate of return (IRR).

2. The discussion in this section is based largely on interviews cited at the end of the References section.

3. Reproduced from the U.S. Central Intelligence Agency *World Fact Book* (public domain), 2010.

4. Reproduced from Dunn (2010).

5. This bifurcation is not uncommon among government transportation departments and ministries—for example, the U.S. DOT has 11 distinct modal administrations.

6. EP relies on fuel taxes and heavy borrowing to meet the requirements specified in its agreement with the state to maintain all existing intercity highway infrastructure in Portugal and to construct new links as directed by the government and in accordance with the 2000 National Road Plan.

7. The government and its private partners are currently in the process of developing nine new concession agreements.

8. Various sources: APCAP (2008), Mota Engil (2007), RAVE (2008), REFER (2006)

9. Under construction as of 2010.

10. Maps of the Trans-European Transportation Network (TEN-T) are available from the sources cited as well as the TEN-T website: http://ec.europa.eu/transport/infrastructure/index_en.htm.

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