A FACTOR ANALYSIS OF TANGIBLE AND INTANGIBLE PROJECT MANAGEMENT ASSETS

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Introduction

Developing and sustaining a competitive advantage is about improving a company's financial performance. Stemming from strategy and economics, the Resource Based View examines competitive advantage in terms of a company's internal resources, which may be tangible or intangible. Companies have many resources (e.g., human, financial, organizational, physical, technological), but few are strategic in nature. Strategic resources (assets) contribute to a firm's competitive position and tend to be knowledge-based (Amit & Schoemaker, 1993). Strategic resources are ***V****aluable* (provide economic value), ***R****are* (unique), ***I****nimitable* (difficult to copy), and involve ***O****rganizational Support* (management support, processes, and systems; VRIO; Barney, 1991, 2002). Both value and rarity are required for a temporary competitive advantage. Value, rarity, and inimitability are required for a sustained competitive advantage (Barney, 1998), and, as a company transitions from competitive parity to a sustained competitive advantage, there is increasing evidence of organizational support (Barney, 1998).

How does project management measure up when assessed with the VRIO framework? Because project management has not been widely examined using the Resource Based View lens, we decided to develop an instrument based on the VRIO framework. Exploratory factor analyses help researchers develop scales and evaluate them. Our focus in this paper is on the independent variables of tangible and intangible project management assets. Our purpose in using exploratory factor analysis is to conduct a preliminary evaluation of the new measures that we developed. We are interested in examining what kinds of factors comprise tangible and intangible project management assets and the nature of the factors. This is an important topic because more companies are turning to project management because successful projects contribute to improved business results. Furthermore, we do not fully understand the dimensions of project management as a source of competitive advantage.

We begin by placing the topic into context within the extant literature. Then we present our study methodology, followed by the results, and discussion. We conclude with this study's contributions as well as next steps, because this paper reports on the findings of a pilot study that is part of a larger initiative.

Literature Review

The Resource Based View is a dominant approach in strategy, and we situate the study within this perspective. Strategic assets (e.g., intellectual property rights, reputation, brand, culture, and tacit

knowledge) contribute to a firm's competitive advantage. These resource bundles involve codified and tacit knowledge (Eisenhardt & Santos, 2000; Kaplan, Schenkel, von Krogh, & Weber, 2001; Kogut, 2000; Nonaka, 1994) that is embedded in a company's unique internal skills, knowledge, and resources (Foss, 1997; Rumelt, Schendel, & Teece, 1994). Barney's VRIO framework has been widely used in empirical studies on strategic assets (Barney, 1998; Castanias & Helfat, 2001; Lopez, 2001; Montealegre, 2002; Ray, Barney, & Muhanna, 2004; Wiggins & Ruefli, 2002; Zahra & Nielsen, 2002). In 2005, the Academy of Management indicated that over 200 academic papers have been published using the Resource Based View. However, few publications are evident on project management and this perspective (DeFillippi & Arthur, 1998).

As a discipline, project management stems from engineering, decision sciences, and operations management. Project management is a new field that is a long way from developing its own theory, so it draws from the field of management (Koskela & Howell, 2002; Packendorff, 1995). Project management is a set of processes applied on a project to deliver a project, product, or service (Project Management Institute, 2000). Project management involves practices based on tangible and intangible assets (DeFillippi & Arthur, 1998; Fernie, Green, Weller, & Newcombe, 2003). Tangible assets are concrete and codified, whereas intangible ones are tacit. Because strategic assets also tend to be knowledge-based (intangible), some distinguish between codified and tacit knowledge by labeling them "know-what" and "know-how" (Nonaka, 1994). Tacit knowledge is shared informally through social exchanges, and is embedded in a firm's culture. To date, most of the project management literature has focused on the tangible assets and codified knowledge as shared through project management offices, methodologies, and tools and techniques (Kloppenborg & Opfer, 2002; Ulri & Ulri, 2000). The intangible dimension warrants further study.

Some of the literature promotes project management maturity models (which assess tangible assets) as sources of competitive advantage (ESI-International, 2001; Hartman, 2000; Ibbs & Kwak, 2000; MicroFrame, 2001). These models consist of five linear stages of increasingly defined and repeatable, codified processes and practices. Evidence that maturity models improve a company's return on investment is weak, and the models do not address intangible assets (Jugdev & Thomas, 2002). We examined project management maturity through items in our survey.

Literature on knowledge management involves formal and informal knowledge-sharing practices. Project teams often share learnings through communities of practice (Lesser & Storck, 2001). Knowledge is also inimitable because it is socially complex and causally ambiguous (Barney, 1999; Mata, Fuerst, & Barney, 1995). The project management literature review revealed few empirical studies on project management as a strategic asset (DeFillippi & Arthur, 1998), and there are few empirical studies on knowledge management in the project management context (Fernie et al., 2003). This study makes a contribution to the growing body of empirical works on strategic assets.

Conceptual Model

Project management's return-potential to the organization will depend on the extent to which a company develops project management as having VRIO characteristics. We propose that an investment in tangible project management assets primarily enhances the *Valuable* and *Organizational Support* dimensions. As such assets are not rare (unless copy-written or trademarked), competing firms can mimic them so that these investments do not help firms improve their competitive positions. However, intangible assets contribute to a resource being *Valuable*, *Rare*, and *Inimitable*, with *Organizational Support*. We also suggest that companies do not recognize the value of intangible assets in the project management context.We developed the following conceptual model in which our dependent variable is the VRIO profile of the project management process, and the independent variables are tangible and intangible assets.

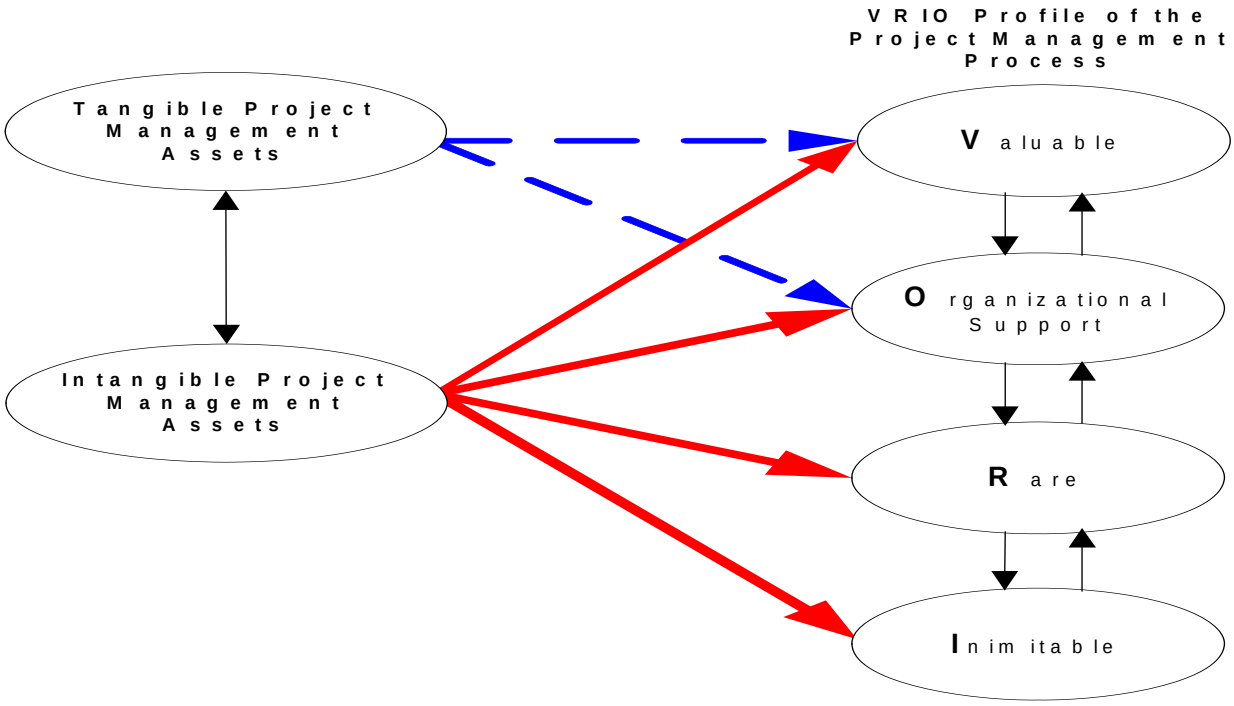

Figure 1: Conceptual Model: Tangible and Intangible Assets and the VRIO Profile of the Project Management Process

Conceptually, the above model shows the unobserved (latent) variables that we assessed with items from our questionnaire. Tangible and intangible assets constitute independent (exogenous) variables that are correlated. In the model, the VRIO characteristics are endogenous (dependent variables). In this study, we examine the factors constituting the independent and dependent variables.

This is an important study for several reasons. First, many people are interested in understanding how project management could be a source of competitive advantage, especially as the use of the discipline increases exponentially. Second, we have yet to understand the intricacies and relationships among the tangible and intangible assets of project management. A deeper understanding using the VRIO lens could help companies better support project management for competitive advantage. Third, in order to conduct confirmatory factor analyses, we need to ensure that we have a valid and reliable instrument with items that are well correlated. Finally, this study is important because it helps heighten awareness of the importance of intangible assets in project management.

Methodology

Our survey design closely followed the format recommended by experts in the field (Couper, Traugott, & Lamias, 2001; Dillman, Sinclair, & Clark, 1993; Fowler, 1992). Based on the literature and our understanding of the concepts, we developed items for each latent variable, and created a survey instrument consisting of 80 questions, 12 demographic questions, and an open-ended question for participants to provide additional input. We used a 7-point Likert scale with the anchors being “Strongly Agree” and “Strongly Disagree.” Where relevant, we included a “Not Applicable” category. We used multiple-item measures and minimized retrospective bias by focusing questions on the past year. We then pre-tested the survey. W e used a large-scale Internet survey design based on Likert scale questions that are appropriate for perception-oriented questions. The Internet approach was faster and more cost-effective than a mail-out

survey, and it helps reduce non-response errors (Couper, 2000). A copy of the instrument is available upon request.

Our sampling frame was the Project Management Institute's® mailing list, from which we used a randomly generated subset (n=2,000; 1,500 Americans and 500 Canadians, which represents the institute's membership). Our unit of analysis was the individual, and participants ranged from project managers to executives. By focusing on North American participants, we controlled for country-specific factors. Based on the 241 participants who indicated interest in completing the study, we achieved a 10.1% response rate (202 participants). Our sample size was fair (Tabachnick & Fidell, 1996) for an exploratory factor analysis because the ratio of sample size (202) to the number of variables (80) was less than 5:1.

We know that surveys are a snapshot of phenomena and, although convenient to participants, self-report studies involve retrospective bias. We are aware that the breadth of items we use to assess tangible and intangible assets in project management are not comprehensive, but we focused on the main ones from the literature. We also know that the mailing list is not representative of all practitioners, but the list represents an up-to-date source as the response indicated that only 44/2,000 (2.2%) letters were returned due to address unknown. We defined our constructs as precisely as possible by drawing from the literature, and we are aware that our measurement items are proxies for latent phenomena (Bontis, Crossan, & Hulland, 2002). This design is appropriate as it helps determine relationships and relationship strength among constructs.

Results

Using SPSS® v. 13, we conducted descriptive statistics, including data screening, distributions, and correlations. We also condensed the demographics for the purposes of this paper as follows:

- About 60% of the participants were from the United States and the rest from Canada.
- The male-to-female participant ratio was nearly 2:1
- Two-thirds of the participants were between 30 and 49 years of age.
- Nearly three-quarters of the participants had their PMP® designation.
- Participants were well-educated, with over 90% at the undergraduate or higher level.
- Most participants were in middle management positions or technical roles.
- About one-third of the participants had - 6-9 years of experience, and about another third had 10-19 years of experience. About two-thirds of the participants had been with their current company for less than 9 years.
- 61% of the participants were in the top four industries: information industry (23.0%); scientific and technical services industry (16.4%); finance and insurance industry (12.0%); manufacturing industry (9.8%).

We analyzed non-response bias by conducting Chi squared tests on the participants and the original mailing list of 2,000. There was no gender bias related to the response rate (Males: 116, 8.9%; Females: 67, 9.9%) versus the non-response group (Males: 1190, 91.1%; Females: 608, 90.1%), $\chi^2(1) = 0.578$, $p = 0.462$ which is not statistically significant.

Exploratory factor analysis is a statistical technique that helps determine the latent structures among variables that are inter-correlated. Factor analysis groups the variables into a smaller number of components that are easier to analyze. Factor analysis is especially useful in developing and refining a new instrument (Conway & Huffcutt, 2003). We conducted exploratory factor analysis with varimax rotation and 0.30 as a cutoff to identify items with the higher loadings for each factor. The varimax (orthogonal) rotation technique rotated the data to give us clear patterns of which items loaded on which factor. In other words, it rotated the data to give us a more interpretable solution (Conway & Huffcutt, 2003). We used principal factor analysis because this technique allowed us to look at the proportion of variance that each item had in common with

other items. Eigen values of over one helped us conduct an adequate extraction of reliable factors. We used listwise deletions to handle the missing data.

We examined the rotated component matrices for the dependent and independent variables, and extracted six factors for the independent variables and three factors for the dependent variables. The number of items that load on a factor are an indication of how well-defined and reliable it is (Tabachnick & Fidell, 1996). We retained two factors consisting of three items because these were factors of interest to us. We then reviewed the items in each factor and developed appropriate labels. Cronbach's alpha measures how well a set of items measures a single uni-dimensional latent construct. A reliability coefficient of 0.70 or higher is acceptable in the social sciences (Nunnally, 1978). We used this test to assess the internal consistency of the items within each concept.

Because of space limitations, we are not able to provide the correlation matrices, Eigen values, or communalities. We do present the rotated correlation matrices, though, because they show the items per factor along with the loadings. Recall from Figure 1 on our conceptual model that the independent variables were tangible and intangible project management assets. We extracted six independent variable factors as per the following table on the rotated component matrix of the independent variables.

Items Constituting Independent Variables	1	2	3	4	5	6
q1.3 We use portfolio/program management practices to effectively manage groups of projects within	.717					
3.9 We use project management to optimize business decisions	.691	.311				
q1.2 We have an effective Project Management Office. A project management office helps organization.....	.689					
q3.10 When it comes to project management ,we are the best of breed	.675			.378		
q3.8 We use project management to understand how one project impacts on other projects	.627	.326				
q3.1 We try to improve our project management practices according to a project management maturity framework	.601	.339	.358			
q3.11 We use project management to make organizational decisions for the future	.598	.407				.312
q1.4 We effectively use project management tools & techniques to manage projects	.589		.358	.336		
q1.1 We have a good project management methodology	.574		.428	.373		
q1.6 Our project management tools are integrated with our enterprise systems	.569			.478		
q3.5 Our project management program is based on organization standards	.569		.359	.315		
q3.6 We use project management to address efficiency issues	.556	.325				
q3.7 We use project management to address effectiveness issues	.550					
q1.5 Our project management tools meet our project needs	.524		.331	.368		
q5.5 Constructive brainstorming is often used to improve project management practices at my org.		.798				
q6.2 Descriptive & vivid language helps provide insights & may lead to 'Aha moments!'.....		.787				

Items Constituting Independent Variables	1	2	3	4	5	6
q5.3 At my org.,we shadow each other to share project management knowledge		.756				
q6.1 At my org., we use collective reflection to share project management knowledge	.386	.692				
q5.2 At my org.,we share project management knowledge by showing each other how we do things in project management	.328	.681				
q5.4 We explore project management topics among ourselves through informal get togethers		.643				
q7.3 We often share know-how through 'war stories' about our project experiences		.641				
q5.1 Our project management mentoring program helps us be more effective on projects	.380	.602				
q7.4 We regularly share project lessons learned in a face-to-face manner		.582				
q7.1 Our community of practice helps us be more effective in project management.....	.304	.533		.440		
q8.4 My org. encourages us to explore project management topics with colleagues at other org.		-.452	-.313			-.318
q7.5 There are people at my org., we can turn to for practical advice on projects		.386			.376	
q2.1 My organization invests in developing project manager competences in tools & techniques			.843			
q2.4 There is support for project management training			.825			
q2.2 My organization invests in developing project manager competences in leadership			.815			
q2.3 My organization invests in developing project manager competences in interpersonal skills			.808			
q2.6 The organization supports project management certification Management professionals			.693		.308	
q3.3 Management supports project management at my organization	.348		.626			
q2.5 We have a career path for those in project management positions			.592			
q3.4 We use project management consistently on projects at my organization	.397		.484	.342		
q4.3 We have adequate organizational systems to share project management knowledge				.805		
q4.4 We have adequate organizational processes to share project management knowledge	.308			.794		
q4.2 We share project management knowledge through databases				.791		
q4.5 We regularly use our organizational systems & processes to share project management knowledge				.747		
q4.1 We share project management knowledge through our internet				.738		
q7.6 We have project management best practice databases to help us with our projects	.308			.677		

Items Constituting Independent Variables	1	2	3	4	5	6
q7.2 We share project management knowledge through documented practices at my org., e.g.,....				.561		
q9.1 Know-how is not important at my org.					-.868	
q9.2 Know-how is not valued at my org.					-.850	
q8.5 Project management knowledge is not shared at my org. because knowledge is power					-.716	-.303
q8.7 Ongoing learning is not a concept that my org. supports			-.450		-.527	-.305
q3.2 Our project management practices are based on 'accidental' processes; i.e., unplanned or ad hoc processes	.334		.325	.316	.453	
q8.3 Knowledge sharing is limited to within departments & rarely takes place across the org.						-.760
q8.6 Project management knowledge is not shared at my org. because it takes too much time					-.300	-.683
q8.2 Knowledge sharing is limited to within project teams at my org.					-.338	-.663
q7.7 Learning by doing is supported at my org.					.399	
q9.3 My org. supports the use of idea sharing in project management, even if the ideas are not backed by "hard facts."						
q8.1 At my org., those with the most "wisdom" in project management are the ones with the most impressive org. titles	.334	.311				
q9.4 My org. supports creative thinking in project management			-.303		-.358	
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 13 iterations.						

Table 1: Rotated Component Matrix of Independent Variables

Factors 2, 5, and 6 in Table 1 represent intangible project management assets and factors 1, 3, and 4, represent tangible project management assets. These factors were labeled to reflect items that define them:

1. The latent construct of *Project Management Maturity* consisted of 14 items and had a Cronbach's Alpha of 0.953.
2. The latent construct of *Sharing Know-How* consisted of 12 items and had a Cronbach's Alpha of 0.881.
3. The latent construct of *Training and Development* consisted of 8 items and had a Cronbach's Alpha of 0.931.
4. The latent construct of *Sharing Know What* consisted of 7 items and had a Cronbach's Alpha of 0.939.
5. The latent construct of *Undervalued Sharing of Know-How* consisted of 5 items and had a Cronbach's Alpha of 0.773.
6. The latent construct of *Undervalued Sharing of Knowledge* consisted of 3 items and had a Cronbach's Alpha of 0.463. Although this was the lowest alpha, it is still acceptable.

The following table shows the rotated component matrix for the dependent variables.

Items Constituting VRIO Characteristics	1	2	3	4
q10.1 Project management has helped us be better, faster, and/or cheaper in what we do	.887			
q10.2 Project management has increased our profitability	.882			
q10.3 Project management has improved our overall business performance	.867	.308		
q10.5 We use project management to provide better products/services	.799			
q10.4 Project management at my org. significantly helps us respond to industry threats or opportunities	.796			
q10.6 Project management is a source of competitive advantage to my org.	.748	.351		
q13.5 Rather than being able to trace our project management advantage to "one big decision" in our org.'s past, our success can be.	.610			
q15.7 Our project management practices have improved year after year	.561	.475		
q13.1 Org. that do not use project management the way we do, are at a cost disadvantage	.464			
q16.1 Our projects are adequately resourced with enough staff that is qualified to do the work		.773		
q16.2 Our projects are adequately resourced to manage them properly		.740		
q15.1 We are well-organized to practice project management at my org. with policies, procedures & routines	.418	.707		
q15.5 Executives at my org. are effective in their project management roles	.416	.700		
q15.3 Project management is an organization-wide initiative	.356	.682		
q15.6 We benchmark regularly to assess best practices in project management that could help us improve our practices		.670		
q15.2 Project management is important to our org.'s mission	.357	.650		
q15.4 Executives at my org. have formal project management roles whereby they make project, program or portfolio....	.334	.641		
q11.3 If 1/3 of those that practice project management at my org. left tomorrow, project management would not change		.467	-.354	
q11.1 Many org. in our industry practice project management the way we do		-.454	.408	
q11.4 Relative to our competitors, project management at my org. is unique			.807	
q11.2 How we practice project management makes the practice unique at my org.			.770	
q13.2 It would be difficult for org. to copy how we practice project management at our org.			.641	
q13.4 We could easily substitute something else for project management without being at a competitive disadvantage	.353			-.631
q16.3 Relative to our org.'s largest competitor, our investment in project management is about the same		.391		.609
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations.				

Table 2: Rotated Component Matrix of Dependent Variables

In our original theoretical model, we described the VRIO profile of the project management process (our dependent variable) as consisting of four characteristics--*Valuable, Rare, Inimitable, and* having *Organizational Support.* We identified three factors in our exploratory factor analysis of the dependent variable:

1. The latent construct of *Valuable* consisted of 9 items and had a Cronbach's Alpha of 0.929.
2. The latent construct of *Organizational Support* consisted of 10 items and had a Cronbach's Alpha of 0.841.
3. The latent construct of *Rare* consisted of 3 items and had a Cronbach's Alpha of 0.690. This is also within an acceptable range.

The fourth expected characteristic from the VRIO framework, *Inimitable* did not emerge as a factor from the analysis. The item that describes project management as difficult to copy was, however, found included in the *Rare* factor, leading to the conclusion that there is an overlap between these two, *Rare* and *Inimitable* characteristics.

Discussion

We present a preliminary interpretation of the factors extracted from the exploratory analysis and discuss them in the context of our original conceptual model (Figure 1).

The six factors extracted as project management assets represent 64.05% of the total variance of the original variables, which is quite acceptable for a factor analysis. Three factors represent tangible project management assets: *Project Management Maturity, Training and Development, and Sharing Know-What.* Three factors represent intangible project management assets: *Sharing Know-How, Undervalued Sharing of Know-How*, and *Undervalued Sharing of Knowledge.* The two factors on undervalued sharing negatively influence the dependent variable. Details on the factors and variance explained by them are provided below.

The *Project Management Maturity* factor was the first factor that emerged, and it reflected the use of project management practices such as a project management office, tools and techniques, methodology, standards, and processes. This factor also addressed the use of program and portfolio management practices and efficient and effective practices. This factor, along with *Training and Development* (below) and *Sharing Know-What* (below) comprised our tangible project management assets. The factor explains 14.11% of the total variance of the original variables. This result shows the breadth of tangible project management assets as well as how widely used these assets are in practice.

The *Sharing Know-How* factor consisted of items that addressed different ways in which tacit knowledge was shared; for example, sharing knowledge informally, mentoring, stories, brainstorming, and shadowing. This factor explains 13.10% of total variance of the original variables. This factor, along with *Undervalued Sharing of Know-How* (below) and *Undervalued Sharing of Knowledge* (below) comprised our intangible project management assets. This result shows the breadth of tacit knowledge-sharing practices being used. We view this to be an important factor because we believe intangible assets contribute to competitive advantage.

Training and Development constituted the third factor. This factor consisted of items on developing project manager competencies, support for PMP® certification, and a career path for project managers. This factor included managerial support for training and development. This factor explains 12.54% of total variance of the original variables. We expect that, as companies invest in the practices shown in the project management maturity factor, they also invest in the training and development factor because both factors reflect concrete investments in project management.

The fourth factor, *Sharing Know-What*, was evident through a set of items on concrete databases, systems, intranets, best practices databases, and processes for sharing knowledge. This factor included codified knowledge sharing-practices. This factor explains 11.92% of the total variance of the original variables.

Undervalued Sharing of Know-How was specific to items indicating that know-how was undervalued. Know-how was not shared or supported widely by the firms. Know-how was not shared because this type of knowledge was perceived to be a source of power. In addition, participants stated that their companies did not value learning. This factor explains 7.33% of the total variance of the original variables.

Undervalued Sharing of Knowledge consisted of items on the lack of knowledge sharing in general within the company. Knowledge sharing was limited to sharing within the team or department, and it was not shared because of time constraints. This factor explains 5.05% of the total variance of the original variables.

Three factors, *Valuable*, *Rare*, and *Organizational Support* explain 55.87% of the total variance of the original variables, and this is a significant amount of variation explained. Our original conceptual model used four concepts to describe the VRIO profile of project management (as the dependent variable). Although the fourth, *Inimitable*, was an important concept in terms of the VRIO framework, we eliminated it because it consisted of only two items, and the Cronbach's Alpha was negligible (-0.104). Details on the factors and variance explained are provided below.

We note that the factor entitled *Valuable* involved items consisting of those that reflected project management as providing economic value; for example, improving business performance, increasing profitability, and responding to environmental threats and opportunities. This factor explains 25.08% of the total variance of the original variables.

The items that comprised the *Organizational Support* factor were those that reflected management support, adequate resourcing for the discipline, and project management as an organization-wide undertaking. In essence, *Organizational Support* reflects support to exploit project management as being valuable, rare, and costly to imitate. This factor explains 21.31% of the total variance of the original variables.

The items that comprised the *Rare* factor were those that showed project management to be unique, controlled by a few firms, and difficult to copy. This factor explains 8.69% of the total variance of the original variables.

Our findings indicate that, over and above the codified practices that are purported to be sources of competitive advantage, companies should examine project management with a broader perspective and consider intangible assets as well. Knowledge sharing emerged as a strong factor, both in terms of codified practices and tacit knowledge. We discovered that sharing of project management knowledge, and in particular, sharing of tacit knowledge is undervalued by companies represented in our sample.

From this preliminary factor analysis, we think that a larger sample size with a modified survey will allow us to further refine the model and constructs. We plan on doing this in 2006, using a large-scale study targeting 5,000 Project Management Institute® members. Based on our response rate to the original study reported here, we anticipate that the large-scale study will provide us with a response rate of 500, which is considered "very good" for a factor analysis (Tabachnick & Fidell, 1996). We are currently working on structural modeling using these data. The larger study will allow us to conduct a more extensive structural equation model.

Conclusion

In this study, we conducted an online survey with North American Project Management Institute® members. We used exploratory factor analysis to identify the independent variables (tangible and intangible assets in project management) and dependent variables (VRIO characteristics of the project management process). We extracted three factors that represent tangible project management assets, three that represent intangible project management assets, and three that represent VRIO characteristics.

This research is an important step towards an improved understand of the elements of tangible and intangible project management assets. In addition, this research is a necessary step towards further analyses on the relationship between these assets and the VRIO profile of the project management process. We believe that we have a valid and reliable instrument, which we can further evolve and use to conduct a large-scale empirical study that will help us better understand how tangible and intangible project management assets contribute to achieving VRIO characteristics in the project management process. Our ongoing research in this area aims at understanding how the project management process can be a source of competitive advantage.

This study on project management is anchored in existing theory, drawing on the Resource Based View of the firm. It contributes to research in project management and adds to the growing body of strategy literature that builds on the Resource Based View.

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