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Project characteristics and performance in Europe: An empirical analysis for large transport infrastructure projects

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ABSTRACT

Infrastructure megaprojects are historically associated with poor delivery, both in terms of cost and schedule performance. Large Transport Infrastructure Projects (TIPs) are amongst the most controversial and are often delivered late, over budget, and providing less benefit than expected. While there is a growing theoretical body of literature addressing TIPs, empirical research is still required to determine which TIPs characteristics affect TIPs schedule & cost performance. This paper addresses this issue, applying an empirically-based methodology to a dataset of 30 European TIPs. The results highlight the importance of financial support from the government and the strong influence of both external and internal stakeholders, mainly in relation to their early engagement and to their nationality. Technological characteristics and the presence of Special Purpose Entities are also correlated with the TIPs performance. These key findings both support and contradict the literature, and are relevant for both policy makers and project managers during the decision-making process, planning and delivery of TIPs.

1. Introduction

Megaprojects are endeavours characterized by vast organizational complexity, long-lasting impact on the economy, environment & society and a large investment commitment (Locatelli et al., 2014b). Gellert and Lynch (2003, p.16) explain that *"Mega-projects can be divided analytically into four types: (i) infrastructure (e.g., ports, railroads, urban water and sewer systems); (ii) extraction (e.g. minerals, oil, and gas); (iii) production (e.g. industrial tree plantations, export processing zones, and manufacturing parks); and (iv) consumption (e.g. massive tourist installations, malls, theme parks, and real estate developments)"*.

However there is not a single accepted definition of megaproject in the literature and different criteria can be adopted. For instance, from the investment point of view, megaprojects have budgets above $1 billion with an high level of innovation and complexity (Flyvbjerg et al., 2003a, 2003b; Locatelli et al., 2014a; Merrow, 2011; Van Wee, 2007). Looking at the operations phase, megaprojects are projects having long-term and far-reaching effects on their environment (Orueta and Fainstein, 2008; Ren and Weinstein, 2013; Warrack, 1993). With respect to the economic dimension, Warrack (1985) argues that $1 billion is not a constraint in defining megaprojects, as sometimes a relative approach is needed because in some contexts, a much smaller project (such as one with a $100 million budget), could constitute a megaproject. Van Marrewijk et al. (2008, p. 591) define megaproject as *"multibillion-dollar mega-infrastructure projects, usually commissioned by governments and delivered by private enterprise; and characterized as uncertain, complex, politically-sensitive and involving a large number*

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of partners". This latter definition emphasizes the organizational complexity that comes with the presence of multiple private firms in connection to the political stakeholders (frequently, some form of national or local government).

Large Transport Infrastructure Projects (TIPs) are megaprojects in the transportation sector (e.g. high speed railways, airports and long bridges) . They are often late, costly, and fail to provide the promised benefits to the society (Cantarelli et al., 2010; Flyvbjerg et al., 2004). Since large TIPs have these characteristics and often exceed the threshold of 1 billion USD (Flyvbjerg, 2014; Zidane et al., 2013), they can be addressed as megaprojects.

TIPs are a key determinant of performance in the transport sector (OECD, 2015), and over the next ten years, a significant level of investment in TIPs is expected. For instance, research by Oxford Economics predicts annual global increase of 5% of the transport infrastructure investments, with investments in the Asia Pacific region expected to grow from $557 bn per year to nearly $900 bn per year in 2025, and more modest investment (but still significant) levels in Western Europe (PWC, 2015).

Budget constraints always play a pivotal role, so decision-makers need information regarding the spending and benefits promoted by infrastructure development to prioritize investment (OECD, 2015). However, a "*lack of common definitions and practices to measure transport infrastructure spending hinders comparisons between countries and spending options*" (ITF, 2013). In particular, it is unclear which TIP characteristics are correlated with the TIP performance.

Considering the prominent role that TIPs will play in the future, their planning and construction will be fundamental in securing their effective and efficient performance during their lifecycle, and a more effective design and delivery of TIPs is becoming increasingly important.

Following the research methodology proposed in (Brookes and Locatelli, 2015) and inspired by (Eisenhardt, 1989) this paper presents the method and the results of a rigorous and systematic investigation to identify the characteristics that contribute to the effective design and delivery of new TIPs, based on data collected of 30TIPs delivered across Europe. The paper identifies the correlation and discusses possible causation linking TIPs characteristics to TIPs performance. This is worthwhile to provide guidance for decision-makers about future projects.

2. Literature review

2.1. Relevance of transportation megaprojects

Transportation plays a critical role in promoting the competitiveness of the economies, as high quality services and infrastructure improve economic performance and facilitate regional competitiveness. The OMEGA Centre (2015) investigates what delineates a successful mega infrastructure project, programme and/or plan. Dimitriou et al. (2013) examine the "agent of change" of mega transport project against their cost, time and quality performance, exposing the different understanding of what are the project boundaries of such investments.

Other authors that focus on the transportation sector broaden their analysis to projects under 1 billion USD of budget. Knowles and Ferbrache (2016) examine the economic impacts of modern light rail systems in the UK and globally. They highlight the benefits of tram and light metro in relation with geographic constraints (e.g. the extension of labour market catchment areas, reorganisation of production and the enhancement of employment) concluding that light rail encourages inward investment by widening labour catchment areas and boosting property prices. Mullen and Marsden (2015) explore the role of TIPs in economic development and city competitiveness, and state that the key to promoting an effective transport scheme is "*a high benefit-to-cost ratio which will typically be dominated by large volumes of relatively small scale time savings*". Melo et al. (2013) conduct an empirical analysis based on the output elasticity of transport infrastructure: they analyse a sample of 563 estimates obtained from 33 studies, drawing the conclusions that the existing estimates of the productivity effect of transport infrastructure can be very different. They show that productivity is higher for the US economy than for European countries, and is higher for roads than other modes of transport. Cantarelli et al. (2012a, 2012b) focuse on the Netherlands and show that cost overruns in this country appears to be lower than the rest of the world. Graham (2007) investigates the relationships between agglomeration, productivity & transport investment and provides an empirical quantification of the links between urban density and productivity.

Given the importance of TIPs as described by the aforementioned research, the authors present an empirically-based methodology to identify the characteristics of TIPs associated to cost and schedule performance.

2.2. Project performance

TIPs performance is a debated topic: on the one hand, the OECD (2015) highlights the relevance of TIPs for the economic development, since TIPs can create employment and promote labour mobility; on the other hand, TIPs can fail to support the expected growth in the regional and national competitiveness (Vickerman, 2010). Even if there has been a long term desire to investigate project performance, according to different stakeholders perspectives over different timescales (Turner and Zolin, 2012; Cooke-Davies, 2002; Atkinson, 1999), this paper still focuses on cost and schedule performances.

Indeed, TIPs are often characterized by schedule spanning over decades and budget in the region of millions or billions of dollars and are affected by significant uncertainties and risks (Bruzelius et al., 2002). Therefore, time and cost forecasts are difficult to estimate, and often prove to be wrong. Anas (2012) analyses the complexity concerning the optimal allocation of the pricing, financing and supply of urban transportation. Berechman and Chen (2011) emphasize that the risk of cost over-