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Performance measurement and the prediction of capital project failure

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Abstract

This paper examines how changes in project-management performance in the execution phase affect project outcomes at completion. While identifying the key determinants of project-management performance is critical, few studies examine the discriminatory power of performance variables for predicting capital project failure at completion. Using 130 capital projects and a longitudinal design, this study develops a performance-measurement model based on changes in project-management performance during the execution phase. Subsequent hierarchical logistic-regression analysis reveals a good explanation of the variation in the failure of capital projects and high classification accuracy. Validating out-of-sample data demonstrates that the optimal model provides a reasonably good overall classification rate of 81.54%. Ultimately, our findings suggest that performance changes in the execution phase explain an important part of project outcomes and, more importantly, are useful predictors for project failure.

Keywords: Project failure; Project-management performance; Performance measurement; Logit analysis; Longitudinal study

1. Introduction

The subject of project management, seen as the basis of a strategic competency in the global economy (Jugdev and Thomas, 2002), has drawn great attention of researchers and practitioners from various disciplines such as management science, operations management, organization theory, and social psychology. A central task in the study of project management is to identify the critical determinants of project management performance. Not surprisingly, researchers and practitioners examine and identify a wide variety of measures to describe project-management performance and the input characteristics that affect project outcomes (e.g., Chen, 2014; El-Sayegh, 2008; Hoegl and Parboteeah, 2007; Oke and Idiagbon-Oke, 2010; Scott-Young and Samson, 2008).

One recent finding, for example, is that management's perception and satisfaction, and project characteristics significantly affect project performance (Lerch and Spieth, 2013). Another finding is that an ambiguous project scope and unclear project goals are the primary risk factors for project performance (Huang and Li, 2012).

Although project-management performance is well-researched and extensively reviewed, most studies are based on the perspective of the overall project life cycle (e.g., Chen, 2014; El-Sayegh, 2008; Oke and Idiagbon-Oke, 2010; Scott-Young and Samson, 2008). Relatively few focus on the perspective of the project execution phase. Some existing studies analyze how project-management performance in the project execution phase affects project outcomes (e.g., Chen, 2014; Hoegl and Parboteeah, 2007; Tabassi and Bakar, 2009), their treatment, however, is contemporaneous in nature. Moreover, little of the focus of these studies' analyses has been on how changes in project-management performance in the execution phase affect project outcomes.

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The first objective of this study, therefore, is to conduct a longitudinal experiment that develops a project-outcome measurement model based on examining the predictive power of changes in project-management performance in the project execution phase. The second objective is to assess, through hierarchical logistic regression analysis, how well the model predicts project failure at completion.

In this study, capital projects served as the basic unit of analysis. The capital project industry includes both the delivery and the maintenance of facilities (e.g., institutional, commercial, and residential buildings; communication, transportation, and energy systems; as well as environmental and industrial facilities). Our focus is on the delivery process of buildings, transportation facilities, environmental facilities, and industrial facilities, e.g., from the initiating to closing phases of projects.[1]

The rest of the paper is organized as follows. Section 2 reviews related studies, Section 3 describes the sample collection and presents the research methodology, and Section 5 depicts the performance-measurement model, and the forecasting-model building and validation. Section 6 discusses the implications of the research results. Section 6 presents the research summary and conclusions.

2. Research background

A paramount question of project-performance management is how to scientifically engineer critical factors and issues to ensure project success. Questions regarding how to manage critical issues systematically and thus enhance project management performance take center stage in the research (Chen, 2011). Naturally, numerous academics and practitioners perform extensive research to develop project management models through examining and identifying the determinants of project-management performance (e.g., Hoang and Rothaermel, 2005; Schwab and Anne, 2008; Scott-Young and Samson, 2008; Wallace et al., 2004).

For example, using the data from 507 software project managers, Wallace et al. (2004) examine the impact of social subsystem risk, technical subsystem risk, and project-management risk on project performance using the structural-equations modeling technique. Their results show that social-subsystem risk significantly affects technical-subsystem risk, which, in turn, influences project-management risk, and ultimately, project performance. Hoang and Rothaermel (2005) use binary logistic analysis to examine the performance of 158 joint research and development (R&D) projects in 43 pharmaceutical firms; they find that the general alliance experience of biotechnology partners, but not of pharmaceutical firms, positively affects joint project performance.

Ho (2006) examines when and how government would initiate a rescue program for a failing project and what the impacts of government's rescue behavior on project procurement and management are. He then develops a game-theory based model to provide theoretic foundations for prescribing effective public–private partnership (PPP) project procurement and management practice. Maytorena et al. (2007) use a combined method of the active information search (AIS) and the cognitive mapping (CM) approach to interview 51 project managers and conclude that information search style, level of education, and risk management training play a significant role in risk identification performance, which in return affects project performance.

Busby and Zhang (2008) examine 13 capital projects using a pathogen approach and concludes that the fundamental causes of project failure are typically decisions, practices, or other basic entities within a project, not external events. Concurrently, Schwab and Anne (2008) examine 239 U.S. movie projects from 1931 to 1940 and determine, using regression analysis, that project performance depends on the perceived relevance of prior performance and on organizational control over project participants.

Subsequent work by Anand et al. (2010) analyzes 98 projects in five companies using hierarchical regression. They show that the inclusion of softer, people-oriented practices for capturing tacit knowledge explains a significant amount of variance in project success. Jani (2011) employs a computer simulation-based experiment to investigate the influence of individual self-efficacy and project risk factors on the perception of risk, using the scenario of a failing IT project. He finds that project managers are more likely to underestimate the risks of a project with endogenous risk factors, and that project managers with higher self-efficacy may underestimate the risks of a troubled IT project as compared to project managers with lower self-efficacy.

Recently, Chou and Yang (2012) use the structural equation modeling (SEM) technique to prioritize the practice of the *PMBOK Guide* in the capital project industry. Based on a sample of 127 project managers and stakeholders, they reveal the interrelationships between the *PMBOK Guide* and project performance. Chen (2013) analyzes 121 capital projects and identifies key variables in the initiation and planning phases of projects that differentiate between healthy and distressed projects at completion. He then demonstrates that it is feasible to discriminate simultaneously between healthy and distressed projects prior to the project execution phase.

Despite the panoply of studies that use a wide variety of measures to describe project-management performance and the input characteristics that affect project outcomes, most studies concentrate on the perspective of the overall project life cycle (e.g., Chen, 2014; El-Sayegh, 2008; Oke and Idiagbon-Oke, 2010; Scott-Young and Samson, 2008; Wallace et al., 2004). For example, Scott-Young and Samson (2008) analyze 56 capital projects in 15 process-industry companies using factor analysis and regression analysis and reveal that organizational context, team leadership, team design, and team process factors

[1] Capital projects have several important characteristics. They (1) involve long-lived assets (e.g., buildings, bridges and roads); (2) typically involve the delivery of a project; (3) usually require long-range planning and extensive financing; and (4) have a project-life focus, rather than a year-to-year focus (Granof and Khumawala, 2012). In addition, one of the major reasons for this study to include a wide range of capital projects is due to the difficulty of data collection. In particular, our research design is longitudinal in nature that considerably increases the difficulty of data collection. To include a wide range of capital projects enables us to maximize our sample size.

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