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# Managing global megaprojects: Complexity and risk management

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## ABSTRACT

“Megaproject,” a concept of growing importance in today’s globally connected business environment, requires a closer examination as a result of the expansion of global networks, increasing collaborations among numerous partners, and the complexity of managing such projects. Yet, given their high rate of failure, it is critical to examine the factors that contribute to success of megaprojects. In such a high-pressure, competitive, and complex environment, it is inevitable that companies will engage in complex, global, collaborative projects in order to reap the rewards of these significant, large-scale initiatives and ultimately become major players in the game. Despite the considerable scale of megaprojects, the international business literature has largely neglected to examine this topic. This paper takes an exploratory approach to identify key characteristics of global megaprojects, factors contributing to disappointing outcomes, and offers a risk management framework and managerial prescriptions for enhancing success. Building on the prospect theory, self-justification theory, and sunk cost effect, we examine the behavior of decision making under risk in megaprojects. We conclude that by adopting a successful risk management approach and following best practice, success rate and the productivity of global collaborative projects can be enhanced.

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## 1. Introduction

In 2009, five countries agreed to cooperatively construct a gas pipeline between the Eastern border of Turkey and Austria in Europe, running through Bulgaria, Romania and Hungary. This international megaproject, called “Nabucco,” consists of the construction of a 3900 km pipeline beginning in 2013 with the initial gas flow scheduled for 2017.<sup>1</sup>

A closer examination of Nabucco project, detailed in [Appendix A](#), serves to illustrate the complexity of megaprojects. An ambitious and large-scale project, Nabucco carries with it a degree of technological sophistication, funding concerns, as well as the political uncertainty brought upon changing political winds among the participating countries. Complexity is an inherent and indispensable part of megaprojects. As globalization trends intensify, the importance of managing complexity cannot be overemphasized for the success of megaprojects. For instance, supply chain structures get more complicated than ever with countless international suppliers, or a partnership may include private and public investors from multiple countries with very diverse cultures. Consequently, such large-scale projects bear high risks that require systematic risk management approaches. Without appropriate risk management strategies in place, megaprojects are bound to fail due to multiple, risk-prone events.

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<sup>1</sup> For detailed information: For detailed information: <http://www.nabucco-pipeline.com>.

Megaprojects are large-scale manufacturing or infrastructure undertakings which transform landscapes rapidly and profoundly in very visible ways. They involve coordinated applications of capital, sophisticated technology, intense planning, and political influence (Gellert & Lynch, 2003). They require the engagement of numerous contractors, often from various countries, and take years for completion. Gellert and Lynch (2003) categorize megaprojects into four types: infrastructure (e.g., dams, ports, and railroads); extraction (e.g., minerals, oil, and gas); production (e.g., massive military hardware such as fighter aircraft, chemical plants, and manufacturing parks); and consumption (e.g., tourist installations, malls, and theme parks). There are abundant examples of megaprojects currently in progress around the world. In Table 1 we highlight a wide variety of recent and current megaprojects around the world.

Worldwide population growth, urbanization, technological developments, enrichment and increased desires for maintaining a comfortable and modern life have stimulated the demand for new physical infrastructure. Companies have discovered a lack of appropriate infrastructure in developing countries and emerging markets. Thus, the number of large-scale projects has exploded in the past two decades. Spending on infrastructure in emerging markets is estimated by Merrill Lynch to be \$2.25 trillion annually between 2009 and 2012. As an example, Table 2 shows that the highest spending among the emerging markets is expected to be in China – estimated at \$725 billion (Businessweek, 2008). Moreover, spending for updating current infrastructure in developed countries and building new infrastructure in emerging markets is estimated by OECD at \$53 trillion between 2007 and 2030 (Gil & Beckman, 2009; OECD, 2007).

In the present study, we examine multi-country collaborations. Megaprojects are often of international scope as they involve the participation of sponsors, funding agencies, and contractors from multiple countries. Long-term nature of these projects, participation of numerous partners and contractors with divergent interests, fluid nature of technologies deployed, and dynamism in the external environments are just some of the factors that contribute to monumental complexity of megaprojects.

Yet this topic has received little attention in the academic literature. Megaprojects have mostly been a topic in the project management literature. Even those few studies in the international business literature that explored this topic have mainly examined it from the perspective of project management (Lam, 1999; Miller & Lessard, 2007; van Marrewijk et al., 2008). Although the present study also discusses project management views, the perspective we adopt is of international business. As an exploratory study in an area yet to be fully developed, this investigation highlights international megaprojects for international business scholars, and leads the way for further theoretical and empirical studies in the field.

Given the paucity of relevant academic studies, and the rise in the number of megaprojects worldwide, this article offers insights into the structure of megaprojects, explores challenges encountered in management of megaprojects, and suggests risk management approaches to leverage the benefits of these huge undertakings. We also offer a risk management framework for megaprojects which should serve as a guide to address the complexity of the projects and yield higher project performance. Since our goal is to develop an overarching framework for megaprojects, our discussion is based on a careful integration of industry practice, pertinent literature, and theoretical contributions. The remainder of this article is organized as follows: first, the features of the international megaprojects are discussed followed by a detailed examination of the major challenges of complexity. We introduce the concept of “illusion of control” as a major factor contributing to complexity. Next, we describe why “sunk cost effect” contribute to ill-fated outcomes of megaprojects. Further, we explain the decision making processes in managing megaprojects based on the prospect theory and the self-justification theory. We then elaborate on effective risk management approaches and offer a conceptual framework for effective management of megaprojects, followed by managerial prescriptions. We conclude with a review of future research questions.

## 2. Key features of global megaprojects

Large-scale investment projects or major infrastructure projects are usually commissioned by governments and delivered by private contractors who specialize in design, architectural, and manufacturing/construction services. Often there are multiple tiers of contractors and subcontractors. High levels of public attention and/or political interest are attracted due to the substantial cost, and direct and indirect impact these projects have on the community, environment, and budgets (Capka, 2004; van Marrewijk et al., 2008).

Megaprojects are characterized by complexity, uncertainty, ambiguity, dynamic interfaces, significant political or external influences, and time periods reaching a decade or more (Florice & Miller, 2001). They also involve international participants with a variety of cultural differences, backgrounds, political systems, and languages (Shore & Cross, 2005). Table 3 highlights some of the differences between megaprojects and other project types (Hass, 2009).

At least three features associated with megaprojects are notable: large sum of resources; high human, social and environmental impact; and extreme complexity (Capka, 2004; Flyvbjerg, Bruzelius, & Rothengatter, 2003).

*Large deployment of resources:* Megaprojects require high amounts of costs, labor, physical and financial resources. The total amount of funding varies depending on the context, but multibillion-dollar mega-infrastructure projects are not uncommon (van Marrewijk et al., 2008).

*High human, social and environmental impact:* Megaprojects affect various communities differently; one project may revive or weaken regional economies. The impact may be transnational, occurring over a long-term period, affecting multiple generations, and impacting the economy, civil society and the natural environment (Flyvbjerg et al., 2003; Kipp, Riemer, & Wiemann, 2008; Warrack, 1993). Moreover, these projects are often an issue of public interest because public

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