Identification of Strategic Project Management Resources in Indian Software Project Management Companies

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Abstract

This paper presents identification of strategic resources for software project management companies. Furthermore, the paper also identified the factors that attained VRIO characteristics amongst these resources. The research used primary data collected from professionals working in Indian software project management companies through a survey instrument. Factors were identified among the variables to identify the resources as well as identification of resources attaining VRIO characteristics. The findings resulted into identification of six important groups of resources and four factors pertaining to VRIO characteristics. The study may help software project companies to enhance their performance from a strategy perspective.

Keywords **: project management, strategic resources, resource based view, VRIO framework, Indian software companies**

JEL Classification : L19, L29, M15, O22

Paper Submission Date : February 28, 2014 ; Paper sent back for Revision : June 25, 2014; Paper Acceptance Date : July 28, 2014

Companies are increasingly resorting to project mode for improving business results or to achieve newer strategic goals. Project management as a process depends on firms possessing certain concrete (codified) and intangible (tacit) assets for their success. The contribution of these strategic assets towards creation of a sustainable competitive advantage for firms can be analyzed in terms of VRIO [1] framework proposed by Barney (1991, 2002). The VRIO framework has its root in the RBV (resource based view) model of firms' analysis of their strength and weaknesses vis a vis their competitors under a dynamic external environment. For resources to be called strategic, they must be valuable (economic), rare (unique), inimitable (prohibitory costly for a competitor to imitate), and need to involve organizational support (management support, processes, and systems).

The purpose of this study is to identify such strategic resources using the VRIO framework for project management and to find if there is any correlation between the firms having these resources. The study also aimed to analyze whether these firms had sustained competitive advantage over their competitors. The conceptual model is project management resources (independent variable) leading to attainment of VRIO characteristics (dependent variable). The variables would be latent variables. So, independent variables may be a combination of observable project management resources. Similarly, dependent variables may also be a combination of observable performance indicators.

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[1] VRIO is an acronym for the four questions this framework asks about a resource or capability to determine its competitive potential: the question of Value, the question of Rarity, the question of Imitability, and the question of Organization.

Literature Review

Researchers have categorized project management resources into different categories. Majority of the researchers have agreed to put them into two categories - tangible and intangible. It has been observed that tangible resources are concrete and measurable, whereas intangibles are often tacit. One such classification of resources is property-based or tangible (i.e. concrete, physical, codified, or based on explicit knowledge) versus knowledge based or intangible (i.e. tacit, unspoken but understood) (Miller & Shamsie, 1996). While tangible resources enable a firm to execute its business processes, it is the intangible ones that are more likely to serve as sources for competitive advantage (Brush, Greene, & Hart, 2001 ; Eisenhardt & Santos, 2002). Barney (1991) viewed resources as physical, human, and capital. Grant (1991) expanded this list by including the technological and reputational groupings, which were also quoted by Jugdev and Mathur (2012). Brush et al. (2001) identified six resource types: human (individual skills, knowledge), social (external relationships, networks), financial (personal wealth), physical, technological, and organizational (internal structures, processes, relationships) assets.

In their survey guidelines, Jugdev and Mathur (2012) proposed the following classification:

- Financial resources (money);
- Physical resources (machinery, equipment, office space, location);
- Technological resources (technological know-how);
- Human resources (individual skills, knowledge, experience, reputation, education);
- Organizational resources (internal structures, processes, systems and procedures); and
- Social resources (external relationships, networks, industry contacts, professional associations).

Project Management is the application of knowledge, skills, tools and techniques to project activities to bring about successful results and meet the project requirements (PMBOK guide 4th edition). Another definition of project management is "A project is a complex, non routine, one time effort limited by time, budget, resources, and performance specifications designed to meet customer needs" (Clifford, Larson, & Desai, 2010, p. 3). Project management practices are based on tangible (concrete and codified) and intangible (tacit) assets (DeFillippi & Arthur, 1998).

Jugdev and Mathur (2012) quoted a study of project management in the strategic resource context involving qualitative field research (DeFillippi & Arthur, 1998), in which DeFillipi and Arthur argued that although projects involved mobile and rented personnel (human capital), they could accumulate core competencies, transmit tacit knowledge and transfer knowledge, and create a competitive advantage through possessing inimitable resources. According to Hughes and Cotterell (2006), many of the techniques of general project management are applicable to software project management too, but Brooks Jr. (1987) pointed out that the products of software projects have certain specific characteristics like invisibility (progress is not immediately visible), complexity (expressed in terms of complexity involved per unit of expenditure), conformity (meeting with inconsistent requirements), and flexibility (to accommodate a high degree of change), which make them different.

- **RBV (Resource Based View) Model and VRIO Framework :** The VRIO framework has its root in the RBV model of firms' analysis of their strength and weaknesses vis-a -vis their competitors under a dynamic external environment. The resource-based view argues that an organization can be regarded as a bundle of resources (Barney, 1991) that are valuable, rare, imperfectly imitable, and organizational oriented (Barney, 2002). For resources to be called strategic, they must be valuable (economic), rare (unique), inimitable (prohibitory costly for a competitor to imitate) and involve organizational support (management support, processes and systems). An increasing number of studies in resource management have suggested that identification of valuable company resources is the first step in enabling these resources to be successfully managed (Andersén, 2011 ; Sirmon, Gove, & Hitt, 2008).

The basic assumptions under which RBV works are :

(1) Resource and/or Capability Heterogeneity: Different firms possess bundles of different resources and capabilities.

(2) Resource and/or Capability Immobility: Some of these resources and capabilities are inelastic in supply or are costly to copy. The RBV theory attributes superior financial performance to resources and skills that are firm-specific, rare, and difficult to imitate or substitute, and have an organizational orientation, also known as the VRIO framework (Barney, 2002). The kind of resources needed for a firm's performance are subjected to four critical questions under the VRIO framework: the question of value, the question of rarity, the question of imitability (ease/difficulty to imitate), and the question of organization (ability to exploit the resource or capability).

Here the question of *value* is : "Is the firm able to exploit an opportunity or neutralize an external threat with the resource/capability?" In the simplest term, value may be defined as the ratio of utility derived by the customer to the price paid by him. So, from the perspective of a company, any resource which is capable of either causing an increase in revenue or decrease in cost or both will be termed as a valuable resource. Bowman and Ambrosini (2000, 2007) defined perceived use value as a price that a customer is prepared to pay for the product if there is only a single source of supply. The opportunities indicate competitive possibilities. Opportunity is a condition in the general environment (dimensions of broader society that influence an industry and firms within it), that if exploited, helps a company achieve strategic competitiveness.

Now, the question of *rarity* is: "Is control of the resource/capability in the hands of a relative few?" Rarity is when a firm has a valuable resource or capability that is absolutely unique among a set of current and potential competitors. These rare resources and capabilities must be both short in supply and persist over time to be a source of sustained competitive advantage. In terms of complex software projects like operating systems enterprise products for automating business processes, companies invest a high amount of their resources to come with a unique set of values with these projects ; hence, this uniqueness also needs to be protected to be able to reap sufficient competitive advantage of such products. Therefore, such software project companies have thousands of patents granted to them to keep the uniqueness, and hence, the competitive advantage. For example, Apple has been the market leader in certain segment of software products because of unique innovative features. Similarly, companies like Microsoft, SAP, Google, and so forth have created uniqueness as a source of competitive advantage.

The question of *inimitability* is: "Is it difficult to imitate, and will there be significant cost disadvantage to a firm trying to obtain, develop, or duplicate the resource/capability?" Only valuable and rare resources that are also imperfectly imitable can be a source of sustained competitive advantage. The concept of imperfect imitability implies that a resource is a source of sustained competitive advantage only if competitors who do not posses this certain resource face major cost disadvantages in developing it internally or purchasing it externally.

The question of *organization* is : "Is the firm organized, ready, and able to exploit the resource/capability?" The question of organization raises the issue that whether a firm is structured in a way to exploit the potential power of valuable, rare, and imperfectly imitable resources and capabilities. Only the realization of the full potential of powerful resources through appropriate organizational structures enables a company to increase value created, and value captured.

The VRIO Framework

The basic premise of the VRIO model is explained in the Table 1. The question starts with - Is it a resource, or a capability, or a combination of resources & capabilities ?

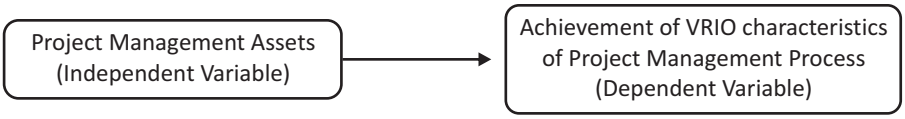
✸ **Conceptual Model :** The conceptual model, as shown in the Figure 1, depicts project management resources (independent variable) leading to the attainment of VRIO characteristics (dependent variable). The variables

Table 1. The VRIO Model

Valuable?	Rare?	Costly to Imitate?	Exploitable by the Organization?	Competitive implications	Economic performance	Strengths or Weaknesses
No	-	-	No	Competitive disadvantage	Below normal	Weakness
Yes	No	-	No	Competitive parity	Normal	Strength
Yes	Yes	No		Temporary competitive advantage	Above normal	Strength and distinctive competence
Yes	Yes	Yes	Yes	Sustained competitive advantage	Above normal	Strength and sustainable distinctive competence

Source: Adapted from F.J. Mata, W. L. Fuerst, & J.B. Barney (1995). Information technology and sustained competitive advantage: A resource-based analysis. *MIS Quarterly, 19* (4), 487-505.

Figure 1. Conceptual Model



would be latent variables. So, independent variables may be a combination of observable project management resources. Similarly, dependent variables may also be a combination of observable performance indicators. This model is based on the study done by Jugdev and Mathur (2006), but is being put to a different context in terms of the domain (targeted to software project management), variables identified, and the population under study.

Project management's potential as a source of competitive advantage will depend on the extent to which a company develops project management according to VRIO characteristics. An investment in tangible project management assets primarily enhances the valuable and organizational support dimensions (Barney, 2002). As such, assets are not rare (e.g. unless the organization owns the copyright or trademark), competing firms can copy them so these investments do not improve a firm's competitive positions. However, intangible assets can be valuable, rare, and inimitable with organizational support (Barney, 2002).

Based on the extant literature on project management and prior research (Besner & Hobbs, 2004; Jugdev & Thomas, 2002; White & Fortune, 2002), a list of 17 project management resources can be observed as under :

(1) hardware;

(2) software (e.g. Microsoft Project, Primavera);

(3) project management methodologies;

(4) decision-making tools;

(5) databases;

(6) information systems;

(7) project management maturity models;

(8) mentoring;

(9) project management offices;

(10) communities of practice;

(11) personal competences;

(12) experience;

(13) skills;

(14) aptitudes;

(15) organizational policies and procedures;

(16) project management templates; and

(17) project management bodies of knowledge.

Objective of the Study

The objective of this study is to identify strategic resources for Indian software project management companies for sustained competitive advantage over their competitors. The scope of this paper is to identify factors for independent variables (software project management resources) and dependent variables (attainment of VRIO characteristics) using factor analysis of data gathered using the survey instrument.

Methodology

In-depth unstructured interviews with software professionals were conducted to understand the resources needed for successful project execution in the Indian software industry. The respondent software professionals had been serving different top software project management companies. Interviewees were having 8-10 years of diversified experience in software product development as well as in software project companies. From the interviews, it was observed that the software companies are basically carrying out two kinds of jobs:

(1) Product Development : In product development, deliverables in strict term of specifications are not defined before the start of the term. In case of product development, customers/clients are not fixed before the start of the job. Many a times, companies gather some latent need through their gap analysis process and try to introduce new products for meeting those unmet demands. Sometimes, some products are introduced if some new breakthrough technology is invented by their R&D teams.

(2) Project Jobs : In project jobs, the deliverables are specified by clients, and many a times, the delivery period is also fixed in advance. For example, any company taking up e-banking job of any bank. In this case, processes and deliverables are specified by clients, and software companies take up the job to meet corresponding requirements of the clients within an agreed time period and scope. Many a times, companies face the problem of scope creep in these kinds of jobs.

An understanding of the above differentiation is important for us, as the resource requirements will be different in both the cases. In case of product development, companies require more innovation and hence, employees are hired and equipped accordingly. R&D has to be strong to continuously introduce new technology, processes, and products. Product development companies do not need to maintain any bench strength. In case of companies undertaking software project jobs, resource requirement is more from proven technology and processes. Project companies necessarily maintain optimal bench strength in terms of quantity as well as skills possessed by the resources so as to replace them with ease.

On the basis of the interviews and literature survey, the following resources were identified to be the most important resources for Indian software project companies:

(1) Hardware infrastructure

(2) Software tools for development

(3) Project management software

(4) Software Project Management Processes : Companies have and follow different SDLC (software development life cycle) processes as per the different requirements of scope and time. For example, the Waterfall model, V model, Agile model, and so forth.

(5) Database systems

(6) Information Systems : Which are being used for bug management, issues management (JIRA, Bugzilla, QC), code collaboration tool, version control system, document management systems, and so forth.

(7) Project Management Maturity Models like CMMI, ISO : These standards have proven to be a double-edged sword, these may avoid some procedural lapses, whereas on the other hand, these may cause delay in execution. For example, if there is an ISO procedure calling recording/logging of every meeting, than it may happen that 2 hours of resource time may be needed to log 1 hour meeting procedures.

(8) Mentoring

(9) Software Project Offices : Here, the aspect of importance is geographical proximity to clients and close interaction with clients/businesses. For example, companies undertaking software projects for companies like Reliance or Tata will be in proximity to the client (having close interaction than compared to companies undertaking software projects for foreign companies).

(10) Communities of technical knowledge

(11) Experience (No. of years, technical, domain)

(12) Technical skills

(13) Behavioural skills

(14) Analytical skills : Here, one aspect of importance is to understand the difference between the technical skills (e.g. PL, SQL etc.) and analytical skills (e.g. SPSS) for the software industry.

(15) Organizational Policies & Procedures : This means whether the organizational policies and procedures are aligned towards software project management as a core competency or not. For example, TCS being a part of Tata Group may have policies and procedures aligned to a conglomerate, whereas Infosys being an organization dedicated for software projects may have its organizational policies and procedures aligned towards software project management.

(16) Bench Strength : Here, companies go for a tradeoff between cost of maintaining bench strength and their ability to replace immediately because of attrition, thereby avoiding any impact on project deadlines. Both quality (resources with relevant skills) and quantity have to be given due consideration.

(17) Scope Management Methodologies : It has been a common phenomena across the software project companies to face scope creep, on an average, 92-95% of the projects face this issue. As the projects have to balance on three legs of scope, quality, and time (deadline), so it will require methodologies to balance each of them, in case one leg (scope) is increased.

(18) Quality Management Methodologies : This resource addresses issues related to quality, especially bug management, leading to a tradeoff between quality (no. of bugs left in the system to be removed after commissioning) and time of release. Many a times, the clients also agree to release the project with a certain amount of bugs to meet the project deadlines.

(19) Learning & development processes

(20) User Training Management Methodologies : The end user training resources and methodologies have also become an important aspect of software project management and delivery since many of software project management failures are because of lack of user training.

✸ **Instrument Development :** In the survey, the instrument was created consisting of questions for each latent variable ; 56 questions, including four demographic questions and two open-ended questions for additional input were included in the questionnaire. A 7-point Likert scale was used with the anchors being *"Not at all important"* and *"Extremely important"* for the independent variable and *"Strongly Agree"* and *"Strongly Disagree"* for the dependent variable. A large-scale Internet survey design was used because of it being faster and more cost

Table 2. Guidelines for Independent Variable

Code	Level of Importance
1	Not at all important
2	Low importance
3	Slightly important
4	Neutral
5	Moderately important
6	Very important
7	Extremely important

Table 3. Guidelines for Dependent Variable

Code	Level of Importance
1	Strongly disagree
2	Disagree
3	Somewhat disagree
4	Neither agree or disagree
5	Somewhat agree
6	Agree
7	Strongly agree

effective than a mail-out survey, and it helps reduce non-response errors (Couper, 2000).

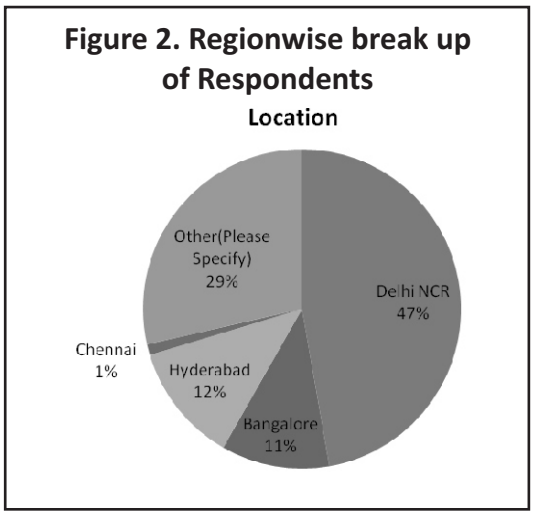
The questionnaire consisted of four questions on demographic aspects, 26 questions on independent variables to identify important resources for software project management, and 24 questions on dependent variables to identify acquiring VRIO characteristics by software project management methodologies and processes being followed. For the independent variables, the respondents were asked to rate project management resources in order of importance for project management success ranging from *least important* to *most important* as per the guidelines mentioned in the Table 2. For dependent variables, the respondents were asked to rate statements regarding project management methodologies being followed in respective organizations from *strongly disagree* to *strongly agree* as per the guidelines mentioned in the Table 3.

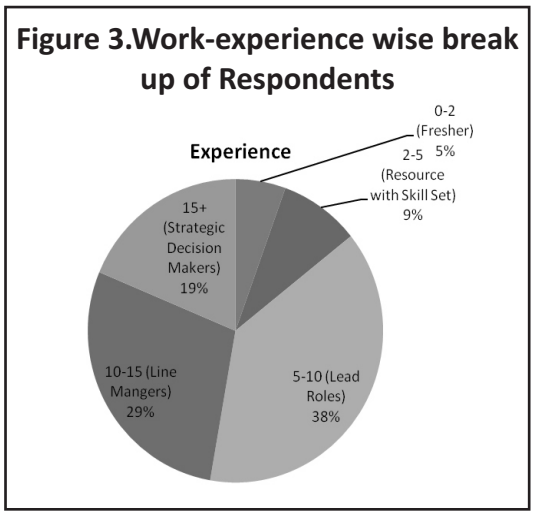
✸ **Population:** The population considered for the study were professionals working in Indian software companies who were executing software projects and were the members of PMI- India. The mailing list of PMI-India was the population of the study.

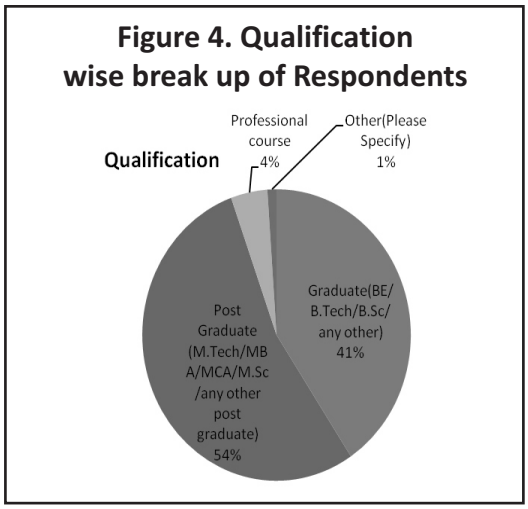
✸ **Sample:** A random response given by the respondents.

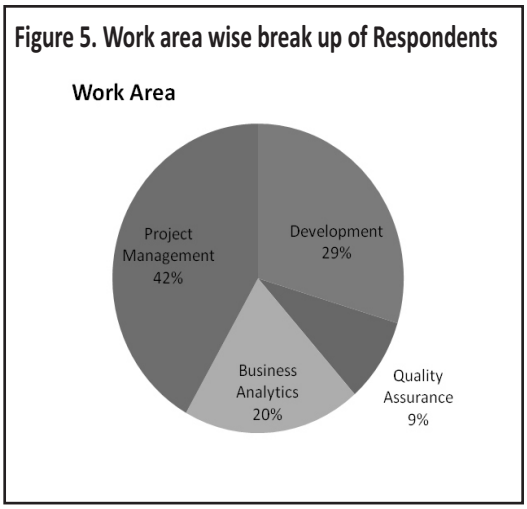
✸ **Data Collection:** A survey questionnaire was mailed to the mailing list of 800+ project professionals who were members of North India chapter of PMI (Project Management Institute). The response period was open from December, 29, 2012 to May, 9, 2013. One hundred and twenty five questionnaires were returned, out of which 21 responses were from project professionals who were not from the software domain. So, those 21 entries were deleted. Out of the remaining 104 entries, 12 entries were incompletely filled, so they were also deleted, resulting in 91 data points. Furthermore, for one response, all questions were answered with a single response (70), so this entry was also deleted. Hence, we got 90 valid responses for final data analysis.

✸ **Sample Profile :** As shown in the Figure 2, 47% of the total respondents were from Delhi NCR (National Capital Region), 11% were from Bangalore, 12% were from Hyderabad, 1% were from Chennai, and 29% were from others, in which majority were from Kolkata. As shown in the Figure 3, work experience wise, maximum number of respondents were resources working in lead roles (38% of the respondents with 5-10 years of total









experience), followed by line managers (29% of the respondents with 10-15 years of total experience), and strategic decision makers (19% of the total respondents). Freshers (0-2 years of total experience) and resources with skill set (2-5 years of total experience) were 5% and 9% respectively.

Qualification wise, maximum number of respondents were postgraduates (54% ; M.Tech, MBA, MCA) followed by graduates (41% ; B.Tech, BE etc.) (Figure 4). The maximum number of respondents (42% of the total) were working in the area of project management, followed by respondents who were working in the area of software development (30% of the total). Respondents working in the area of business analytics and quality assurance were 20% and 9% of the total respondents respectively (Figure 5).

Analysis and Discussion

SPSS -19 was used for factor analysis. Principal component analysis was conducted to extract the factors. Varimax rotation was adopted to improve upon the factor loadings of the variables on the factors. In the analysis, the factors having limit roots or Eigenvalues greater than 1 were considered. Furthermore, it is considered to have 0.5 as the limit for communalities of variables to be taken for further analysis, as variables with communalities 0.5 will not be having sufficient explanation. As the sample size for the analysis was 90 respondents, so the threshold limit of factor loading for variables to be included into a particular factor considered was 0.58. This is based on the 0.05 significance level (a) and a power level of 80%.

(1) Factor Analysis for Identifying the Types of Resources Used by the Indian Software Industry : Part B of the questionnaire of the survey with 26 questions was used for identifying the types of resources used in the Indian software industry. So, in the first factor analysis, these 26 variables were considered in a manner as elaborated in the previous paragraph. In the rotated component matrix with Eigenvalue greater than 1, eight factors were extracted. One factor contained seven variables with significant factor loadings; two factors were with four variables, each with significant factor loadings; three factors were with only two variables, each with significant factor loadings ; whereas one factor was with only one variable with significant factor loading.

To improve upon the solution, the number of factors to be extracted was restricted to six factors. After that, one factor contained six variables with significant factor loadings ; one factor contained four variables with significant factor loadings ; three factors were with three variables, each with significant factor loadings ;

Table 4. Factors for Identifying Types of Resources

S.No.	Name of Factor/Variable	Factor Loading	Factor Ranking	% Variance Explained	Cumulative Variance
F-1	**Project controlling process (R-1)**		**1**	**15.393**	**15.393**
a	Managing scope creep	0.585			
b	Quality assurance process	0.755			
c	Learning and development	0.729			
d	User training infrastructures	0.612			
e	Behaviour skills	0.705			
f	Analytical skills	0.772			
F-2	**Organisational policies and procedures for software project management (R-2)**		**2**	**10.867**	**26.260**
a	Organisational policies and procedures	0.672			
b	Bench strength	0.729			
c	Keeping operations/resources in geographical proximity to client	0.611			
F-3	**Hardware and software resources (R-3)**		**3**	**10.311**	**36.571**
a	High end hardware infrastructure	0.856			
b	Software for office use	0.823			
c	Project management software	0.577			
F-4	**Mentoring and guidance including client team (R-4)**		**4**	**10.191**	**46.762**
a	Team mentoring and guidance	0.677			
b	Guidance and mentoring by higher management	0.773			
c	Working closure to client business	0.658			
F-5	**Relevant technical and domain experience and availability of forums and communities for knowledge sharing (R-5)**		**5**	**9.846**	**56.607**
a	Relevant technical skills	0.707			
b	Relevant domain experience	0.633			
c	Forums and communities	0.655			
d	Database management system	0.613			
F-6	**Information and communication among different stakeholders (R-6)**		**6**	**6.883**	**63.490**
a	Information and communication	0.652			

Table 5. KMO and Bartlett's Test Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.718
Bartlett's Test of Sphericity	Approx. Chi-Square	1172.144
	Df	325
	Sig.	.000

whereas one factor was only with one variable with significant factor loading. The percentage of variance explained by the eight factor solution was 72.061%, whereas percentage of variance explained by eight factor solution was 63.490%, which is still more than 60%. Hence, it can be expected as a reasonable solution with improved distribution of variables between the factors. The factor analysis output is summarized in the Table 4. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is 0.718 (Table 5). A KMO value of 0.6 is the minimum threshold value for sampling adequacy (thereby indicating that the data were fit for factor analysis); whereas, values between 0.7 and 0.8 are considered to be good. Bartlett's test value is also significant (thus rejecting the null hypothesis that the population matrix is an identity matrix), indicating a correlation in the data sets, which is appropriate for factor analysis.

In Factor 1, six variables appear with significant factor loadings. This is giving one factor representing two different subsets. One subset includes managing scope creep, quality assurance process, learning & development, and user training infrastructure. The second subset includes behavioral skills and analytical skills. The variable representing relevant technical skills appeared at factor loading (.529), which is slightly less than the threshold limit (0.6). This indicates that the respondents considered relevant technical skills to be an important factor, but it was not extremely significant. So, we can get one group of resources as the project controlling process, which will include all variables in subset 1. Appearing variables in subset 2 at significant factor loading are indicative of the opinion of the respondents that these two skills, namely behavioral and analytical skills are closely related to the project controlling process. We name this identified important resource group for project management as R1.

✸ **R1** (project controlling process comprising of managing scope creep, quality assurance process, learning & development, user training infrastructure, and necessary skills for the same)

In Factor 2, three variables appeared with significant factor loadings. This is giving one factor representing organization policy and procedures, bench strength, and geographical proximity to customers. The variable representing project management maturity model appeared at factor loading (.510),which is less than the threshold limit. This indicates the fact that the respondents considered project management maturity model to be an important resource, but it was not that very important. So, we can get one group of resource as organization policy and procedures. At a broader level, this will decide the policy on keeping the bench strength as well as placing the operations/resources in geographical proximity of the client. We name this identified important resource group for project management as R2.

✸ **R2** (organization policy and procedure for software project management, including policy on bench strength and keeping operations/resources in geographical proximity of the client)

In Factor 3, three variables appeared with significant factor loadings. This is giving one factor representing high end hardware infrastructure, software for office use, and project management software. The variable representing hardware infrastructure appeared at factor loading (.552), which is slightly less than the threshold limit. This indicates the fact that the respondents considered hardware infrastructure as an important resource, but it was not an extremely significant resource. So, we can get one group of resource as hardware and software infrastructure as one of the important resources for project management. We name this group as R3.

✸ **R3** (hardware and software resources comprising of three variables, namely representing high end hardware infrastructure, software for office use, and project management software)

In Factor 4, three variables appeared with significant factor loadings. This is giving one factor representing team mentoring and guidance, mentoring and guidance by higher management, and working closure to client

Table 6. Factors for Identifying Strategic (VRIO) Characteristics

S.No.	Name of Factor/Variable	Factor Loading	Factor Ranking	% Variance Explained	Cumulative Variance
F-1	**Rarity of resources and reasons leading to inimitability (RI)**		1	17.921	17.921
a	Rare resources and capabilities	0.690			
b	Resources and capabilities unique to organization	0.903			
c	Resources and capabilities difficult to copy	0.852			
d	Resources and capabilities backed by unique historical conditions	0.673			
e	Resources and capabilities having causal ambiguity with organizational performance	0.701			
F-2	**Resources capable of meeting different kinds of environmental threats (V-1)**		2	17.867	35.789
a	Threat of buyers	0.735			
b	Threat of suppliers	0.770			
c	Threat of new entrants	0.568			
d	Threat of competitive rivalry	0.789			
e	Threat of substitutes	0.682			
f	Threats arising out of changes in legal and political conditions	0.672			
F-3	**Focused organization system capable of exploiting resources and capabilities (O)**		3	17.422	53.211
a	Organizational effectiveness in utilizing resources and capabilities	0.787			
b	Organizational decentralization	0.874			
c	Project management as organization wise initiative	0.867			
d	Organization's mission includes project management	0.624			
e	Projects are adequately resourced	0.701			
F-4	**Resources capable of exploiting different kinds of opportunities in the environmental (V-2)**		4	12.973	66.183
a	Opportunities arising out of technological changes	0.665			
b	Opportunities arising out of demographic changes	0.808			
c	Opportunities arising out of political, legal, and cultural changes	0.760			
d	Opportunities arising out of changes in the economic climate	0.690			
F-5	**Inimitability of resources (I)**		5	7.652	73.835
a	Resources can be directly duplicated	0.909			
b	Resources can be substituted with equivalent resources	0.855			

business. The variable representing working closure to client business at appearing along with mentoring and guidance variables at significant factor loading indicates that the respondents considered working closure to client business will be like working in a broader team, including that of clients. Thus, mentoring and guidance will be extended to the clients' team, who will in turn operate the system onwards. So, here, we can get one group of resource to be mentoring and guidance. We name this identified important resource group for project management as R4.

- **R4** (mentoring and guidance including working closure to client business)

In Factor 5 four variables appeared with significant factor ladings. This is giving one factor representing forum and communities, relevant technical experience, relevant domain experience, and database management systems. The variable representing total experience in years appeared at factor loading (.565), which is slightly less than the threshold limit. This shows that thethat respondents considered total experience as an important variable, but it was not at a significant level. So, we can get one group of resource as relevant technical experience and domain experience. Availability of forums and communities for knowledge and experience sharing and employees' participation in those will help in furthering the relevant technical experience and domain experience and vice versa. We name this identified important resource group for project management as R5.

- **R5** (relevant technical experience and domain experience, including availability of forums and communities for knowledge sharing)

In Factor 6, only one variable, that is, information and communication among stakeholders appeared with significant factor loadings. We name this identified important resource for project management as R6. The reason behind keeping this factor with only one variable into consideration is due to the responses received from the respondents against open ended questions, indicating it to be an important variable.

- **R6** (information and communication among different stakeholders)

The variable software for development did not appear with significant factor loadings along with any of the factors, which may be indicative of the fact that software for development is a prerequisite for all companies. Hence, possession of this may not provide any strategic competitive advantage.

(2) Factor Analysis for Identifying Strategic (VRIO) Characteristics in Resources used by Indian Software Industry : Part C of the questionnaire of the survey contained 24 questions, and was used for identifying the type of resources that are required in the Indian software industry. So, in the second factor analysis, these 24 variables were considered in a manner as elaborated in the previous section.

In the unrotated component matrix, 22 out of 24 variables with significant factor loadings appeared in only one factor, so we considered rotated component matrix. In the rotated component matrix, five factors appeared, explaining 73.835% of the variance, which can be considered to be good. The factor analysis output is summarized in the Table 6. The KMO measure of sampling adequacy value indicated in the Table 7 is 0.824. The KMO value of 0.6 is the minimum value for sampling adequacy, whereas values between 0.7 and 0.8 are considered to be good, and values closer to 1 are considered excellent. Bartlett's test value is also significant (thus rejecting the null hypothesis that the population matrix is an identity matrix), indicating correlation in the data sets, which is appropriate for factor analysis.

In Factor 1, variables related to the rarity of the resources and inimitability of the resources appeared with significant factor loadings. This is giving one factor representing variables which indicates that the resources are rare ; possessed by merely few players in the market; are unique, hence, these are not available to any other player in the market ; are very difficult to copy ; can be directly duplicated ; can be substituted with equivalent resources and capabilities that are readily available in the market ; resources and capabilities are backed up by unique historical conditions ; resources and capabilities consist of certain resources, the interactions among them, and their impact on performance of an organization is difficult for competitors to understand and imitate. Furthermore, the variables representing resources and capabilities are protected through patents and copyrights to have exclusivity are present in the factor with factor loadings value slightly less than the cut off value. We will

Table 7. KMO and Bartlett's Test Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.824
Bartlett's Test of Sphericity	Approx. Chi-Square	1824.046
	Df	276
	Sig.	.000

include this variable in the factor because of the theoretical backup of patents and copyrights being important for inimitability. As per extant literature on strategic management, possession of rarity and inimitability properties can be a source of sustained competitive advantage. Hence, this group is named as RI.

✸ **RI** (resources are rare ; possessed by merely few players in the market ; are unique, hence not available to any other player in the market ; are very difficult to copy ; can be directly duplicated ; can be substituted with equivalent resources and capabilities that are readily available in the market ; resources and capabilities are backed up by unique historical conditions ; resources and capabilities consist of certain resources, the interactions among them, and their impact on performance of organization are difficult for competitors to understand and imitate ; and resources and capabilities are protected through patents and copyrights to have exclusivity)

In Factor 2, all variables related to the resources dealing with different kinds of threats appearedwith significant factor loadings. This is giving one factor representing that resources are capable of meeting various threats mentioned in Michael Porter's model (threat of suppliers, threat of buyers, threat of new entrants, threat of competitive rivalry, threat of substitutes) (Porter, 1979). Apart from the above mentioned 6 variables, one more variable also appeared, that is, resources capable of exploiting opportunities from changes in the legal and political environment. Appearing of this variable along with threats may be indicative of the fact that the respondents treated changes in legal political environments to be more of a threat than an opportunity to be exploited. As per extant literature on strategic management, any group of resources which is capable of meeting the threats is termed as valuable resources. Hence, this group is named as V-1.

✸ **V-1** (resources capable of meeting threat of suppliers; threat of buyers ; threat of new entrants ; threat of competitive rivalry ; threat of substitutes ; and opportunity from changes in the legal political environment)

In Factor 3, all variables related to the resources related to the organizational aspect of the VRIO model appeared with significant factor loadings. This is giving one factor that is representing an organization which is able to adapt its systems and structures to exploit valuable resources for gaining strategic competitive advantage (the organization is focused and is able to use the resources and capabilities; has decentralized decision making to exploit the resources and capabilities efficiently and effectively; project management is an organization-wide initiative at all levels; the organization's mission statement constitutes project management as one of the most important methods to achieve organizational goals ; and different projects are adequately resourced). As per extant literature on strategic management, only the realization of the full potential of powerful resources through an appropriate organizational structure enables a company to increase value created and value captured, thereby leading to strategic competitive advantage. This group is named as O.

✸ **O** (Organization is focused and is able to use the resources and capabilities ; has decentralized decision making to exploit the resources and capabilities efficiently and effectively; project management is an organization-wide initiative at all levels; the organization's mission statement constitutes project management as one of the most important methods to achieve organizational goals; and different projects are adequately resourced)

In Factor 4, four variables related to the resources capable of exploiting different kinds of opportunities due to changes in the external environment appeared with significant factor loadings . This is giving one factor representing that resources are capable of exploiting opportunities due to changes in the external environment (changes in the technological environment ; changes in the social and legal environment ; demographic changes ; and changes in the economic climate). The variable representing resources capable of exploiting opportunities due to certain specific international events did not appear in any of the factors with significant factor loadings. This may be due to the fact that respondents treated opportunities arising out of specific international events as

temporary in nature and not having any long-term strategic impact. As per extant literature on strategic management, any group of resources which is capable of exploiting the opportunities is termed as valuable resources. This group is named as V-2.

✸ **V-2** (resources capable of exploiting opportunities due to changes in technological environment, changes in social and legal environment, demographic changes and changes in economic climate)

In Factor 5, only two variables related to the inimitability of the resources appeared with significant factor loadings. This is an interesting finding, giving one factor exclusively on this aspect representing variables that indicate that resources can be directly duplicated without any significant effort, and resources and capabilities in your organization can be substituted with equivalent resources and capabilities that are readily available in the market. As per extant literature on strategic management, possession of inimitability properties can be a source of sustained competitive advantage. But the results from this factor can be interpreted that the inimitability properties of VRIO model could not be identified. This group is named as I.

✸ **I** (resources can be directly duplicated without any significant effort ; resources and capabilities in organizations can be substituted with equivalent resources and capabilities that are readily available in the market)

(3) Summary of Responses on Open Ended Questions on Important Resources for Software Project Management : Based on the responses collected from open ended questions, the following resources were indicated as important by the respondents: Behavioral skills ; working in a team ; communication between team members ; motivation and guidance from the top management ; commitment of top management ; good coordination between technical teams ; good communication with clients ; project management skills and tools ; organizational culture supporting quick decision making ; processes for planning and proper implementation in place ; domain knowledge and experience. The above are in line with R2, R4, and R5 identified through factor analysis.

(4) Summary of Responses on Open Ended Questions on Project Management Methodologies being Followed in Organizations and their Impact on Organizational Performance : Based on the responses collected from open ended questions, the following were indicated by the respondents: organization is focused on running projects, which may lead to future growth of the organization; project management methodologies are transparent and easily accessible to employees, thereby creating a "buy in," practice of benchmarking against best practices ; use of project tracking tools, including client specific tools to maintain timeline ; structured approach of sharing information ; compliance with standards to avoid any contractual deviation ; integrated project management and quality management systems ; following agile management techniques ; strict monitoring on project parameters and reporting regularly to senior management. The above cumulatively confirm the presence of the organization (O) dimension of VRIO model in project management methodologies adopted by software management companies.

Managerial Implications

The present paper was prepared with a focus on analysis of resources in software project management aspect of the Indian software development industry, and the aim of the study was to identify the most important resource categories contributing to the success/failure of software project management. The results of the research show that the various types of resources identified can majorly be categorized into project controlling processes, organizational policies and procedures, hardware and software resources, mentoring and guidance capabilities, relevant technical and domain experience with availability of relevant knowledge forums and communities, and information and communication among different stakeholders of the project group. This categorization will help the management to understand the focus to be put in various areas so as to align corresponding resource elements

to add value to the organization. The different factor loadings also indicate the relative contribution of various resource elements that may help the management to understand the relative importance of corresponding resource elements in value addition for the project management process. Another implication for the managers is the identification of different resources that are capable of meeting threats or opportunities, those having organizational focus, and having a quality of rarity as per the competition.

Although, the relationship between different factors and their relative importance with various types of resources as per the VRIO model is not within the scope of the present research, identification of such resources will certainly help the management to identify the focus areas. Whether these resources will add value with respect to specific dimension of the VRIO model is a further area of research. Outcome of such research will help the management(s) to align its resources according to its competitive landscape and will help it to invest/divest in the direction of resources where it is lacking/over-burdened so as to attain a sustainable competitive advantage for the firm.

Conclusion

The present analysis was conducted for identifying important software project management resources and identifying the VRIO characteristics. The former represents independent variables, and the latter represents dependent variables for the model. The analysis was based on factor extraction using factor analysis on the data collected from members of the North Indian chapter of the Project Management Institute (PMI). The following independent variables (or important resources for project management) are identified :

- R1 (project controlling process comprising of managing scope creep ; quality assurance process ; learning & development ; and user training infrastructures ; necessary skills for the same),
- R2 (organizational policy and procedure for software project management including policy on bench strength and keeping operations/resources in geographical proximity of the client),
- R3 (hardware and software resources, namely high end hardware infrastructure ; software for office use ; project management software),
- R4 (mentoring and guidance, including that of the client's team),
- R5 (relevant technical experience and domain experience, including availability of forums and communities for knowledge sharing),
- R6 (information and communication among different stakeholders, e.g. reporting & analytics tool, bug management tool, etc.).

Presence of R3, R4, and R5 dimensions was also substantiated by open ended responses of the respondents.

The following VRIO characteristics or dependent variables are identified:

- V1 (resources capable of meeting threats in the external environment),
- V2 (resources capable of exploiting opportunities due to changes in the external environment),
- O (The organization is focused and is able to use the resources and capabilities),
- RI (resources are rare, possessed by merely few players in the market. Hence, the resources are unique, and are not available to any other player in the market. Inimitability as such is not emerging as an identified dimension but reasons leading to inimitability like resources and capabilities being backed up by unique historical conditions, the interactions among resources and capabilities, and their impact on performance of organizations are difficult for competitors to understand and imitate, and resources and capabilities are protected through patents and copyrights to have exclusivity.).

The inimitability dimension is coming in the reverse way, that is, the respondents expressed their opinion that software project management resources can be directly duplicated without any significant effort and resources & capabilities in organizations, and can be substituted with equivalent resources and capabilities that are readily available in the market. Presence of O (organization) dimension was also substantiated by the open ended responses of the respondents.

Limitations of the Study and Scope for Further Research

The limitations of the study lie in its selection of the population in the form of the mailing list of PMI (Project Management Institute) India. Hence, the opinions of those software project managers who were not the members of PMI could not be captured in the study. Ideally, a larger population comprising of the mailing list of all major software project companies and a random sample generated out of that combined list would have given excellent results. However, considering the limitations of resources and time, the present results can be concluded to be satisfactory for the Indian software project management companies.

The study can be further developed in terms of deriving the actual relationship between dependent variables (VRIO characteristics) and independent variables (types of important resources identified). This may give some more insights into the actual dependencies of resources in software project companies that may create a sustainable competitive advantage. This study, if used by software project companies, may help them to enhance their performance from a strategy perspective. Further independent studies can be planned to explore this relationship of dependency with the help of advanced statistical tools like path analysis or structural equation modeling (SEM).

Acknowledgment

I would like to express my profuse thanks to Dr. Sanjay Rastogi, Associate Professor, Indian Institute of Foreign Trade for his guidance and critical review of the paper many a times before it was finalized. I would also like to sincerely thank Mr. Milind Kumar Jha of CPA Global for his valuable contribution at every stage of writing this paper.

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