

Mediated effect of project management asset characteristics on firm performance

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Abstract

Purpose – The purpose of this paper is to study how project-level performance mediates the effect of project management assets on firm-level performance by examining the direct and mediated relationships between the project management process characteristics: valuable, rare, inimitable and organizationally supported on project-level and firm-level performance outcomes.

Design/methodology/approach – This paper analyzes data from an online survey completed by 198 North American Project Management Institute® members. Linear regression and Sobel Tests are used to examine the relationships between nine factors extracted from an exploratory factor analysis that comprise project management asset characteristics, one factor that comprises project-level performance outcomes, and one factor that comprises firm-level performance outcomes.

Findings – Not only does project-level performance positively and significantly affect firm-level performance, but project-level performance also significantly mediates the effect of project management asset characteristics (for all nine factors) on firm performance.

Research limitations/implications – Limitations of this study include sample size and self-report bias, calling for a larger sample in ongoing research.

Practical implications – This study contributes to the stream of literature on project management assets as sources of competitive advantage and makes the case for sustained organizational investments in the project management process.

Originality/value – This paper contributes to the limited, but increasing interest in applying the resource-based view of the firm to project management capabilities as a source of competitive advantage.

Keywords Competitiveness, Firm performance, Project management, Strategic management, Resource-based view, Strategic resources, Project management performance, Project management resources

Paper type Research paper

This paper presents findings from a continuing investigation of project management assets as sources of firm competitiveness. The objective of the research is to contribute to an improved understanding of project management as a source of competitive advantage for management theory and practice. The broad question driving the research is: What characteristics of project management assets lead to competitive advantage for a firm?

This work builds on prior strategic management research that theorizes that resources of a firm, that are valuable, rare, difficult to imitate and in addition, are organizationally supported to leverage value are sources of competitive advantage (Barney, 1991, 2011;

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Barney and Wright, 1998). In the associated framework, referred to as Barney's VRIO framework, a resource that has organizational support contributes to competitive parity by being valuable; it contributes to temporary competitive advantage if it is both valuable and rare; and it provides sustained competitive advantage if it is valuable, rare and inimitable. Prior empirical research has examined the competitive characteristics of project management assets – valuable, rare, inimitable and organizationally supported (Jugdev and Mathur, 2006; Jugdev *et al.*, 2007; Mathur *et al.*, 2007). Empirical testing of Barney's VRIO framework shows the relationship between the project management asset characteristics valuable (V), rare (R), inimitable (I) and organizationally supported (O) as independent variables and project-level performance (P) and firm-level performance (F) as dependent variables (Mathur *et al.*, 2014). These prior studies, while examining project and firm performance as dependent variables, do not examine the impact of project performance on firm performance. It is also not clear if the investment in project management assets with these competitive characteristics (VRIO characteristics) affects firm performance through the project management process or more generally through strengthening other organizational processes. A better understanding of the mediating role of project performance would have implications for an investment in project management assets as well as the measurement and reward of project performance. The research presented in this paper attempts to address this gap in understanding by examining the relationships linking project management assets, project-level performance and firm-level performance.

This manuscript adds to the understanding of the effect of project management asset characteristics on firm performance, mediated by project management performance. The central hypothesis is: Project-level performance mediates the effect of the VRIO characteristics of project management assets on firm-level performance. The conceptual model in this study deviates from prior models (Mathur *et al.*, 2014) in proposing project management performance as a mediating variable between project management asset characteristics and firm-level performance outcomes. The research draws on data collected from responses to an online survey by 198 North American Project Management Institute® members (Mathur *et al.*, 2013). Six factors that comprise valuable, rare and inimitable characteristics of project management assets, three factors that comprise organizational support for project management assets and two factors that comprise project management performance outcomes – project-level and firm-level performance – were extracted using exploratory factor analysis (EFA) with varimax rotation. The relationships between project management asset characteristics, project-level performance and firm-level performance are examined in this paper. The proposed high-level conceptual model and the hypothesized direct and mediated relationships between these factors are examined using the Sobel Test.

A contribution of this research is that it empirically examines and highlights the importance of investing in project management assets that are valuable, rare and inimitable and organizationally supporting them. Furthermore, the findings on project management performance as the mediating variable between these asset characteristics and firm performance imply that a firm should go beyond investing in project management assets; it makes a case for the firm to measure and reward project management performance.

The sections that follow include a literature review, the conceptual model and hypotheses, the study methodology, summarized results of the EFA, the results of the linear regression and Sobel Tests, and a discussion of findings and conclusions.

Literature review

An earlier article by Mathur *et al.* (2013) presented a literature review on the resource-based view of the firm (RBV), outlined the related VRIO framework, and discussed it in relation to project management resources. In this paper, the literature review provides an overview of

the RBV and highlights empirical contributions to the field of project management based on the RBV and the VRIO framework.

The RBV, which is also known as the resource-based theory, is a strategic management theory that focuses on the firm, rather than emphasizing the external environment (Porter, 1998). Derivative views of the RBV include the knowledge-based view (Grant, 1996), the natural RBV (Hart, 1995) and dynamic capabilities (Teece *et al.*, 1997). Viewed as an analytical tool (Peteraf and Barney, 2003), the RBV is a complement to the externally focused five forces model on industry attractiveness (Porter, 1998). The RBV explains performance differences among competitors based on their “superior in use” (Peteraf and Barney, 2003, p. 311) resources as controlled by the firm. Superior in use resources make the company more efficient and effective by producing more economically and satisfying customer expectations to create more value. Thus, the RBV is a theory of sustainable competitive advantage. To achieve a competitive advantage over rivals, a firm’s superior advantage is either temporary or sustained (Barney, 1986) and firms that achieve below normal financial performance risk survival.

In her classic book *The Theory of the Growth of the Firm*, Penrose (1959) first introduced the RBV by explaining that all firms consist of resource bundles. The term resource spans resources and capabilities (Wernerfelt, 1989). Broadly, organizational resources are bundles of tangible or intangible assets. Further resource classifications span physical capital resources (e.g. physical technology and plant and equipment), human capital resources (e.g. training, experience and relationships) and organizational capital resources (e.g. formal reporting structures and control and coordination systems) (Barney, 1991).

The RBV “focuses on the idiosyncratic, costly-to-copy resources controlled by a firm – resources whose exploitation may give a firm a competitive advantage” (Barney, 2011, p. 133). This definition encapsulates the two main assumptions of the RBV. *Idiosyncrasy* refers to the heterogeneous nature of each firm’s unique bundles of productive resources. Resource heterogeneity precedes the other attributes of competitive advantage (Peteraf and Barney, 2003). *Costly-to-copy* addresses resources’ immobility (Barney, 2011), meaning that the resources’ differences are lasting.

Barney’s (1991) original RBV framework discussed resource attributes of value, rarity, inimitability, and non-substitutability. “Barney (1995) has come to regard substitutability as a sub-dimension of inimitability (making duplication and substitution two different dimensions of inimitability) and inimitability has come to be seen as a prerequisite for rareness” (Andersén *et al.*, 2016, p. 373).

To elaborate on the VRIO framework, the resource *value* question asks, “Do a firm’s resources and capabilities enable the firm to respond to environmental threats or opportunities? In order for a firm’s resources and capabilities to be strengths, they must enable a firm to exploit environmental opportunities or neutralize environmental threats” (Barney, 2011, p. 125). The resource *rarity* question asks, “How many competing firms already possess particular valuable resources and capabilities?” (p. 127). The resource *imitability* question concentrates on whether firms without the specific resources are at a cost disadvantage in developing or obtaining that resource and asks, “Do firms without a resource or capability face a cost disadvantage in obtaining it compared to firms that already possess it?” (p. 128). Inimitability is also referred to as imperfectly imitable (Lippman and Rumelt, 1982). Inimitability is due to three isolating mechanisms – unique historical conditions (path dependence), causal ambiguity (Reed and DeFillippi, 1990) and social complexity (Barney, 1991; Dierickx and Cool, 1989). *Path dependence* means that it takes time to develop unique and heterogeneous resources. *Causal ambiguity* refers to the process of capability development being unclear to rivals. Finally, *social complexity* means that not all resources can be transactionally traded. Examples of inimitable resources include reputation, trust, friendship, teamwork and culture (Barney, 1995).

Andersén *et al.* (2016) analyzed 218 RBV empirical studies to examine how researchers measured immobility. They report, “17% of the studies directly measured some dimension of immobility (by, for example, actually measuring the level of social complexity, unique history, tacitness, or tradability). Fewer than 2% of the studies measured the outcome of resource immobility, i.e., sustained performance differences” (p. 371). Out of the 61 studies that directly measured resource immobility, ten studies measured tacit knowledge. Finally, the resource question of *organization* focuses on the firm’s policies and procedures that help leverage the value of the resources and asks, “Is a firm organized to exploit the full competitive potential of its resources and capabilities?” (Barney, 2011, p. 134).

Evolving theories are often referred to as views or perspectives. Over time, some theories mature and others decline in use. The RBV has evolved to a stage of maturity through the lifecycle stages of introduction (1959–1991), growth (1992–1999) and maturity (2000–present) (Barney *et al.*, 2011). During the introduction stage, key contributions focused on the concepts of the RBV and included salient empirical publications on topics such as CEOs as firm resources with idiosyncratic qualities and organizational identity as a core competency (Barney *et al.*, 2011). In the growth stage of theory development, the RBV debates centered on tautological challenges (Priem and Butler, 2001a, b). These arguments were countered (Barney, 2001; Peteraf and Barney, 2003) with the justification that when Barney (1991) first introduced the competitive advantage framework, he could have positioned the RBV using the structure–conduct–performance theory, neoclassical microeconomics or evolutionary economics but chose the structure–conduct–performance theory. The three approaches “provide a body of related yet distinct resource-based theoretical tools that can be applied in different ways in different contexts” (Barney *et al.*, 2001, p. 626). Researchers interested in examining the specific resources contributing to a competitive advantage for a firm, link their research to the basic logic of Barney’s (1991) paper based on the structure–conduct–performance theory (Peteraf, 1993). Currently in the mature stage of theory development, the broader use of the RBV reflects theory sophistication and precision (Barney *et al.*, 2011).

To highlight some of the contributions by Barney, based on the VRIO framework, Mackey and Barney (2005) examined strategic leadership as a source of competitive advantage. Barney and Wright (1998) applied the VRIO framework to the human resources function (involving programs, policies and practices, such as knowledge, experience, skill and commitment). In the IT domain, Barney and Ray (2015) examined IT resource bundles and their ability to create value for the customer service process. In their research on IT providing a competitive advantage in customer service, Ray *et al.* (2005) emphasized the importance of assessing the intermediate or process-level contributions of the value of IT, in terms of how it supports activities and processes, before its higher order value at the enterprise level. Ray *et al.* (2013) explored the role of IT in moderating the relationship between assets and firm scope with respect to vertical integration and diversification. Barney (2012) applied the VRIO framework in operations management to examine purchasing and supply chain management. As part of the introduction to an entire issue in the *Journal of Management* on the RBV titled “Resource-based theory: 20 years of accomplishments and future challenges,” the RBV was described as “one of the most prominent and powerful theories for understanding organizations” (Barney *et al.*, 2011, p. 1299). Empirical studies indicate that the RBV has contributed extensively to various managerial domains such as human resource management, economics and finance, entrepreneurship, marketing and international business (Barney *et al.*, 2011, 2001). To exemplify some applications of the RBV in operations management and project management, research has examined supply chain visibility (Barratt and Oke, 2007), software service industry capabilities (Ethiraj *et al.*, 2005), the manufacturing strategy process (Paiva *et al.*, 2008) and operational improvements and innovation routines as distinct bundles (Peng *et al.*, 2007).

Researchers in project management have investigated the importance of linking project management to strategy. For example, Srivannaboon (2006) conducted an inductive study to explore alignment between the competitive facets of the firm's business strategy (Porter, 1998) that drive the focus and content of project strategy, organization, process, tools, metrics and culture. However, there is limited empirical work that applies RBV and the VRIO framework to the field of project management. In an early study, DeFillippi and Arthur (1998) used the case study approach to explore the accrual and transfer of knowledge-based competences within film industry projects. More recently, a stream of project management research anchored in the RBV and the related process-oriented VRIO framework (Jugdev and Mathur, 2006; Jugdev *et al.*, 2007; Mathur *et al.*, 2007, 2014). This research examined project management assets, the VRIO characteristics of these assets, and the relationships between the assets and their characteristics, and project performance and firm performance outcomes. The research moved attention away from the traditional view of project management as an operational construct emphasizing tangible resources (e.g. tools and techniques, templates and software) toward a more strategic view that considers intangible project management resources (e.g. communities of practice, job shadowing and mentoring) as sources of competitive advantage.

The importance of developing intangible project management assets as sources of competitive advantage was empirically examined in a survey of project managers, using an instrument drawing on the RBV literature (Jugdev and Mathur, 2006; Jugdev *et al.*, 2007; Mathur *et al.*, 2007). Based on a conceptual model that links tangible and intangible assets and the VRIO characteristics of the project management process, structural equation models were used to examine relationships between factors extracted for project management assets and project management process characteristics using EFA (Jugdev *et al.*, 2007). Subsequently, the mediating role of intangible assets in the relationship between tangible assets and the VRIO characteristics of the project management process was examined with a modified conceptual model (Mathur *et al.*, 2007). The findings supported the importance of intangible project management assets. Assets involving sharing know-how were found to be a determinant of competitive advantage from the project management process, both directly and in a mediating role between tangible assets and process outcomes. In contrast, tangible project management assets were not direct sources of competitive advantage. Two tangible asset factors (project management maturity and sharing know-what) significantly predicted the project management process as being rare when mediated by sharing know-how. However, none of the tangible asset factors directly predicted the project management process as being rare. In their discussion on the degree of competitive advantage offered by the tangible and intangible factors, the authors noted that the tangible assets were important but not sufficient to develop a temporary competitive advantage.

The links between the project management process characteristics and project management performance outcomes, based on RBV theory and the VRIO framework, have been empirically researched more recently (Mathur *et al.*, 2014). The authors extend their prior research by proposing relationships between the VRIO characteristics of project management assets and project management performance outcomes. They collected data using a survey of North American project managers. Using EFA, they identified the factors that comprise the valuable, rare and inimitable characteristics of project management assets, organizational support for these assets, and project management performance outcomes. Hierarchical linear regression models were used to test hypotheses for each project management asset characteristic predicting a dependent variable. They found that for project-level performance, organizational support for project management assets explains 48.1 percent of the variance in performance, valuable assets explain 33.0 percent, inimitable assets explain 14.8 percent and rare assets explain 8.9 percent. For firm-level performance, they found that organizational support for project management assets explains 38.8 percent of the variance in performance, valuable assets explain 16.4 percent,

inimitable assets explain 15.6 percent and rare assets explain 3.0 percent. The most significant factors included project management integration, valuable project management knowledge, inimitable proprietary tangible assets and inimitable embedded intangible assets.

Building on the importance of intangible assets as sources of competitive advantage, in the IT project management sector, Ashrafi and Mueller (2015) examined the relationships between IT resources (human resources, knowledge resources and relationship resources), IT capabilities (strategic planning and the tactical deployment of IT projects) and the resulting tactical deployment of IT projects leading to an IT competitive advantage and, in turn, improved business financial performance. They found that in contrast to tangible IT resources, the intangible “competitive business strategies together with the competence of senior IT executives play the most important role in creating the strategic value of IT in organizations” (p. 15). Perkins *et al.* (2018) also adopted the RBV lens in their empirical study on IT project management capability, which was designed to replicate prior research on linking the characteristics of project management assets to project management performance outcomes. Ghapanchi *et al.* (2014) also used the RBV to examine the defect-fixing process in open-source software projects. They found that developer interest, user contributions and frequent releases enhanced defect-fixing. In a broader set of sectors (construction, engineering, manufacturing/production and government) Kim *et al.* (2015) studied Korean firms to examine the impact of project management assets on the VRIO characteristics of the project management process. Their findings were that intangible project management assets result in the process contributing to competitive advantage both directly and by mediating the relationship between tangible project management assets and the characteristics of the project management process.

Recent graduate dissertations in project management have also adopted the RBV as a lens with which to study project management resources as sources of strategic advantage. For example, Bakar (2011) explored the relationship between firm resources and product innovation performance in small and medium-sized manufacturing enterprises. Isreal (2014) used the VRIO framework to study competitive advantage in Malaysian super multimedia corridor companies. Shuaib (2016) studied engineering change processes and leadership as constructs influencing project success in Saudi Arabian projects. Wen and Qiang (2016) considered the Organizational Project Management Maturity Model (Project Management Institute, 2013) with the RBV lens as drivers of business value in Chinese projects. Nanthagopan *et al.* (2016) used the VRIO framework in a pilot study followed by case studies to examine intangible resources and project success. More recently, Alameri (2018) examined the relationship between intangible project management resources and project success in public sector projects in Abu Dhabi.

Although the scope of this study is restricted to the application of the VRIO framework to project management as a source of competitive advantage, there is related research that provides promising directions for future work. Several scholars examine benefits realization management and how it influences project success and the execution of business strategies (Ashurst *et al.*, 2008; Breese *et al.*, 2015; Peppard *et al.*, 2007; Serra and Kunc, 2015). Benefits realization management involves “a set of processes structured to close the gap between strategy planning and execution by ensuring the implementation of the most valuable initiatives” (Serra and Kunc, 2015, p. 53) and emphasizing return on investment (Ashurst *et al.*, 2008; Peppard *et al.*, 2007). A recent empirical study shows that benefits realization practices are “positive predictors to project success on the creation of strategic value for the business” (Serra and Kunc, 2015, p. 53). Ashurst *et al.* (2008) used the RBV lens to develop a benefits realization capability model and, using IT projects, empirically examined benefits realization capabilities, competences and practices. More recently, other scholars (Müller, 2017; Musawir *et al.*, 2017) have examined the relationship between project governance, organizational success and organizational outcomes. Other research anchored in the behavioral view of

decision making uses simulations to examine resource conceptualization, resource development and firm performance (Kunc and Morecroft, 2010). In a recent publication, Wang *et al.* (2017) reported on their system dynamic behavioral model that evaluates value realization from project implementation under conditions of strategic and tactical uncertainty.

What is missing in the body of empirical work that specifically applies the RBV and the VRIO framework to project management is an understanding of the mediating effect of project performance on the relationship between project management assets and firm performance. The prior studies, while examining project and firm performance as dependent variables, do not examine the impact of project performance on firm performance. It is important to understand if the investment in project management assets with VRIO characteristics affects firm performance through the project management process or more generally through strengthening other organizational processes. A better understanding of the mediating role of project performance would have implications for an investment in these assets, as well as the measurement and reward of project performance. The research presented in this paper attempts to address this gap by empirically examining how project-level performance mediates the effect of the V, R, I and O characteristics of project management assets on firm-level performance. This paper presents an extended conceptual framework, hypothesizes the relationships and reports on empirical research that tests these relationships.

Conceptual model

This study uses a high-level conceptual model based on Barney's (2011) VRIO framework to link the characteristics of project management assets (as independent variables) to firm-level performance outcome (the dependent variable), in direct relationships and mediated by project-level performance (Figure 1). Project management assets can have one or more of the following characteristics: valuable (V), rare (R), inimitable (I) and being organizationally supported (O). It is expected that these characteristics of the project management process (V, R, I, O) will affect project management performance outcomes, both project-level and firm-level performance, thereby contributing to competitive advantage.

Strategic management research by Barney (VRIO framework) theorizes that strategic assets that are valuable, rare, inimitable and organizationally supported are sources of competitive advantage. Previous empirical research reports on factors that constitute project management strategic assets and links them to the achievement of the VRIO characteristics of the project management process (Jugdev and Mathur, 2006; Jugdev *et al.*, 2007; Mathur *et al.*, 2007). Additional research links these project management process characteristics to project management performance outcomes (project-level performance and firm-level performance) (Mathur *et al.*, 2014). Empirical testing of the Barney VRIO framework shows the relationship

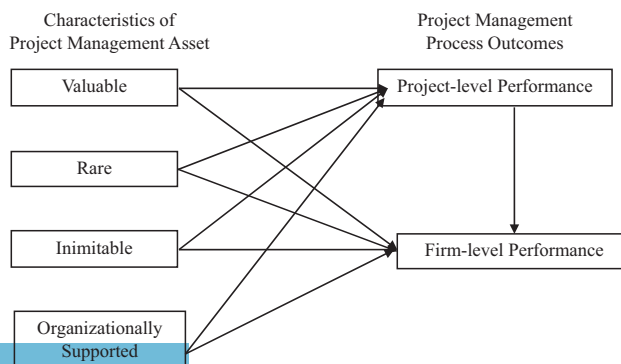


Figure 1.
Conceptual framework

between the project management asset characteristics V, R, I and O as independent variables and project-level performance (P) and firm-level performance (F) as dependent variables (Mathur *et al.*, 2014). Figure 1 extends the conceptualization in this prior study to include the mediating effect of project-level performance on the relationship between the independent variables and firm-level performance.

The central hypothesis for this study is: Project-level performance mediates the effect of the VRIO characteristics of project management assets on firm-level performance. The VRIO characteristics of project management assets increase firm-level performance via increased project-level performance. The direct and mediating effects in the relationship between project management asset characteristics, project-level performance and firm-level performance (conceptualized in Figure 1) are tested using linear regression and Sobel Test with the model in Figure 2.

It is expected that the valuable (V), rare (R), inimitable (I) and organizationally supported (O) characteristics of project management assets (the independent variables) have a positive effect on project-level performance (P the mediator). It is expected that the mediator (P) positively predicts the dependent variable (F). It is expected that the valuable (V), rare (R), inimitable (I) and organizationally supported (O) characteristics of project management assets have a positive effect on firm-level performance (F), but that the effect of the independent variables on F decrease in the presence of P. The central hypothesis of the paper is: The effect of V, R, I and O on F is mediated by P. The following associated hypotheses are examined in the sections that follow to determine if the effect of V, R, I and O on F is mediated by P:

- V, R, I and O positively predict P;
- P positively predicts F;
- V, R, I and O positively predict F; and
- V, R, I and O do not have a direct effect on F, in the presence of P.

Using data from an online survey completed by 198 North American Project Management Institute® members, the methodology section that follows addresses the EFA extracted factors that comprise the project management asset characteristics, project-level performance and firm-level performance. Linear regression and Sobel Tests are used to examine the relationships between the factors.

Methodology

This section highlights the study methodology. A prior publication (Mathur *et al.*, 2013) provides survey details including a copy of the instrument and complete EFA results. The researchers used an existing valid and reliable survey instrument based on Barney's (2011) VRIO framework, items from the strategic management literature (Barney and

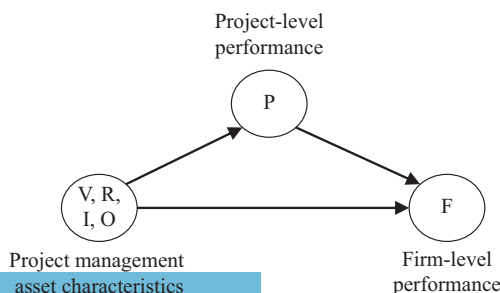


Figure 2. Mediating effect of project-level performance (P) on relationship between project management asset characteristics (V, R, I, O) and firm-level performance (F)

Wright, 1998; Chakraborty, 1997; Mata *et al.*, 1995), project management success (Belassi and Tukel, 1996; Pinto and Slevin, 1988; Shenhar *et al.*, 2002; Wateridge, 1998) and project management practices (Barczak *et al.*, 2007; Besner and Hobbs, 2002; White and Fortune, 2002). This literature guided survey development. The concepts of the VRIO framework and project management were captured in the items. Additionally, the project management practices literature guided item development on tools and techniques as well as project management resources.

The survey consisted of 17 closed-ended questions plus an open-ended question. The survey questions were designed to focus on the constructs of interest: valuable, rare, inimitable, organizational alignment, project communication, organizational integration, project-level performance and firm-level performance. More specifically, as defined in the prior publication (Mathur *et al.*, 2013, p. 117):

- Question 1 addressed valuable project management resources with 12 items;
- Question 2 addressed rare project management resources with 12 items;
- Question 3 addressed inimitable project management resources with 12 items;
- Question 4 addressed the overall maturity of the project management process with one item;
- Question 5 addressed the organizational alignment of project management practices with the company's mission, services and products and the construct organizational support with three items;
- Question 6 addressed project communication and the construct organizational support with three items;
- Question 7 addressed organizational integration and the construct organizational support with five items;
- Question 8 addressed impact of project management resources on project-level performance with five items;
- Question 9 addressed impact of project management resources on firm-level performance with six items;
- Questions 10–17 addressed demographics; and
- Question 18 was open-ended.

The instrument was based on a seven-point ordinal Likert scale with the anchors as “Strongly Agree” and “Strongly Disagree.” As the unit of analysis was the project management process, participants were asked to respond to the questions in the context of projects within the past year. This minimized retrospective bias.

The study followed standard survey design guidelines (Couper *et al.*, 2001; Dillman *et al.*, 1993; Fowler, 1992; Groves *et al.*, 2009). To improve external validity, a randomly generated mailing list ($n = 4,000$) was purchased from the Project Management Institute®, and participants invited by mail to complete the survey. The list reflected Canadian and American membership with the Association. The 240 respondents were provided with a link to the survey, which was hosted at Zoomerang® (now SurveyMonkey®). The researchers sent two e-mail reminders to study participants. Although 315 letters (7.9 percent) were undeliverable, the researchers secured a response rate of 212 (5.75 percent), which is considered fair for internet surveys (Tabachnick and Fidell, 2013). Since the researchers could only follow-up with those expressing interest in completing the survey, there was self-report bias. Following data cleaning, the final sample size was 198. With 55 percent holding advanced degrees, 80 percent of survey respondents also had their project management professional designation.

The male to female ratio was 3:1 (74.7 percent male to 25.3 percent female). Approximately 60 percent worked as project managers with 30 percent in senior-level capacities. Participants worked primarily in information technology, financials, government and healthcare sectors. Approximately half of the participants were from companies 0–50 years old. Approximately half of the participants worked at companies with over 5,000 employees.

Exploratory factor analysis results

IBM SPSS® v. 21 was used for the statistical analyses. For the EFA, the researchers used the principal components extraction method (Tabachnick and Fidell, 2013). Eigenvalues greater than 1 were used to extract reliable factors, and 0.40 was used as a cut-off to identify items with the highest loadings for inclusion with a factor (Conway and Huffcutt, 2003). The analysis extracted a total of nine factors: two factors each for the independent variables valuable (V1, V2), rare (R1, R2) and inimitable (I1, I2) characteristics of project management resources; three factors for the independent variable organizationally supported (O1, O2, O3); one factor for the mediator variable project-level performance (P); and one factor for the dependent variable firm-level performance (F). A reliability coefficient of 0.70 or higher is acceptable in the social sciences (Nunnally, 1978). All extracted factors had Cronbach's α greater than 0.7. Summarized results of the factor analysis with varimax rotation are provided in Table I, including the labels assigned to each factor, the percentage variance explained by it, Cronbach's α , the range of factor loadings for the items and the items that define the factor. The labels were assigned based on the items that constitute the factor.

Linear regression and Sobel Test results

For each of the nine factors representing project management asset characteristics (independent variables), V1, V2, R1, R2, I1, I2, O1, O2 and O3, the researchers examined the following hypotheses (see Figure 2) using linear regression (IBM SPSS® v. 21) and Sobel Tests. In Figures 3–11, the results of the linear regression are provided for each path, including the path coefficient, standard error, p -value and t -value. The central hypothesis of the paper is: The effect of V, R, I and O on F is mediated by P. The Sobel Test was used to examine if P mediates the effect of each independent variable on F, without controlling for any other independent variable:

- H1. The project management asset characteristics V, R, I and O positively predict P.
- H2. P positively predicts F.
- H3. The project management asset characteristics V, R, I and O positively predict F.
- H4. The project management asset characteristics V, R, I and O do not have a direct effect on F, in the presence of P.

The Sobel (1982) test and the online Sobel calculator (Preacher and Leonardelli, 2003) were used to examine the significance of mediation effects in the model. The Sobel Test provides “an approximate significance test of the indirect effect of the independent variable on the dependent variable via the mediator” (Baron and Kenny, 1986, p. 1177). The mediation effect is statistically significant when the resultant reduction in the effect of the independent variable (by taking the mediator in the model into account) reflects a significant reduction. The authors conclude that the mediating effect is strongly significant if $p < 0.01$, moderately significant if $0.01 \leq (p < 0.05)$, and weakly significant if $0.05 \leq (p < 0.10)$ (Baron and Kenny, 1986).

V1: valuable project management resources (project management knowledge):

Results of linear regression and Sobel Test are provided in Figure 3. The Sobel Test indicates that the hypothesis, P mediates the effect of V1 on F, is significantly supported ($z = 6.916, p < 0.001$). Results of the linear regression validate H1–H4 for V1:

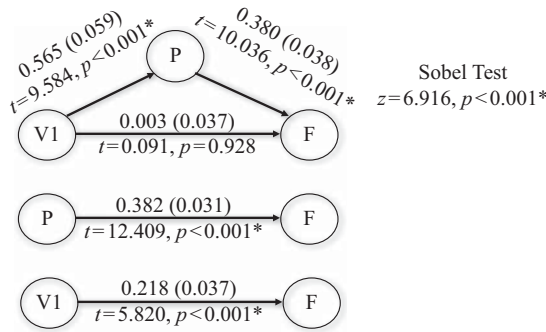
- H1: V1 has a positive effect on P – significantly supported.

Factor	Variance explained (%)	Cronbach's α	Factor loadings	Items constituting factor
V1: valuable project management resources (project management knowledge)	42.6	0.863	0.609–0.815	Project job shadowing, project management methodologies, project management offices, project management templates, databases and printed project management material
V2: valuable project management resources (IT tools)	22.7	0.703	0.847–0.855	Computer hardware and software
R1: rare project management resources (knowledge sharing processes)	35.0	0.849	0.628–0.791	Project job shadowing, project mentoring, project databases, project management communities of practice, project management offices and printed project management material
R2: rare project management resources (knowledge sharing tools and techniques)	31.5	0.895	0.732–0.917	Project software, project computer hardware, project management methodologies and project management templates
I1: inimitable project management resources (proprietary tangible assets)	36.2	0.877	0.678–0.846	Difficult to imitate project-management-related software, computer hardware, databases, project management methodologies, printed project management material and project management templates
I2: inimitable project management resources (embedded intangible assets)	30.4	0.866	0.768–0.846	Difficult to imitate project social capital, tacit project management knowledge, project management communities of practice and mentoring
O1: project management alignment	84.0	0.904	0.896–0.928	The importance of the quality of project management practices to the company's mission, services and products
O2: project management communication	82.6	0.893	0.881–0.925	Ability to communicate upward in the project hierarchy, upward in the company hierarchy, and openly on the project
O3: project management integration	71.9	0.900	0.774–0.884	A company environment that promotes sharing of knowledge/information, a company environment that encourages learning, people trusting each other, people working well together and upper management support, even in critical project phases
P: project-level performance	78.9	0.932	0.846–0.913	Achievement of project scope requirements, project schedules, customer expectations, quality of deliverables and project costs through project management processes
F: firm-level performance	69.8	0.912	0.806–0.856	Achievement of sales targets, customer loyalty, profitability levels, market share, continuous innovation and customer satisfaction through project management resources and capability

Table I.
Summary of
EFA results

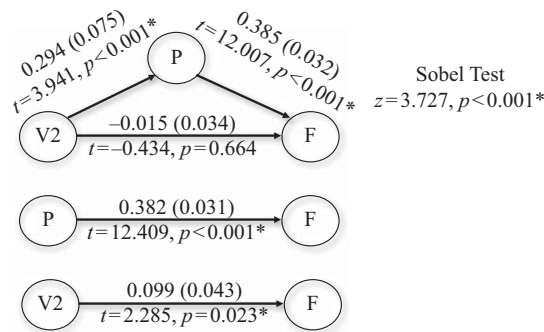
Source: Adapted from Mathur *et al.* (2013)

- *H2*: P has a positive effect on F – significantly supported.
- *H3*: V1 has a positive effect on F – significantly supported.
- *H4*: V1 does not have a direct effect on F, in the presence of P – significantly supported.



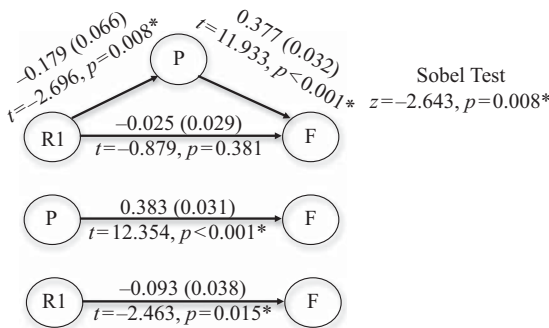
Notes: Standard error of *b* coefficient reported in parentheses. *Significant at 0.05 level

Figure 3. Linear regression and Sobel Test results for effect of V1 on F, mediated by P



Notes: Standard error of *b* coefficient reported in parentheses. *Significant at 0.05 level

Figure 4. Linear regression and Sobel Test results for effect of V2 on F, mediated by P



Notes: Standard error of *b* coefficient reported in parentheses. *Significant at 0.05 level

Figure 5. Linear regression and Sobel Test results for effect of R1 on F, mediated by P

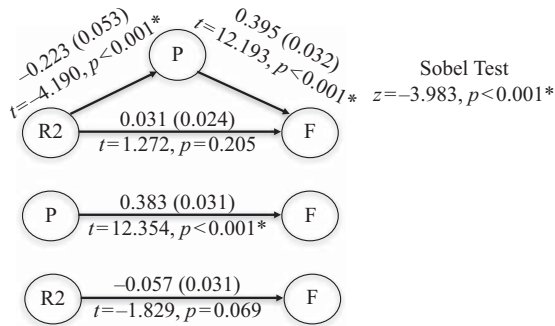


Figure 6.
Linear regression and Sobel Test results for effect of R2 on F, mediated by P

Notes: Standard error of b coefficient reported in parentheses. *Significant at 0.05 level

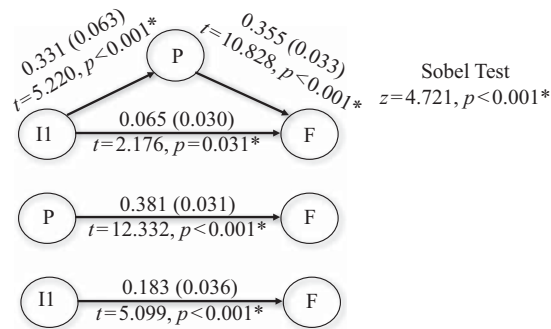


Figure 7.
Linear regression and Sobel Test results for effect of I1 on F, mediated by P

Notes: Standard error of b coefficient reported in parentheses. *Significant at 0.05 level

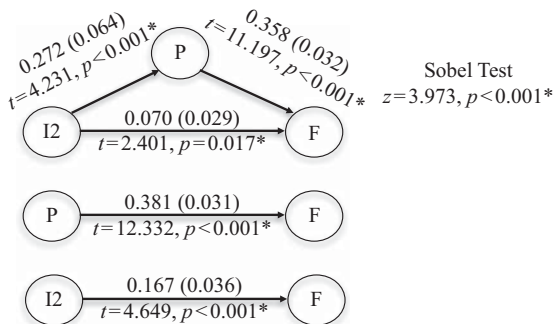
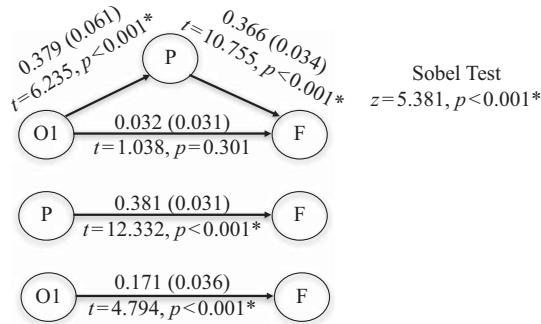


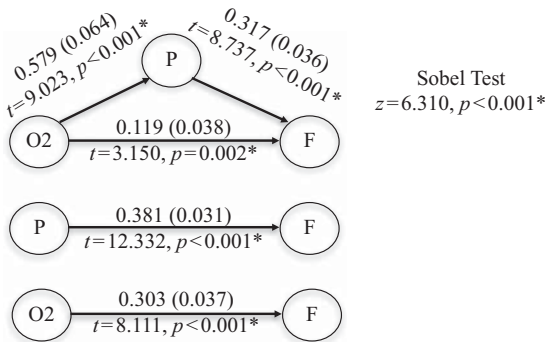
Figure 8.
Linear regression and Sobel Test results for effect of I2 on F, mediated by P

Notes: Standard error of b coefficient reported in parentheses. *Significant at 0.05 level



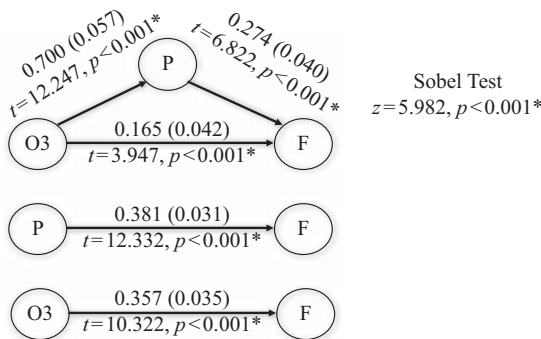
Notes: Standard error of b coefficient reported in parentheses. *Significant at 0.05 level

Figure 9.
Linear regression and
Sobel Test results for
effect of O1 on F,
mediated by P



Notes: Standard error of b coefficient reported in parentheses. *Significant at 0.05 level

Figure 10.
Linear regression and
Sobel Test results for
effect of O2 on F,
mediated by P



Notes: Standard error of b coefficient reported in parentheses. *Significant at 0.05 level

Figure 11.
Linear regression and
Sobel Test results for
effect of O3 on F,
mediated by P

V2: valuable project management resources (IT tools):

Results of linear regression and Sobel Test are provided in Figure 4. The Sobel Test indicates that the hypothesis, P mediates the effect of V2 on F, is significantly supported ($z = 3.727, p < 0.001$). Results of the linear regression validate *H1-H4* for V2:

- *H1*: V2 has a positive effect on P – significantly supported.
- *H2*: P has a positive effect on F – significantly supported.
- *H3*: V2 has a positive effect on F – significantly supported.
- *H4*: V2 does not have a direct effect on F, in the presence of P – significantly supported.

R1: rare project management resources (knowledge sharing processes):

Results of linear regression and Sobel Test are provided in Figure 5. Results of the linear regression validate *H2* and *H4* for R1. However, R1 was found to have a significant negative effect on both P and F. The Sobel Test indicates that P mediates this negative effect of R1 on F significantly ($z = -2.643, p = 0.008$):

- *H1*: R1 has a positive effect on P – not supported.
- *H2*: P has a positive effect on F – significantly supported.
- *H3*: R1 has a positive effect on F – not supported.
- *H4*: R1 does not have a direct effect on F, in the presence of P – significantly supported.

R2: rare project management resources (knowledge sharing tools and techniques):

Results of linear regression and Sobel Test are provided in Figure 6. Results of the linear regression validate *H2* and *H4* for R2. However, R2 was found to have a significant negative effect on both P and F. The Sobel Test indicates that P mediates this negative effect of R2 on F significantly ($z = -3.983, p < 0.001$):

- *H1*: R2 has a positive effect on P – not supported.
- *H2*: P has a positive effect on F – significantly supported.
- *H3*: R2 has a positive effect on F – not supported.
- *H4*: R2 does not have a direct effect on F, in the presence of P – significantly supported.

I1: inimitable project management resources (proprietary tangible assets):

Results of linear regression and Sobel Test are provided in Figure 7. The Sobel Test indicates that the hypothesis, P mediates the effect of I1 on F, is significantly supported ($z = 4.721, p < 0.001$). Results of the linear regression validate *H1-H3* for I1. However, I1 was found to have a significant direct effect on F in the presence of P. The results suggest that P partially mediates the effect of I1 on F:

- *H1*: I1 has a positive effect on P – significantly supported.
- *H2*: P has a positive effect on F – significantly supported.
- *H3*: I1 has a positive effect on F – significantly supported.
- *H4*: I1 does not have a direct effect on F, in the presence of P – not supported.

I2: inimitable project management resources (embedded intangible assets):

Results of linear regression and Sobel Test are provided in Figure 8. The Sobel Test indicates that the hypothesis, P mediates the effect of I2 on F, is significantly supported

($z = 3.973, p < 0.001$). Results of the linear regression validate *H1–H3* for I2. However, I2 was found to have a significant direct effect on F in the presence of P. The results suggest that P partially mediates the effect of I2 on F:

- *H1*: I2 has a positive effect on P – significantly supported.
- *H2*: P has a positive effect on F – significantly supported.
- *H3*: I2 has a positive effect on F – significantly supported.
- *H4*: I2 does not have a direct effect on F, in the presence of P – not supported.

O1: project management alignment:

Results of linear regression and Sobel Test are provided in Figure 9. The Sobel Test indicates that the hypothesis, P mediates the effect of O1 on F, is significantly supported ($z = 5.381, p < 0.001$). Results of the linear regression validate *H1–H4* for O1:

- *H1*: O1 has a positive effect on P – significantly supported.
- *H2*: P has a positive effect on F – significantly supported.
- *H3*: O1 has a positive effect on F – significantly supported.
- *H4*: O1 does not have a direct effect on F, in the presence of P – significantly supported.

O2: project management communication:

Results of linear regression and Sobel Test are provided in Figure 10. The Sobel Test indicates that the hypothesis, P mediates the effect of O2 on F, is significantly supported ($z = 6.310, p < 0.001$). Results of the linear regression validate *H1–H3* for O2. However, O2 was found to have a significant direct effect on F in the presence of P. The results suggest that P partially mediates the effect of O2 on F:

- *H1*: O2 has a positive effect on P – significantly supported.
- *H2*: P has a positive effect on F – significantly supported.
- *H3*: O2 has a positive effect on F – significantly supported.
- *H4*: O2 does not have a direct effect on F, in the presence of P – not supported.

O3: project management integration:

Results of linear regression and Sobel Test are provided in Figure 11. The Sobel Test indicates that the hypothesis, P mediates the effect of O3 on F, is significantly supported ($z = 5.982, p < 0.001$). Results of the linear regression validate the *H1–H3* for O3. However, O3 was found to have a significant direct effect on F in the presence of P. The results suggest that P partially mediates the effect of O3 on F:

- *H1*: O3 has a positive effect on P – significantly supported.
- *H2*: P has a positive effect on F – significantly supported.
- *H3*: O3 has a positive effect on F – significantly supported.
- *H4*: O3 does not have a direct effect on F, in the presence of P – not supported.

In summary, the Sobel Test results indicate that project-level performance significantly mediates the effect of the project management asset characteristics V, R, I and O on firm performance as hypothesized. The results show both direct and indirect effects of I1, I2, O2 and O3 on firm performance. An unexpected finding was that the asset characteristics R1 and R2 negatively affect project outcomes. These findings are discussed further in the next section.

Discussion of findings

This empirical research validates that project-level performance has a positive and significant impact on firm-level performance. The research findings also indicate that project-level performance significantly mediates the effect of project management characteristics V, R, I and O on firm performance for all nine factors that represent the independent variables.

Valuable project management assets significantly and positively predict firm-level performance, mediated by project-level performance as expected.

Rare project management assets negatively predict project-level performance. They also negatively predict firm-level performance when mediated by project-level performance. This finding did not support the hypothesis derived from the VRIO framework, where it is expected that rare project management assets will positively predict project-level and firm-level performance. A possible explanation of rare project management assets negatively predicting project-level and firm-level performance could be that while theory suggests that rare assets are valuable assets, respondents view project management assets that are rare as not being prevalent because they are not worth investing in. With project management tools and techniques converging on standards, investments in rare tools and techniques may no longer be perceived as worthy investments to the profession. This perception of a rare asset not being a worthy investment, therefore, results in rare project management assets having a negative effect on project-level performance and firm-level performance.

Inimitable project management assets positively and significantly predict firm-level performance, mediated by project-level performance. Proprietary tangible project management assets and embedded intangible project management assets that are inimitable were also found to have a significant and positive direct effect on firm-level performance. It is likely that some inimitable project management assets (e.g. methodologies and mentoring) are generally applicable to other cross-functional business processes of the firm, resulting in enhanced firm-level performance from other processes besides project management.

Organizationally supported project management assets positively and significantly predict firm-level performance, mediated by project-level performance. Organizationally supported project management assets that include communication and integration also have a significant and positive direct effect on firm-level performance. Organizational support for project management in the form of communication and integration is likely to be more generally applicable to all cross-functional business process of the firm, resulting in enhanced firm-level performance from other processes besides project management.

Summary and conclusions

This paper presents several important implications for management practice and research in the area of project management. In summary, project management assets that are valuable, inimitable and organizationally supported are particularly important to firm success, directly impacting project-level performance and also impacting firm-level performance, both directly and mediated by project-level performance. To further test the mediating effect of project performance on the relationship between the asset characteristics and firm performance, additional research is warranted with a larger data set to facilitate path analysis.

Most importantly for practice, this study draws attention to project management assets as sources of competitive advantage. The empirical findings of the research make a case for more sustained investment in project management assets. The research also suggests that beyond investments in project management assets, organizational support for project management through processes and systems for organizational communication and integration is likely to positively impact firm-level performance, mediated by other processes besides project management. The findings that project-level performance has a direct effect on firm-level performance as well as mediates the relationship between the asset

characteristics and firm-level performance have important implications. These findings suggest that a firm should go beyond investing in project management assets; it makes a case for the firm to measure and reward project management performance.

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This paper contributes to the emerging literature that examines the impact of project management assets on firm competitive advantage, beyond operational efficiency. There is limited empirical work that applies RBV and the VRIO framework to the field of project management. What is missing in this body of limited empirical work is an understanding of the mediating effect of project performance on the relationship between project management assets and firm performance. A better understanding of the mediating role of project performance has implications for an investment in project management assets and the measurement and reward of project performance. The research presented in this paper attempts to address this gap. It adds to the understanding of the effect of project management asset characteristics on firm performance by examining the direct and mediated effects of these characteristics on firm performance, mediated by project management performance. This paper presents an extended conceptual framework, hypothesizes the relationships, and reports on empirical research that tests these relationships. The robust nature of the RBV and the developing body of empirical research in project management anchored within the RBV encourage future research on project management resources as a source of competitiveness.

Limitations of this study include sample size and self-report bias, calling for a larger sample in ongoing research. A study is in progress using a larger sample size with the same survey tool. Future work to revise the survey instrument is warranted. There is an opportunity to better define the concept and further develop the construct of rarity from the VRIO framework. In particular, there is a need to distinguish between assets that are valuable but not prevalent and those that are not prevalent because they are not perceived as worthy investments. Future research is also warranted to examine the relationship between project management asset characteristics on project and firm performance by project type, project complexity, industry and country.

The scope of this research is restricted to the application of the VRIO framework to project management as a source of competitive advantage. Next steps in the research agenda would include expanding and enriching the understanding of project management as a strategic process through the integration of other theoretical perspectives. Streams of

research that provide promising directions for future work apply the RBV of the firm to link project management processes to project and firm performance using benefits realization management (Ashurst *et al.*, 2008; Breese *et al.*, 2015; Müller, 2017; Musawir *et al.*, 2017; Serra and Kunc, 2015) and behavioral models of decision making (Kunc and Morecroft, 2010; Wang *et al.*, 2017).

Further research toward understanding the project management process and its competitive implications will help guide managers toward more strategic investment in project management assets and organizational support for these assets.

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