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THE IMPACT OF COLLABORATION AND COMPETITION ON PROJECT PERFORMANCE

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Abstract

This study explores the role of collaboration and competition among teammates in the context of IT development. Collaboration and competition has often considered as two ends of a common spectrum of group behavior. In contrary, this study conceptualizes intra-team collaboration and competition as two distinct and independent constructs in an attempt to assess the unique effect of each on project performance. In this study, 176 IT projects from Motorola and some of its partner firms were analyzed using quantitative methods. The results suggest a strong influence of collaboration on project performance while only a limited influence from competition. The study findings are then synthesized as guidelines for understanding effective project teams.

Keywords: IS project, success factors, collaboration, competition

Introduction

This study explores the role of collaboration and competition among teammates in the context of IT development. Specifically, we conceptualize intra-team collaboration and competition as two distinct and independent constructs in an attempt to assess the unique effect of each on project performance.

Collaboration is an organizational imperative in response to the complexity of work and the diverse and changing business environment. Most organizational initiatives require collaboration among individuals across various functional areas. Collaboration has become particularly essential in light of globalization, when individuals from multiple cultures, regions, and functional areas work together on projects, and inevitably bring divergent interests, perspectives, differing orientations towards goals, interpersonal relations, and key external constituents. As a result, there is increasing emphasis on collaboration within and across teams to enhance participation and information sharing for streamlining operational processes and ensuring superior competitive results, while simultaneously increasing organizational responsiveness and agility (Veneeva 2006).

The potential lack of collaboration creates difficulties in reaching agreement on integrated action programs and subsequent implementation (Gersick and Davis-Sacks 1990). Over the past few years, many researchers and practitioners have addressed the significance of teamwork and collaboration, and their significant role in the execution of business transformations (Austin 2000; Bradley and Nolan 1998; Evans and Wolf 2005; Gajda 2004; Hardy et al. 2003; Huxham and Vangen 2005; Mukhopadhyay et al. 1995; Treacy and Wiersema 2002; Smith 2004).

Such collaboration-oriented cross-functional teamwork presents a challenge in structuring project teams for collaborative behavior, where little empirical research exists to assist practitioners in this regard. Lacking guidance, organizations select candidates based on their willingness and enthusiasm for working in teams, and their affinity for the particular project. The assumption is that individuals showing evidence of "team orientation" and motivation with regard to the project objectives will be more collaborative, and thus, productive on the project team than those having more of an "individual contributor" orientation. While intuitively appealing, little direct empirical evidence exists to support this assumption (Bennis and Biederman 1997; Davenport et al. 1997).

Qualitative analysis of collaboration among business units in a multi-unit organization reveals that collaborating units are simultaneously engaged in competition as well (Singh 2005). For example, the heads of business units, while advocating collaboration for leveraging resources across business units, are also engaged in competition for the single CEO position. Could project teams structured for competitive behavior be productive as well? Competition is believed to reduce slack, provide incentives for efficient organization of production, and enhance innovation (Nickell 1996). It may explain, at least in part, how individuals respond to working in team-based organizations. In case of corporate performance, it has been argued that competition is associated with a significantly higher rate of total factor productivity growth (Nickell 1996). However, such perspective has received scanty attention at the project level. In fact, competition has been often viewed as the opposite end of collaboration on a common spectrum (e.g., Lado et al. 1997).

Collaboration and competition are alternate structuring approaches for project teams. While collaboration may be useful in understanding project team processes and project effectiveness, competition may explain the motivation, drive, and creativity of the individual team members (Gladstein 1984; Lawrence and Lorsch 1967). Collaboration and competition at the project team level can be conceptualized as the overall homogeneity of cohesiveness and sharing among the project team regardless of level or direction for collaboration, and level of competition for resources, attention, and favors (Axelrod 1997; Olson et al. 1992).

This paper examines particular form of collaboration and competition that are conceptualized as distinct and independent constructs. The collaboration examined is the propensity of project team members to share information, resources, and tasks – as the proportion of members reporting high levels of sharing increases, so will the collaborative behavior among project members and ultimately project performance. The competition examined is the propensity of project team members for individual contributions, lack of reciprocity, conflict, and pursuit of self-interest – as the proportion of members reporting high levels of self-interest pursuit increases, so will the competitive behavior among project team members and ultimately project performance. Preliminary evidence suggests that such propensities for collaboration and competition among project team members may be helpful in understanding project performance. IT development is an excellent context because of its inherent collaborative nature in leveraging common elements of the infrastructure for reducing costs, while simultaneously competing to serve individual business needs. With increasing globalization and global competition, IT is facing competing business demands while forced to reduce costs through common platform. Understanding the collaboration and competition dynamics are fundamental to IT success in today's globally competitive environment.

The study is based on data from 176 IT projects in Motorola and its affiliates that were analyzed for the influence of intra-team collaboration and competition on project performance. The results suggest a strong and broad influence of intra-team collaboration behavior on project performance; but only a limited influence of intra-team competition. However, when combined with critical success factors, both collaboration and competition had significant mediation effect on project performance, thereby suggesting consideration of collaboration and competition as additional project success factors. Though derived from IT projects, the study provides generally applicable insights that can potentially serve as guidelines in structuring effective project teams in other functional areas.

Theoretical Background and Model Development

Nature of Competition and Collaboration

An exploration of intra-team competition and collaboration faces two major obstacles. Firstly, from an academic perspective the concept is not well established. Although the literature is abundant with theories of competition and collaboration, it often treats the two as ends of the same bipolar scale (Axelrod, 1997, Cox et al., 1997, Macbeth et al., 1995, Gibson and Rogers, 1994), and in some sporadic instances, as independent phenomena that could coexist (Eisenhardt and Gahmic, 2000, Brandenburger and Nalebuff, 1996). Solutions to the famous prisoner's dilemma are characterized in terms of cooperation or competition behavior along the same scale (Axelrod 1980). Closely related are the notions of "private" and "common" benefits to explain a firm's behavior along a continuum in the context of an alliance—private benefits accruing to competing firms while common goods accruing to cooperative firms (Khanna et al. 1998). Similarly, combinations of competition and collaboration are prevalent in the practitioner world (Brandenburger and Nalebuff 1996; Luo 2005; Quint 1997; Tsai 2002). For example, Eisenhardt and Gahmic (2000) observed that "coevolving companies let collaboration and competition coexist... while senior managers don't actively seek out competition, they don't discourage it either."

Secondly, the empirical phenomenon of competition is not well recognized even among practitioners; those engaging in it. Competition is typically dispersed among organizational elements, and often lasts for a limited period of time, and ends up being managed on an exceptional basis. Additionally, competition is viewed very negatively among practicing managers, and considered a waste of resources and indicative of lack of control (Birkinshaw and Lingblad 2005). Managers are interested in projecting decisiveness and not lack of control. Nonetheless, there are also sporadic references to the positive impacts of competition (Becker 1983; Vickers 1995).

Collaboration versus Competition

Collaboration and competition are dual approaches to performance. They can occur at many levels of the organization and in many different ways. In terms of the level of analysis, competition and collaboration are classically viewed as modes of interactions among social units like, nations, organizations, firms, teams, groups, etc. This paper focuses on competition and collaboration among members of project teams. The level of analysis extends from competition or collaboration among two members of the project team to simultaneous competition and collaboration in pursuit of the project objectives. The second key parameter is the nature of competition and collaboration among the project team members. Both competition and collaboration can occur in a number of ways. For example, individual team members collaborate for leverage through information, resources, and task sharing, and compete for self-interest, scarce resources (e.g., financial rewards, political, and physical resources), as well as attention (Daft 2004; Thibaut and Kelley 2004). The underlying assumption is that financial resources for rewards are limited, and thus, must be allocated to the most worthwhile opportunities – individuals who will ensure positive project performance.

The degree to which projects should employ competition or collaboration among team members is an ongoing dilemma. Competition emphasizes individual performance by rewarding high performers while sanctioning low performers in an attempt to motivate and stimulate individuals to outperform one another in achieving project objectives. However, competition may be counterproductive because the competing individuals place self-interest ahead of the project interests, and thus, gains achieved by one members are not only achieved at the expense of another, but might negate the efforts of others. In contrast, collaboration emphasizes group accomplishments and minimizes any individual performance-based distinctions that may impede teamwork, sharing, and cooperation. The tension between collaboration and competition with respect to rewards is especially salient if organizations transform gradually to teamwork-orientation over the years, but have left their reward structure unchanged (Nelson and Quick 2006), resulting in failure of team-based initiatives (Hackman 1998).

It is often argued that individual-based competitive rewards are suited best for individual contributor members working alone, while team-based rewards are suited for situations when members are interdependent. Clearly, collaborative rewards promote team cohesion and mutual supportive behaviors that support project performance. However, the shared information during collaboration may be used for other purposes than the pursuit of common interests. The competitive aspects of organizational life may drive individuals to use the shared information also to make private gains in an attempt to outperform the other members (Khanna et al. 1998).

Using the metaphor of internal market for project teams, there is a large body of literature that extends from economics to management and is applicable at the project team level (March and Simon 1958; Williamson 1975). The underlying concern is whether to apply a form of competition in which two or more team members undertake duplicate activities to compete for the limited rewards, or to collaborate for the available information through sharing and leverage the task synergies. In its extreme case, competition among team members would involve parallel work streams housed within the same project with their outputs directly competing with each other; while collaboration among team members would involve synergistically coordinated networks of interdependent work streams jointly leading to a non-redundant project performance.

Competition is beneficial especially when trying out unconventional ideas (e.g. changing technology), speed is critical, and the cost of duplication is insignificant (Birkinshaw and Lingblad 2005). The beneficial aspects of team collaboration are well documented (Bennis and Biederman 1997; Galbraith 1973; Hoegl and Gemuenden 2001; Kraut and Streeter 1995; Montoya-Weiss et al. 2001). However, it should be noted that intra-team collaboration and competition may have both positive and negative consequences: collaboration could lead to groupthink (Bennis and Biederman 1997; Esser 1998; Olson et al. 1992), and thereby limiting output to known solutions, while competition could lead to extreme waste through redundant outputs (Fehr 1999; Tsai 2002).

Conceptual Model

Building on the prevalent relationship between critical success factors of an IT project and performance, the study aims to understand the influence of intra-team collaboration and competition. Collaboration and competition are considered distinct and independent constructs that impact project performance. They are explored in the context of the standard critical success factors for IT projects. Figure 1, illustrates the conceptual model of the study.

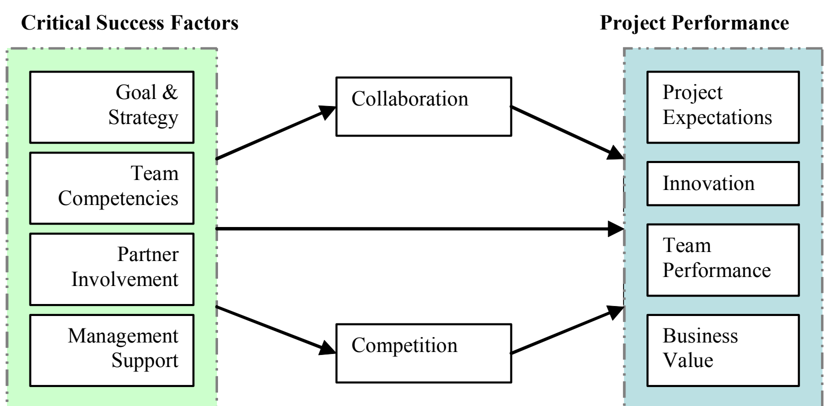

Figure 1. The Role of Collaboration and Competition

Project Performance

Project performance is described in terms of its components: project expectations, innovation, team performance, and business value. *Project expectations* refers to the operational aspects of project performance such as project completion within schedule, budget, and meeting customer requirements (Kerzner 2003), as well as meeting the expectation of the management and the project team. *Innovation*, on the other hand, is the level of creativity and innovation of the project deliverables (Anderson and West 1998; Dewar and Dutton 1986). *Team performance* is the teams' responsiveness to customer needs, adaptability to changing requirements, overall efficiency, and team reputation (Ancona and Caldwell 1992). *Business Value* is the resulting boost to company performance from project execution and deliverables (Mukhopadhyay et al. 1995; Soh and Markus 1995; Turban et al. 2000). Since it was suggested previously that intra-team collaboration and competition both impact project performance, this leads to the following hypotheses:

H1. *Intra-team collaboration has a positive effect on project performance*[1]
H1a – Intra-team collaboration has a positive effect on project expectations
H1b – Intra-team collaboration has a positive effect on innovation
H1c – Intra-team collaboration has a positive effect on team performance
H1d – Intra-team collaboration has a positive effect on business value

H2. *Intra-team competition has a positive effect on project performance*
H2a – Intra-team competition has a positive effect on project expectation
H2b – Intra-team competition has a positive effect on innovation
H2c – Intra-team competition has a positive effect on team performance
H2d – Intra-team competition has a positive effect on business value

Critical Success Factors

Information System project failures are still prevalent in the IT industry. The latest report from Standish Group suggests that only 31% of the IT projects started in 2006 can be categorized as successful, that is, they completed on time, within budget, and met the requirements. Further, the Standish Group study identified that 19% of the projects started in 2006, were outright failures (Rubinstein 2007). Subsequently, researchers have focused on identifying critical success factors to enhance the success likelihood of IS projects (Holland and Light 1999; Somers and Nelson 2001; Sumner 1999). For example, research identified critical success factors for different objectives in construction projects (Chua et al. 1999), provided a cultural framework for project success (Kendra and Taplin 2004), and benchmarked the critical success factors in product innovation (Cooper and Kleinschmidt 1995a; Johne and Snelson 1998). Insights gained from these and other studies (Cheng and Li 2002; Cooke-Davies 2002; Holland and Light 1999) have identified collectively a small set of critical success factors, such as user involvement and participation, clarity of goals and strategy, team competencies, partner involvement, and management support and commitment.

User Involvement and participation in the system development process reflects a set of behaviors or activities that potential users or their representatives perform, including providing advice as well as participating in project execution. Indeed, there is strong support in the literature for the impact of user involvement and participation on project performance (Barki and Hartwick 1994; Baroudi 1986; Ives and Olson 1984). However, in the projects selected for this study, all users are internal members of the organization who do not reflect the user involvement and participation that is discussed in the literature, and thus, this success factor was excluded from the study.

Goal interdependence theory predicts that team members' beliefs about how their goals are related determines how they interact, which in turn affects their individual and project performance (Deutsch 1949). Respectively, the level of understanding of the project goals, objectives, and strategy adopted, is likely to influence the behaviors of project team members, and in turn to impact project performance (Ancona and Caldwell 1992; Gladstein 1984). This leads to the following hypotheses:

H3. *Clarity of goals and strategy has a positive effect on project performance*
H3a – Clarity of goals and strategy has a positive effect on project expectations
H3b – Clarity of goals and strategy has a positive effect on innovation
H3c – Clarity of goals and strategy has a positive effect on team performance
H3d – Clarity of goals and strategy has a positive effect on business value

Team competencies reflect a set of the combined fundamental competencies of all project team members. The appropriate mix of technical and managerial skills, as well as necessary resource capacity is essential to project

[1] H1-H6 are top-level hypotheses that are operationalized by their respective components marked H1a, H1b, etc.

execution (Cockburn and Highsmith 2001; Epstein and Hundert 2002; Evans and Dion 1991; Guinan et al. 1998). This leads to the following hypotheses:

H4. *Team competencies have a positive effect on project performance*
H4a – Team competencies have a positive effect on project expectations
H4b – Team competencies have a positive effect on innovation
H4c – Team competencies have a positive effect on team performance
H4d – Team competencies have a positive effect on business value

With the increasing use of Commercial of the Shelf Applications (COTS) in IS projects, vendor involvement has become critical. The importance of this emerging success factor is illustrated, for example, in Goodman's (2003) account of the impact of vendor involvement in the development of a shuttle navigation software system. Vendor and other related partner involvement during project execution is essential for the project's success. This leads to the following hypotheses:

H5. *Partner involvement has a positive effect on project performance*
H5a – Partner involvement has a positive effect on project expectations
H5b – Partner involvement has a positive effect on innovation
H5c – Partner involvement has a positive effect on team performance
H5d – Partner involvement has a positive effect on business value

Lastly, management support and commitment is long recognized as essential to project success. Significant evidence exists in the literature showing that the support and commitment of management has a direct impact on project success (Cooper and Kleinschmidt 1995a; Wooldridge and Floyd 1990). This leads to the following hypotheses:

H6. *Management support has a positive effect on project performance*
H6a – Management support has a positive effect on project expectations
H6b – Management support has a positive effect on innovation
H6c – Management support has a positive effect on team performance
H6d – Management support has a positive effect on business value

Finally, we pose some additional hypotheses not necessarily supported by the literature, but derived from the conceptual model:

H7. *Clarity of goals & strategy has a positive effect on intra-team collaboration*
H8. *Clarity of goals & strategy has a positive effect on intra-team competition*
H9. *Team competencies have a positive effect on intra-team collaboration*
H10. *Team competencies have a positive effect on intra-team competition*
H11. *Partner involvement has a positive effect on intra-team collaboration*
H12. *Partner involvement has a positive effect on intra-team competition*
H13. *Management support has a positive effect on intra-team collaboration*
H14. *Management support has a positive effect on intra-team competition*

Figure 2 extends the conceptual model in Figure 1, and summarizes the hypothesized research model as discussed above.

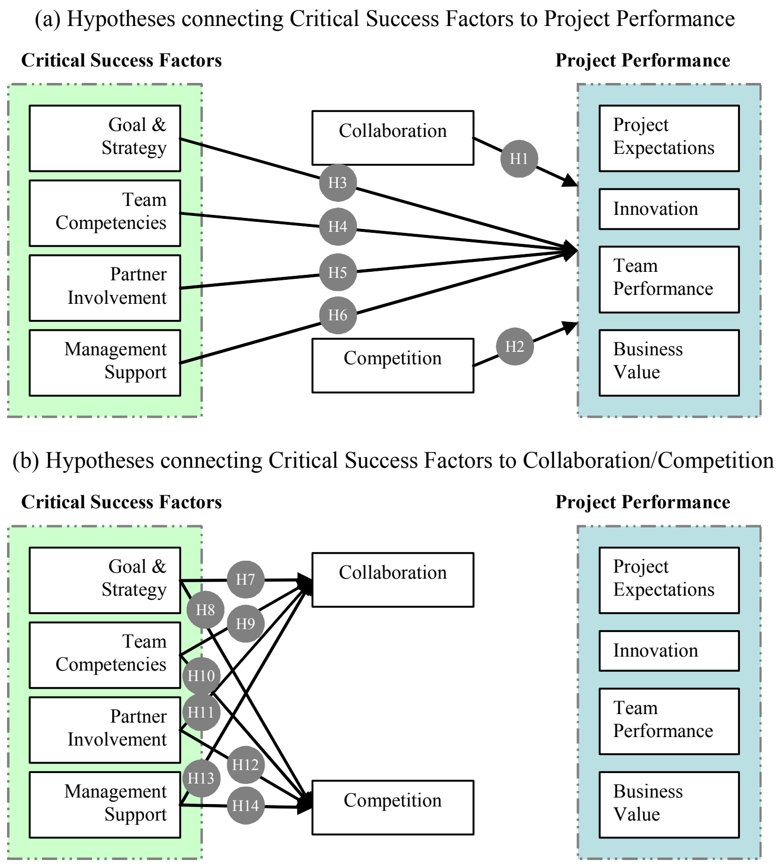

Figure 2. Hypothesized Model

Scale development and Data Collection

Sample

In order to test the theory and hypotheses, data was collected from projects within Motorola and some of its partner organizations. The target sample included projects or clearly bounded project phases that were completed in the last two years. The population included different project size, type of project, and functional areas involved to account for and test the impact from such differences. The survey was web-hosted and participation was voluntary. As the unit of analysis was projects, the survey participants were individual project team members representing a particular project. Lists of projects completed in the last two years were collected from the central project registries, and the participation of associated project leaders was solicited using email. Project leaders in turn solicited the participation of their respective project team members.

Out of the 675 projects solicited, 409 were eliminated due to overlapping member participation. Of the remaining 266 projects, a total of 566 surveys were fully completed. The complete responses were later sorted by project name and synthesized into the dataset for the study. All individual responses for a project (ranging from 2 to 11 people per project) were averaged to yield a single project data point. Thus, 566 responses when synthesized resulting in 176 projects data points, yielding a response rate of 66%.

The demographics of the respondents reflect a highly educated, diverse, and balanced sample of respondents. The projects surveyed had been distributed globally, and the geographical distribution reflects the distribution of the survey population. Survey respondents were primarily based in North America (69%), followed by Asia Pacific (21%). This distribution is reflective of Motorola and its partners' workforce distribution. 77% of the respondents were male and 23% female; and 99% of the respondents had some college degrees.

Measurements

All measurement scales were developed with items borrowed from relevant literature, synthesized, and adapted for the current research context. Multiple researchers had utilized different scales in diverse research settings. They were all normalized to the seven-point Likert scale (from "1 = strongly disagree" to "7 = strongly agree").

Since measures of comparable objective performance across diverse projects have yet to be developed, subjective measures were used that are similar to those used by other studies. Respondents were asked to indicate the degree to which they agreed or disagreed with the subject project having met project performance in terms of project expectations, innovation, team performance, and business value. The project expectation scale measured operational aspects of project, such as meeting schedule, budget, reliability, and customer satisfaction with items adopted from project performance scales in Katz (1982) and Katz and Allen (1985); and the expectations of customers, management, and the team, with items adopted from product success scale in Lynn et al. (1999). The innovation scale measured the degree of creativity and innovation of the project deliverable with items adopted from the performance scale in Tushman and Katz (1980). The team performance scale measured the responsiveness, efficiency, and reputation for excellence, with items adopted from team performance and stakeholder-rated performance scales in Ancona and Caldwell (1992) and Guinan et al. (1998). The business value scale measured internal impact to the organization in terms of advanced strategy, improved decision making, streamlined business processes, and operating flexibility and external impact in terms of enhanced product/service value, customer relations, time to market and competitive advantage adopted from process planning and support, production and operations, product and service enhancement, and customer relations scales in Tallon et al. (2000).

The critical project success factors formed the independent variables: team competencies, clarity of team competencies, partner involvement, and management support and commitment. The team competencies scale is a modified version of the staff scale from Cooper and Kleinschmidt (1995b) and measures project team members' perception of team expertise, right mix of skills, relevant knowledge and experience, and resource sufficiency. The goals and strategy scale measures the level of an individual project team member's understanding of project goals and strategy for it to be actionable. It is adopted from the strategic focus scales used in Cooper and Kleinschmidt (1995b) and Lynn et al. (1999). Partner involvement is a modified version of the user involvement scale used in Barki and Hartwick (1994) and the supplier relations scale from Tallon et al. (2000). It measures the level of vendor, supplier, and other partner involvement in project execution as perceived by the project team members. Managerial support scale measures the extent of managerial support and commitment to the project as perceived by the project team members. It is adopted from the senior managerial commitment and accountability scales used in Cooper and Kleinschmidt (1995) and Guinan et al. (1998).

The measures of collaboration and competition in particular required the development of new items through blending original work with contributions of several researchers. Collaboration and competition has been studied mostly at the organizational unit, and only in a limited form at the project level. Few researchers have engaged in the applicability of collaboration and competition measurement in studies at the project level based on analyses of individual level perceptions. Hence, the collaboration scale used in this study measures the perception of intra-team collaborative behavior in terms of communication, information, resources, expectations, and task sharing. It is synthesized from scale items used in Frey et al. (2004) for collaboration, Dooms and Oijen (2005) for resource sharing, Luukkonen et al. (1992) and Baggs (1994) for information sharing, Pinto et al. (1993) for cooperation, and Nobeoka and Cusumano (1994) for coordination. Moving on, the competition scale measures the level of perceived intra-team competitive behavior in terms of conflict and contention for resources and rewards. It consists of modified items adopted from inter-unit competition for resources in Tsai (2002), and individual self-interest, and rewards in Beersma et al. (2003).

Due to the modification or adaptation of the original items used from the relevant literature, considerable development-through-validation rigor was applied and the resulting measurement reflects strong composite reliabilities (.795 to .933, average .885) and provides evidence of convergent and discriminant validity for all constructs. The full survey consisting of 84 questions was deployed through online hosting for eight weeks to obtain responses from an ultimate sample of 176 projects.

Measurement Model Invariance Analysis

Half-split measurement invariance analysis were conducted to verify instrument equivalence, testing the hypothesis that there would be no significant difference at the survey item level between responses from the two halved data sets. This work lent methodological insight into the ramifications of measurement error and unequal reliability, overall error rate and construct equivalence. To assure construct equivalence, no differences are expected in the scales of measurement for all constructs utilized in this study. Factorial similarity (scale items load on the same factor or construct) and factorial equivalence (each scale item has the same loading within statistical bounds and on the same factor) are expected (Singh 1995). Next, variance extraction analysis was performed with a disaggregated CFA model. Forty models were initially run (unconstrained, fully constrained, each item independently constrained), identifying only four items with p values < .05 (CM2, CM4, TP3, and GS3). Four successive models were then run, constraining all but each of the four items of concern. In each instance, p>.05 indicated that our model displayed measurement invariance. This cleared the way to create the composites and to proceed with structural model specification and hypotheses testing. Table 1 summarizes the uni-variate statistics of the composites (calculated as a simple averaging of the items) and the bi-variate inter-correlations among the constructs for the 176 projects.

Table 1. Descriptive Statistics and Inter-correlations among Variables

	CL	CM	CC	GS	MS	PI	BV	TP	IN	PP
Collaboration (CL)	1									
Competition (CM)	-0.532	1								
Team Competencies (CC)	0.622	-0.434	1							
Goals & Strategy (GS)	0.463	-0.377	0.586	1						
Management Support (MS)	0.573	-0.366	0.599	0.476	1					
Partner Involvement (PI)	0.489	-0.212	0.465	0.397	0.481	1				
Business Value (BV)	0.588	-0.262	0.52	0.576	0.536	0.441	1			
Team Performance (TP)	0.664	-0.501	0.607	0.517	0.533	0.458	0.48	1		
Innovation (IN)	0.392	-0.248	0.258	0.39	0.28	0.372	0.318	0.319	1	
Project Expectation (PP)	0.518	-0.384	0.485	0.421	0.411	0.241	0.373	0.663	0.227	1
Mean	5.57	3.13	5.40	5.55	5.11	4.92	5.35	5.79	5.23	5.61
Standard Deviation	1.07	1.09	1.11	1.10	1.17	1.18	1.05	1.13	1.42	1.26
Reliability	0.933	0.838	0.795	0.891	0.916	0.826	0.888	0.892	0.938	0.928

Analysis and Findings

Prior to testing the hypotheses, analytical methods were employed to examine possible data quality issues. Specifically, we checked for confounding effects of measurement error, pursuing evidence of acceptable construct reliability, as well as convergent and discriminant validity. Variance extraction, reliability, and highest and average shared variance for a disaggregated model were then calculated prior to composite formulation to address these concerns. Additionally, a half split-group analysis of the data sample was performed to test the model items for measurement invariance. With an overall sample size of 176, the key concern is the presence of random error that could bias the estimation of structural paths in an unpredictable fashion. We also tested for possible effect of control variables, such as project type, size, and duration model. However, no significant effects were found.

We also examined potential for misspecification bias and tested for mediation and moderation effects. Our proposed theoretical model (Figure 2) had two systems of perceived effects: (1) the extent to which the critical success factors are influencing the project performance, and (2) the extent to which intra-team collaboration and competition mediates the influence of the critical success factors on project performance. Misspecification bias can occur if some of the effects not hypothesized are significant, yet not included in the empirical analysis. The theoretical model was used as a baseline to ensure model fit. Then, any new paths not hypothesized were tested through incremental increases while examining individual coefficients, and model fit indices to retain the significant effects for the next step of analysis. Systematic implementation of this procedure to test potential effects mitigated misspecification bias in addition to testing for the significance of partial mediation.

Variance Extraction and Reliability

A fully disaggregated CFA measurement model with all observed indicators was estimated to ensure the measures corresponded only to their hypothesized constructs (Fornell and Larcker 1981; Ramaswami and Singh 2003). The measurement model included 41 of the 69 original items that remained after the initial EFA and CFA process.

According to the conceptual definitions, all individual measures loaded only on a single factor. The significant Chi-square of 1355.09 with 774 degrees of freedom, relative and absolute fit indicators (CFI=0.9, NFI=0.797, RMSEA=0.065) and indicator of parsimonious fit (PCFI=0.809) suggest that the hypothesized measurement model is a moderately good representation of the variance-covariance matrix of the measures. Richness of model constructs in terms of number of items used for each construct was preferred instead of forcing stronger fit indicators. Appendix 1 provides details on factor loadings and the measurements properties of the constructs. The variance extracted for the 10 constructs are all above the desired 0.50 threshold and higher than the highest shared variance. The composite reliabilities are at the low end of 0.795 and with the most approaching 0.938. The standardized factor loadings, without exception, are highly significant statistically (t-values > 2.32 and $p < 0.001$) and substantially large (greater than 0.5 with the majority between 0.6 and 0.933, except for CM2=0.498 and CM2=0.526). These EFA results were rechecked through CFA to ensure the measures corresponded only to their hypothesized constructs.

Fit of Hypothesized Structural Model and Estimated Coefficients

Using the full data sample, the hypothesized model of Figure 2 was tested and encountered no particular problems in estimation. Slight modifications, as suggested by the modification indices, were made to the theoretical model – correlating the error terms of Collaboration (CL) and Competition (CM) as well as Project Expectation (PP) with Innovation (IN) and Team Performance (TP). Appendix 1 shows the resulting coefficients, and indices summarized as Chi-square = 25.253, d.f. = 4, CFI = 0.974, NFI = 0.971, PCFI = 0.082, RMSEA = 0.174 and SRMR = 0.0323.

The final model was tested path by path. Reviewing the R^2 correlations in Appendix 1, overall the final model provides a reasonable explanation for Team Performance (TP), Business Value (BV), and Collaboration (CL) (R^2 = 0.55, 0.506, and 0.478 respectively). Innovation (IN), and Competition (CM) are not as strong (R^2 = 0.25 and 0.222 respectively) while Project Expectation (PP) is in between (R^2 = 0.359). These variations are likely related to the EFA/CFA process, and a trimming strategy based on interaction with dependent variables for project performance.

Hypotheses Testing

Table 2 below summarizes the hypotheses testing, as indicated by the estimated coefficients and their significances for the dataset, as follows:

The effect of collaboration and competition on project performance: while *Collaboration* (CL) has a positive influence on Project Expectations (PP), Innovation (IN), Team Performance (TP), and Business Value (BV) with coefficients of 0.305, 0.248, 0.32, and 0.362, respectively, *Competition* (CM) has a negative influence on Team Performance (TP) of -0.158 and a positive influence on and Business Value (BV) of 0.147. Among the H1 and H2 hypotheses groups, only hypothesis H2a and H2b are not significant.

The effect of success factors on project performance: *Goals and Strategy* (GS) has significant impact on Project Expectation (PP), Innovation (IN), Team Performance (TP), and Business Value (BV) of 0.156, 0.279, 0.133, and 0.342 respectively. Thus, H3 hypotheses group is valid. *Team Competencies* (CC) have significant impact on Project Expectations (PP), Innovation (IN), and Business Value (BV) of 0.175, -0.173, and 0.168 but had no significant impact on Team Performance (TP). Hence, hypotheses H4a and H4c are valid while hypothesis H4d is invalid, and hypothesis H4b is valid for negative influence on Innovation (IN). The influence of *Partner Involvement* (PI) is significant only for Innovation (IN) of 0.216. Therefore, hypothesis H5b is valid while hypotheses H5a, H5c and H5d are not valid. Similarly, *Management Support* (MS) have significant influence only on Business Value (BV) of 0.174 and as a result hypotheses H6a, H6b and H6c are invalid while hypothesis H6d is valid.

The effect of critical success factors on collaboration and competition: *Goals and Strategy* (GS) has no significant effect on Collaboration (CL), thus hypothesis H7 is invalid. However, Goals and Strategy (GS) has a significant negative effect of -0.168 on Competition (CM). Though not positive as expected, hypothesis H8 is valid for negative effect. *Team Competencies* (CC) has significant affect on both Collaboration (CL) and Competition (CM) of 0.353 and -0.27 respectively. Hence hypotheses H9 is valid but hypothesis H10 is negative instead of positive as expected. *Partner Involvement* (PI) has a significant effect of 0.181 on Collaboration (CL) but has no significant effect on Competition (CM), thus hypothesis H11 is valid but H12 is invalid. Finally, *Management Support* (MS) has significant effect of 3.347 on Collaboration (CL) and -1.701 on Competition (CM). Hence hypothesis H13 is valid while hypothesis H14 is valid only for negative effects. Table 2 and Figure 3 summarize the results of the hypothesis testing as discussed above.

Table 2. Hypothesis Tests and Structural Coefficients[2]

Hs	IVs	DVs	Coefficient	t-value/ p-value	Comments
H1a	CL→	PP	**0.305**	**3.406*** **	Valid
H2a	CM→	PP	-0.087	-1.185	Invalid
H1b	CL→	IN	**0.248**	**2.555***	Valid
H2b	CM→	IN	-0.045	-0.561	Invalid
H1c	CL→	TP	**0.32**	**4.259*** **	Valid
H2c	CM→	TP	**-0.158**	**-2.56***	Valid for negative effect
H1d	CL→	BV	**0.362**	**4.599*** **	Valid
H2d	CM→	BV	**0.147**	**2.283***	Valid
H3a	GS→	PP	**0.156**	**2.004***	Valid
H3b	GS→	IN	**0.279**	**3.325*** **	Valid
H3c	GS→	TP	**0.133**	**2.051***	Valid
H3d	GS→	BV	**0.342**	**5.016*** **	Valid
H4a	CC→	PP	*0.175*	*1.935*	Valid at low significance
H4b	CC→	IN	*-0.173*	*-1.772*	Valid for negative effect at low significance
H4c	CC→	TP	**0.168**	**2.216***	Valid
H4d	CC→	BV	0.023	0.294	Invalid
H5a	PI→	PP	-0.106	-1.424	Invalid
H5b	PI→	IN	**0.216**	**2.695** **	Valid
H5c	PI→	TP	0.098	1.583	Invalid
H5d	PI→	BV	0.065	1	Invalid
H6a	MS→	PP	0.085	1.033	Invalid
H6b	MS→	IN	-0.011	-0.121	Invalid
H6c	MS→	TP	0.08	1.163	Invalid
H6d	MS→	BV	**0.174**	**2.409***	Valid
H7	GS→	CL	0.069	0.999	Invalid
H8	GS→	CM	**-0.168**	**-1.991***	Valid for negative effect
H9	CC→	CL	**0.353**	**4.595*** **	Valid
H10	CC→	CM	**-0.27**	**-2.888** **	Valid for negative effect
H11	PI→	CL	**0.181**	**2.796** **	Valid
H12	PI→	CM	0.052	0.656	Invalid
H13	MS→	CL	**0.241**	**3.347*** **	Valid
H14	MS→	CL	*-0.149*	*-1.701*	Valid for negative effect at low significance

Discussions

The findings from the quantitative analysis above fall into three categories, namely, the impact of critical success factors on project performance, the influence of competition and collaboration on project performance, and the mediation effect of collaboration and competition on influence of critical factors on project performance. Additionally, collaboration and competition were combined for testing the influence of *coopetition* (operationalized as the interaction: Collaboration X Competition) on project performance and found to be insignificant. It was not included in the paper for space considerations.

While the evidence for relationships between critical success factors and project performance is prevalent in the literature, the analysis provides some interesting new insights. Clarity of goals and strategy had significant effects on all aspects of project performance as expected. But the influence of team competencies was limited to team performance. Team competencies in terms of right mix of technical, managerial, and people skills should enable the team to self-manage for meeting project performance. Yet, the findings did not support such causality.

Similarly, the analysis found the influence of partner involvement limited to innovation and not significantly affecting any other aspect of project performance. It is likely that the external involvement brings a diverse perspective adding to the richness of project team knowledge and facilitating out-of-the-box thinking that paves the way to innovation. From this perspective it is understandable that the diversity injected into the project through partner involvement would not be helpful in meeting project expectations, requiring a narrower and more focused effort.

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[2] Note: Coefficient is the best fit estimated standardized coefficient accounting for misspecification bias. Coefficients in bold are significant at **p <= .05 (with p <= 0.5 indicated by * p-value, p <=0.01 indicated by ** and p <= 0.001 indicated by ***)**, italics at ***p*** *<= 0.1.* The remaining coefficients are not significant.

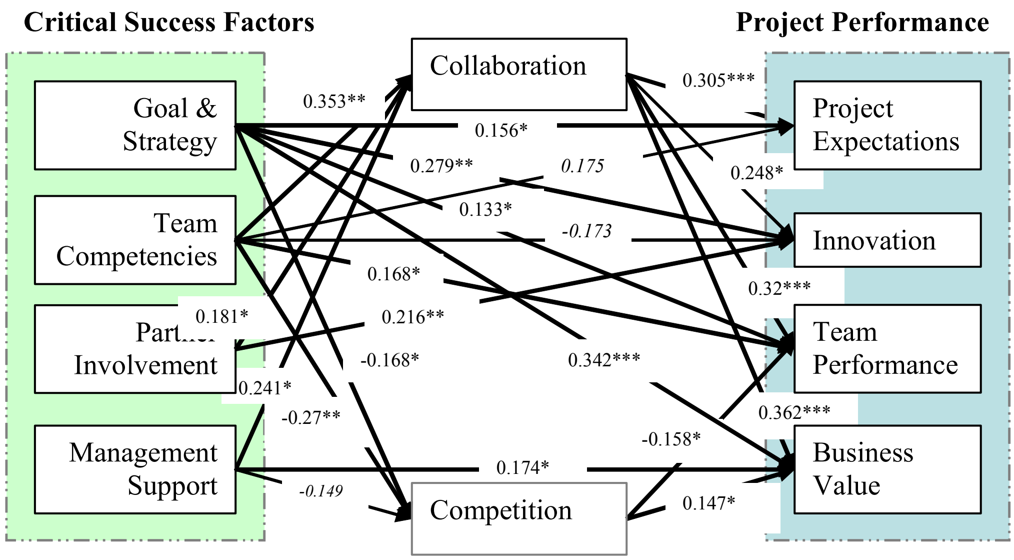

Figure 3. Final Estimated Model[3]

Furthermore, similarly partner involvement would not be expected to help team performance. However, the lack of significant relations between partner involvement and business value is a surprise. Perhaps the partner involvement is restrictive in the sample population, and thus, does not rise to an appropriate level to generate business value.

The analysis also suggests that the influence of management support is limited to business value. Management support in terms of participating in critical decision making, coordination with other groups, protection from external interference, and managing external communication help ensure focus and proper alignment to generate desired business value, which is in line with the findings. However, such management support also protects project team from external distractions, and thus, allow it to remain focused on the task at hand in better meeting project expectations, innovation, and yield better team performance. Clearly, these findings are not in line with the literature, and may be a peculiar attribution of the study population.

Next, examining the influence of collaboration and competition on project performance, we find that collaboration has a reasonability strong influence on project performance. However, influence of competition is limited to just team performance and business value. The negative influence of competition on team performance is understandable since competition among individuals is bound to negatively impact the collective team performance. From these analyses it is clear that collaboration is preferred over competition. There could be two reasons for this finding: the projects surveyed are more collaborative by nature than competitive; i.e. the tasks involved are inherently collaborative. Another explanation is that people are less likely to report on competitive behavior as it is considered counter-productive and reprimanded, especially in light of constant communication to collaborate and behave as one team. Either way, the analyses reveal deeper insights when collaboration and competition are combined with the critical success factor. There are two interesting observations: the impact of critical success factors on collaboration and competition and the mediation effects. Firstly, it is interesting to note the lack of influence from goals and strategy on collaboration. One would expect that clarity of project goals and strategy would facilitate identification of collaborative and competitive tasks–what to share when and where for the common good, and when and where to compete for the private rewards and self-interest. Secondly, the positive influence of team competencies, partner involvement, and management support on collaboration, as expected, but negative influence of goals and strategy, team competencies, and management support on competition – dampen individual competition. The lack of influence on competition from partner involvement is explainable as partner involvement by its very nature is collaborative.

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[3] Note: Number on the shown path is the best fit estimated standardized coefficient accounting for misspecification bias. Coefficients in bold are significant at **p <= .05 (with p <= 0.5 indicated by * p-value, p <=0.01 indicated by ** and p <= 0.001 indicated by ***)**, italics at ***p*** *<= 0.1.*

Examination of the mediation effects reveals interesting insights too. Where no influence existed from team competencies to business value, collaboration fully mediated such relationships. Similarly, competition fully mediates the influence of team competencies on business value, for example. In other situations both competition and collaboration partially mediated the influence of critical success factors on project performance. Furthermore, such mediation effects for both competition and collaboration are positive except for a few cases. Including the mediation effect, the findings from this study are a lot closer to the prevalent view of the literature regarding the influence of critical success factors on project performance. Probably the previous studies included collaboration and competition as embedded concepts in their constructs. In that case, a closer examination of the critical success factors is necessary to explicitly separate collaboration and competition as independent factors.

Contributions and Implications to Practice

The differences in the nature of collaboration and competition's influence on project performance and mediation of critical success factor influence on project performance, as evidence from the above analysis, reinforces the notion that competition and collaboration are independent and different scales. To conclusively determine this would require a separate and more detailed study.

The collective findings can be synthesized into Figure 4 segments of the plot-mapping propensity for intra-team collaboration and against propensity for intra-team competition. The plot provides guidance for practitioners – high propensity for collaboration among project team members would lead to high project performance in terms of Project Expectations, Innovation, Team Performance, and Business Value. On the other hand, high propensity for competition among project team members would lead to high project performance in terms of only Team Performance and Business Value. Thus, for high Team Performance and Business Value, practitioners are advised to encourage collaborative and competitive behavior at the same time. However, they should stay with collaboration for higher performance in terms of Project Expectations and Innovation.

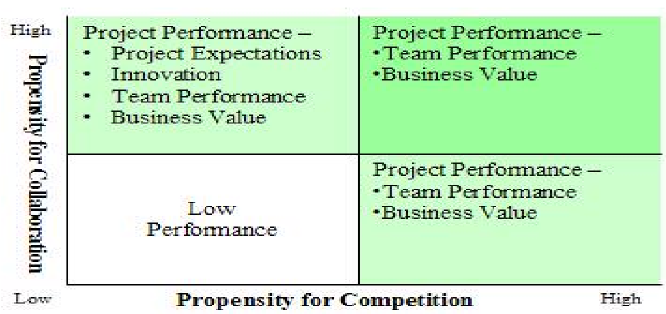

Figure 4. Propensity for Collaboration versus Competition

Some additional findings that can serve as guidelines for practice include

- Team competencies are critical to team performance
- Partner involvement is critical to innovation
- Management support is critical for business value
- Collaboration and competition should be considered as independent critical success factors.

Although the study population was limited to Motorola and some of its partner firms, there is nothing inherently restrictive about these findings, and hence, could serve as guidelines that are generally applicable to team-based projects at large.

Challenges and Suggestions for Future Research

Several limitations of this study are noteworthy that should be taken into account in interpreting the results. First, a limitation is the small size of survey sample, n=176. A sample size of greater than 300 would be more appropriate for the hypothesized model. However, this represents a significant data collection challenge, since each data point is an averaged perception of a number of project team members greater than two.

A second limitation of the study is the span of data collection being limited to Motorola and its partner organizations. Although the survey included data from several geographical regions, it was still limited to Motorola's IT. A more robust data collection should include companies from diverse industries representing projects spanning more diverse functional areas. Further differentiating the types of projects (dealing with front-end or back-end office) would provide greater insight – potentially, collaboration may have greater influence on performance for projects dealing with front-end processes while competition may yield higher influence for projects covering the back-end processes.

The third limitation was that all data was self-reported, and thus, may be skewed based on self perceptions. Additionally, the association among constructs may be inflated as a result of common method variance resulting from the use of a single questionnaire. For a robust data collection a different mode of data collection is needed with performance data being collected from project managers, line managers, and users, while the data for remaining constructs, especially collaboration and competition being collected from the project team members. This would also ensure a more balanced perspective among projects leaders and workers, thus, addressing prestige bias.

Nevertheless, the study findings point to several areas for future study. Firstly, a relationship between collaboration and competition was observed (with correlation of -0.34). Modeling this relationship separately with non-recursive modeling showed it to be significant. Recursive modeling is more appropriate for the exploration of this phenomenon. But it requires rigorous treatment of antecedent constructs for competition and collaboration that are independent of each other. This aspect has been left for future research.

Secondly, recognizing that collaboration and competition have negative as well as a positive impact on project performance, the scope of this study was limited to exploring just the positive aspects. An area for further investigation would be the exploration of negative aspects, as well as combination of negative and positive aspects.

Thirdly, an extended area of study is the introduction of project life cycle—exploring when collaboration, competition, or their combination is appropriate with respect to the project life cycle. For example, just collaboration may be more effective during initial phases of project life cycle with competition following in the later phases.

A fourth area for further investigation is the exploration along the collaboration life cycle developed in the earlier qualitative research (Singh 2005). Different forms of collaboration and competition are appropriate for different types of problems and projects. Hence, the findings from one form of collaboration may not necessarily be applicable to other forms. This aspect is left for future research.

Conclusion

The objective of this study was to explore the influence of collaborative and competitive behavior among team members on project performance. Collaboration and competitions have previously been considered as opposite ends of the same scale. However, it was conceptualized collaboration and competition as distinct and independent constructs – collaboration comprised primarily of information, resource, and task sharing, while competition comprised of individual contribution, conflict, and pursuit of self-interest among team members. This study explored the mediation effects of collaboration and competition in light of critical success factors' influence on project performance. The results revealed a strong and broad influence of collaboration on performance in terms of Project Expectations, Innovation, Team Performance, and Business Value. However, competition affected only Team Performance and Business Value.

We also encountered some surprises, especially in terms of the influence of critical success factors on project performance. The influence of Goals and Strategy on all aspects of project performance was confirmed by the study as expected from the literature. However, Team Competencies significantly influenced only Team Performance; Partner Involvement influenced only Innovation; and Management Support influenced only Business Value, which is not in line with the expectations from the literature. This finding could be characteristic of the survey population or represent a phenomena resulting from the unique formulation of competition and collaboration constructs – requiring further investigation. However, introducing the mediation effects of collaboration and competition brings the influence of critical success factors more in line with the expectations from the literature.

Appendix 1. Factor Loadings and Measurement Properties of Constructs Used

	Factors	Items	Description	Loading	t-value/ p-value	Variance Extracted	Variance Shared R**2 Highest	Variance Shared R**2 Average	Reliability
Project Performance	Project Expectation (PP)	PP1	Schedule	0.74	11.307***	0.684	0.506	0.252	0.928
		PP2	Budget	0.722	10.925***				
		PP4	Customer Satisfaction	0.8	12.683***				
		PP6	Team's expectations	0.96	17.138***				
		PP7	Management's expectations	0.933	16.291***				
		PP8	met/exceeded similar projects	0.806	12.823***				
	Innovation (IN)	PP9	Innovative project	0.894	14.45***	0.883	0.534	0.285	0.938
		PP10	Creative Outcome	1.024	18.004***				
	Team Performance (TP)	TP1	Responsive	0.782	11.995***	0.737	524	0.392	0.892
		TP2	Efficient	0.895	14.73***				
		TP3	Reputation for Excellence	0.877	14.27***				
	Business Value (BV)	BV2	Improved decision making	0.768	11.627***	0.572	0.426	0.302	0.888
		BV3	Streamlined business processes	0.656	9.364***				
		BV4	Enhanced operating flexibility	0.811	12.573***				
		BV5	Enhanced product/service value	0.74	11.03***				
		BV7	Enhanced customer attraction/retention	0.795	12.195***				
		BV8	Reduced time to market	0.751	11.266***				
Collaboration/Competition	Intra-team Collaboration (CL)	CL2	Shared information	0.775	12.013***	0.698	0.523	0.353	0.933
		CL6	Shared resources	0.881	14.652***				
		CL8	Shared expectations	0.806	12.72***				
		CL9	Shared suggestions	0.844	13.685***				
		CL10	Shared tasks	0.891	14.953***				
		CL11	Switching responsibilities	0.821	13.098***				
	Intra-team Competition (CM)	CM2	Preference for working alone	0.498	6.741***	0.524	0.331	0.199	0.838
		CM4	Competition for resources	0.526	7.217***				
		CM5	Criticism	0.842	13.39***				
		CM6	Persistent conflict	0.935	15.733***				
		CM7	Focus on Self-interest	0.707	10.386***				
Critical Success Factors	Team Competencies (CC)	CC1	Team Expertise	0.74	10.594***	0.565	0.524	0.373	0.795
		CC2	Right mix of technical & managerial skills	0.817	12.166***				
		CC3	Sufficient Resources	0.689	9.585***				
	Goals & Strategy (GS)	GS1	Goal clarity	0.901	14.959***	0.739	0.461	0.267	0.891
		GS2	Role clarity	0.951	16.318***				
		GS3	Strategic focus areas	0.656	9.533***				
	Partner Involvement (PI)	PI1	Partner advice	0.805	11.772***	0.614	0.327	0.214	0.826
		PI2	Partner sign-off authority	0.722	10.209***				
		PI3	Partner team Membership	0.817	12.051***				
	Management Support (MS)	MS3	Project Decision Involvement	0.811	12.706***	0.687	0.481	0.291	0.916
		MS4	Coordination with external groups	0.817	12.87***				
		MS5	Protection from outside interference	0.862	13.993***				
		MS6	Scan threats	0.817	12.89***				
		MS8	Inform others	0.83	13.177***				

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