Investigating the Impact of Teamwork Quality on Project Effectiveness in a Multiple-project Management Setting

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ABSTRACT

Managing multiple projects simultaneously is the current trend in project management particularly in the oil and gas industry. The objective of this research is to investigate the impact of teamwork quality on project effectiveness in a multiple-project management setting in order to help project managers manage multibillion dollar projects effectively. Teamwork quality is measured against six variables: communication, coordination, balance of member contributions, mutual support, effort and cohesion, while effectiveness is measured by project performance. A total of 184 project managers participated in the survey. The findings show that all six variables of the teamwork quality construct had a measurable impact on project performance.

Keywords
Managing Multiple Projects, Teamwork Quality, Multi-project Manager, Project Performance.

This study is conducted within the field of project management in the oil and gas industry, and it focuses specifically on project managers who lead multiple projects simultaneously through showing the impact of teamwork quality on project effectiveness. Leading more than one project at a time of multimillion/multibillion dollars is a difficult task for project managers. Project managers are required to deliver successful projects within schedule and budget. Therefore, multi-project managers require more effective ways and tools to help them improve project performance in terms of time, cost and quality. Teamwork quality is found to be one of the most important factors impacting projects performances. This study investigates the impact of teamwork quality on project performance. The findings show that teamwork quality has a positive impact on project performance. Hence, multi-project managers may improve project performance by evaluating their project team collaboration using the following six factors: communication, coordination, balance of member contributions, mutual support, effort and cohesion. Improving these factors within a project team shall enhance project performance.

1. Introduction

Oil and gas is one of the major industries globally, particularly in the USA. This industry is also the main source of energy in the USA (Guilford, Hall, O'Connor & Cleveland, 2011) and in many other countries. Oil and gas products are heavily used in our everyday lives for power generation. As the world demand for oil and gas increases, producers invest more in developing new projects, both on shore and off shore, to increase and enhance oil and gas production worldwide (Campbell & Laherrère, 1998). The sizes of such projects vary between small, medium, large, major and mega, depending on the project's value and scope of work complexity. Currently, it is common in the oil and gas industry to have multiple projects running simultaneously because of market need and high demand; hence, project management discipline is mandatory to improve the management of multiple projects and boost their performance and efficiency. Project management has become increasingly important. Indeed, many project managers lead more than one project simultaneously for many reasons, such as the market need, project manger's skills and expertise in managing multiple projects, linking multiple concurrent projects, and leading multiple teams, while others lead single projects (Patanakul, 2013).
The focus of this study is the effectiveness of project performance through project managers who lead multiple simultaneous projects. Usually, such type of management for different project simultaneously are independent in terms

of deliverables and objectives (Archibald, 2003 & Ireland 1996). For example the assignment of two new pipeline system upgrading projects and an elevated power substation project to one project manager. i.e. pipeline projects may be of a higher budget than the substation one but they are all assigned to the same project manager and they take similar effort going throughout the project cycle. The reason behind assigning many projects simultaneously to one project manager is to enhance the management of such projects, enhances project's performance, coordinate projects of the same nature in order to save time and transfer of knowledge and technology between projects (Archibald, 2003 & Ireland 1996).

Project managers leading multiple projects usually suffer more stress and work pressure than single project managers, due to the fact that they have list of deliverables for different projects to be delivered on time and within budget, they get usually dragged to different meetings during the day, they are also requested to provide an updated information of all projects status, need to deal sometimes with different project teams and interact with other teams, they face pressure from senior management due to contractors delays and other issue, etc. Such work load require enormous effort in addition to skills and expertise in order to control many projects at a time.

The study aims to identify the gaps of multi-project management from managers side in terms of projects delays and lack of project performance while managing multiple projects due to the previously mentioned reasons. Therefore, this study answers the research question "what is the impact of teamwork quality on project effectiveness in a multiple-project management setting in the oil and gas industry? Hence the answer contributes to fill the gaps in the theory of multiple-project management by helping multi-project managers' boost their projects performance through team collaboration i.e. enhance teamwork quality in order to complete projects on time and within budget. Up to date there is no deep investigation of the effect of teamwork quality on project success in oil and gas project teams.

In some cases multiple project managers practice multiteam management competency while managing multiple projects, i.e. one project manager may lead different projects with different project team, and this means each team will have a dedicated project. Additionally, multiple project managers may lead different projects with the same project team. However, the effectiveness of such management is highly dependent on teamwork within a project team. Hence, it is important to study teamwork quality in a multiple project management setting in order to discover how effective is team collaboration for multi-project managers to deliver projects on time and within budget.

One study identified the factors affecting managers' effectiveness in a multi-project management setting to achieve project-related and organizational goals (Pillai et al. 2002). Patanakul identified four key drivers that help multiple-project managers effectively manage simultaneous projects and these are: the project manager's assignment, resource allocation, interdependency management and multiple-project management competencies (Patanakul, 2013). Based on the importance of team collaboration in managing multiple projects, Patanakul suggested to investigate the potential impact of teamwork quality on the effectiveness of managing multiple projects for future studies.

Patanakul defines effectiveness in managing multiple projects using two categories: the accomplishment of project performance, in terms of time, cost and quality, and the project manager's learning, in terms of knowledge acquisition from leading multiple projects (Patanakul, 2013).

This study focuses on project effectiveness only i.e., the effectiveness from the project perspective, which corresponds to project performance. The study is conducted to verify the impact of teamwork quality on project performance in a multiple-project management setting in the oil and gas industry.

Hoegl and Gemuenden suggested that teamwork quality consists of six facets: communication, coordination, the balance of member contributions, mutual support, effort and cohesion (Hoegl & Gemuenden, 2001).

Teamwork quality is measured against the six facets mentioned earlier, with project performance being defined as the aggregation of cost, time and quality. The research is conducted using a quantitative method for surveying multi-project managers from 13 major oil and gas companies worldwide: Aramco, Chevron, Kuwait Petroleum Company, BP, Shell, ExxonMobil, Total, Petro China, Qatar Petroleum, ADNOC, Gazprom, Eni and ConocoPhillips. A total of 184 multiple-project managers participated in the survey.

2. Literature Review

2.1 Conceptualizing Teamwork Quality

Project teams are fundamental to organizations. According to Homan human behavior in teams is defined as activities, interactions and sentiments (Homans, 1974). A team is formed when it consists of three or more people which belongs to an organization and each persons of that team is a member and they collaborate to perform common

tasks, i.e. team collaboration to perform a common task is called teamwork (Guzzo & Shea 1992). In fact, Hackman conceptualized teamwork quality as high order construct that contains six sub constructs based on a model designed by him for team behavior and effectiveness (Hackman, 1987) as shown in Table 1, which is initially derived from a previous researcher (McGrath, 1964). Hoegl and Gemuenden suggested work success in teams depends on how good team members interact and collaborate,

Table 1. Sub constructs of Teamwork Quality

Subconstruct	Description
Communication	Frequency, formalization, and openness of the information exchange.
Coordination	Common understanding when working on parallel subtasks, and agreement on common work-down structures, schedules, budgets, and deliverables
Balance of Member Contributions	The ability to employ the team members' expertise to its full potential. Contributions should reflect the team member's specific knowledge and experience.
Mutual Support	Team members' ability and willingness to help and support each other in carrying out their tasks.
Effort	Team members' ability and willingness to share workload and prioritize the teams' task over other obligations.
Cohesion	Team members' motivation to maintain the team and accept that team goals are more important than individual goals.

hence, they proposed the construct of "Teamwork Quality" (Hoegl & Gemuenden, 2001). Many researchers used the term "Collaboration" to describe different type of interactions between team members when performing a task. Bedwell et al. described collaboration as a high level process that includes many factors such as cooperation, teamwork and coordination (Bedwell et al. 2012). Chioccio et al. suggested that team collaboration predicts task performance (Chioccio et al. 2012). Therefore, teamwork competencies are important to the team and hence team members must possess expertise in the social dynamics of collaboration (Salas et al., 2009).

Patanakul suggests that it is worth investigating the impact of teamwork quality on the effectiveness of managing multiple projects (Patanakul, 2013). Over the past two decades, teamwork quality has been defined differently from one researcher to another, sometimes it is defined in terms of free open communication, or concurrent efforts and some other researchers defined it by supportive behavior among team members. There was no precise definition of how to measure teamwork quality exists. Some previous old studies investigated *teamwork* as an entire measure without defining its natures. However, Suprapto et al. suggested number of common teamwork elements such as: team identity, cohesion, shared vision, information/ knowledge sharing, affective trust, attitude in problem solving, and the reflection of self-assessment (Suprapto, Bakker, Mooi, & Moree, 2015). In project context, teamwork is defined as working in a team together on the basis of supports in team members interactions (Hoegl & Gemuenden, 2001), (Baiden & Price, 2011). The effectiveness of teamwork is linked to team collaborative relationship and is documented in project management researches (Baiden & Price, 2011; Chan APC, Chan DWM, Chiang, Tang, Chan EHW, & Ho, 2004; Cheung, Yiu, & Chiu, 2009; Kumaraswamy & Rahman, 2006).

Cheung et al. (2009) found that the spirit of teamwork is one of the vital key drivers for adopting cooperative behavior (Cheung, Yiu, & Chiu, 2009).

Furthermore, many studies explain teamwork and its quality based on the team performance within an organization, without considering how to define the nature of teamwork. Indeed, measuring teamwork quality was vague because no clear concept or measure was available until Hoegl and Gemuenden answered important questions, such as "What is teamwork?" and "How is it measured?" They proposed defining teamwork quality as the quality of interactions in a team (Hoegl & Gemuenden, 2001). Then, a construct measuring the characteristics of a team was developed, specifying six facets of the process of team collaboration that constitute the concept of teamwork quality; this concept reflects both the team's tasks and the social interactions within the team. In other words, teamwork quality measures the collaborations within a team.

The six identified facets of teamwork quality are as follows: communication, coordination, the balance of member contributions, mutual support, effort and cohesion (Hoegl & Gemuenden, 2001). Easley el al. agreed that teamwork quality measures the quality of collaboration in teams, and found that teamwork quality influence project performance (Easley, Devaraj, & Crant, 2003). Hoegl and Gemuenden present evidence indicating that teamwork quality affects team performance (Hoegl & Parboteeah, 2003).

This research employs the six facets of the teamwork quality construct as a comprehensive measure of the quality of collaboration within teams: "(*communication*, i.e., the open discussion and sharing of information; *coordination*, i.e., coordinating tasks between team members; *balance of member contributions*, i.e., utilizing team members' knowledge; *mutual support*, i.e., team members supporting each other; *effort*, i.e., expending effort on given tasks; and *cohesion*, i.e., promoting team unity and consistency) holding the quality of task-related and social interaction within teams" (Hoegl & Parboteeah, 2003).

In several empirical studies, Hoegl and colleagues (Hoegl & Gemuenden, 2001); Hoegl, & Parboteeah, 2006; Hoegl, & Parboteeah, 2007; Hoegl & Weinkauf, 2005; Hoegl, Weinkauf, & Gemuenden, 2004)**.** showed that 'teamwork quality' contributes significantly to the success of innovative projects.

2.2 Conceptualizing Project Effectiveness in a Multiple-project Management Setting

Although the literature on project effectiveness in a multiple-project management setting is limited, managing multiple projects is a common practice in many industries, particularly the oil and gas industry. Prior studies confirmed the importance of researching project management in multi-project settings (Yaghootkar & Gil, 2012).

According to Kozlowski & Ilgen, project effectiveness that is represented in project performance is derived from team effectiveness i.e. team's task defines the work structure and coordination needed such as behavior exchange, information, etc. which is necessary to achieve team goals and task requirements (Kozlowski & Ilgen, 2006). Mathieu et al. suggested that characteristics of team members (i.e. competencies), team level characteristics (i.e. task framework) and organizational factors (i.e. environment) drive team members' interactions towards tasks performance (i.e. successful completion of tasks) (Mathieu et al., 2008). According to researchers, project teams are quite involved with task outcome performance (Chiocchio & Essiembr, 2009).

A multi project setting is defined as project managers leading several (more than one) projects on the operational level simultaneously (Caniëls & Bakens, 2012). However, it has been generally accepted that time, cost, and quality are the main factors for measuring projects performance (Leong, Zakuan, Mat Saman, Ariff, & Tan, 2014). Cooke-Davies distinguished between *project success* (measured against the overall project objectives) and *project management success* (measured against project performance in terms of cost, time and quality) (Cooke-Davies, 2002).

In project management, high performing projects are those fulfilling project management's objectives, for example, an effective processes for managing multiple stages of a project life cycle is measured against project's success outcomes i.e. meeting project completion date, cost and quality objectives. (Din, Abd-Hamid & Bryde, 2011)..

From the project perspective, project effectiveness is defined by the project performance in terms of time, cost, and customer satisfaction/quality (Patanakul, 2013). In managing multiple projects, project managers/leaders are required to control multiple project objectives and their performance. Dietrich *et al*. emphasize that project success should be measured according to factors beyond time and budget (Dietrich & Lehtonen, 2005). Project management in a multiple-project context is complex. Frustration, stress and disruption are common in project load situations when many parallel projects are running (Gustavsson, 2016). It is not easy for one project manager to manage multiple projects simultaneously due to lack of time sharing time among different projects. Therefore, project managers must have effective time management when managing different projects (Patanakul & Milosevic, 2008). Patanakul and Milosevic expect multiple-project managers to be effective in ensuring their projects' performance to satisfy the requirements of project time, cost and customer satisfaction (Patanakul, 2013).

To clearly understand the teamwork quality construct as an entire measure, the concepts of the six facets and the hypotheses are presented below.

2.3 Communication

Communication is the process of exchanging information among members of the project team. Communication is not only exchanging information but also delivering messages, sharing ideas, discussing issues, and solving problems. Communication between project team members can take the form of verbal communication (i.e., communication through discussions, meetings, and chatting and be formal or informal) or written communication (i.e., through letters, memos, emails, text messages, and computer applications). Hoegl and Gemuenden describe the quality of communication within a project team in terms of its frequency, formalization, structure and openness (Hoegl & Gemuenden, 2001). The frequency of communication means how often/frequently project team members communicate, e.g., daily or weekly. The formalization of communication relates to whether communication is formal, e.g., memos, letters, and emails, or informal, e.g., chatting over the lunch break, visiting each other's offices to discuss issues or talking on the phone. The structure of communication is defined as whether project team members communicate freely with each other or require a mediator, such as the team leader or manager, to control the meeting

and avoid miscommunication. Finally, open communication means that team members are free to exchange information without restrictions or holding back information.

Communication is defined as the extent to which a team member are capable to openly and effectively inform and share with other teams of information without hiding critical information.

Communication quality is defined by its efficiency, adequacy, structure, openness, and timeliness of the exchanged information among teams and team members (Dietrich, Eskerod, Dalcher & Sandhawalia, 2010; Salas, Sims & Burke, 2005). . Communication is a fundamental element of teamwork quality and it is very important for team collaboration. Being able to communicate directly and freely with all team members in order to exchange information without mediator (i.e. coordinator or team leader) is essential in multiple project management setting as the multiple project manager leads multiple teams and hence communication among team members is vital to avoid lack of time.

2.4 Coordination

Hoegl and Gemuenden consider coordination to be an important factor of teamwork quality (Hoegl & Gemuenden, 2001). Coordination is the operation of aligning the tasks and activities in sequence between teams sharing the overall project activities (LePine, Piccolo, Jackson, Mathieu & Saul 2008). However, Hoegl and Gemuenden define coordination as the harmonized work performed in subtasks within the project by the project team (Hoegl & Gemuenden, 2001). They also include the clear understanding and acceptance of the project's subtasks goals by all project team members and the absence of any conflict of interest within the subtasks or goals.

2.5 Balance of Member Contributions

Balance of member contributions is defined as the extent to which teams and team members share their knowledge and expertise to teams' activities according to their specific potentials (Hoegl & Gemuenden, 2001). It is also refers to team members' abilities to recognize each other's strengths and weaknesses (i.e., specific potentials). When this is the case, team members contribute to achieving the team's goals in accordance with each member's specific potentials. Every team member does not have to provide the same quantity of ideas to share, but must not be restricted to contribute relevant knowledge and expertise (Suprapto, Bakker & Mooi, 2015).. That is, for teamwork quality, team members must be able to balance their contributions to the team's tasks with respect to each team member's specific knowledge and experience. An imbalance of the member contributions may cause conflicts within the team. This important variable of teamwork quality is essential for multiple project management setting since leading multiple teams require that all team members contribute their knowledge and experience to the relevant task in order to avoid project delays.

2.6 Mutual Support

Mutual support is defined as the degree of two teams supporting each other to resolve obstacles that raised from their tasks. Mutual support is also considered as behaviors of mutual respect, support, and ideas development of team members' to expect unforeseen issues (Ahola, 2009; Salas, Cooke & Rosen, 2008).

Mutual support, then, is defined as the help, support and expertise shared between team members for reaching team goals and their respect for each other. Team members should develop their team members' ideas and contributions rather than try to outdo each other. Hoegl and Gemuenden (Hoegl & Gemuenden, 2001) also suggest that mutual support means that, when conflicts occur between team members, they should be easily and quickly resolved. Additionally, discussions and controversies should be addressed in a constructive manner. Mutual support leads to fostering team members collaboration and expertise which is highly required in a multiple project management setting, where multiple project managers suffer lack of time sharing knowledge and expertise between project.

2.7 Effort

Effort is certainly an essential factor of teamwork quality, according to Hoegl and Gemuenden (Hoegl & Gemuenden, 2001). It is defined as sharing and prioritizing the workload of the team's tasks over its obligations.

Effort also means that every team member makes the project his/her highest priority and works as hard as possible to ensure that the project achieves its goals. Finally, to achieve high teamwork quality, team members should realize and accept contributing sufficient effort into the project (Hoegl & Gemuenden, 2001). Effort from all team members is vital in a multiple project management setting, since multiple project managers seek successful projects, and because

of leading multiple projects simultaneously, a high level of effort is required to achieve the required project deliverables.

2.8 Cohesion

Cohesion is defined as team member's sense of belonging to his/her team and desire to remain part of the team. It is also defined as how important it is for the team member to be part of the team's task/project and his or her attachment to it (Hoegl & Gemuenden, 2001). It is also important to feel that the given task/project is important to the team and that all members are fully integrated. Finally, every team member should feel proud to be part of the team and fully responsible for maintaining and protecting it. The lack of a sense of belonging to the team or pride in being part of the team corresponds to a lack of cohesion, which will eventually lead to an inability to maintain the level of collaboration between team members and, hence, low teamwork quality (Hoegl & Gemuenden, 2001). In multiple project management setting, cohesion is an important element that forms team collaboration. It is very difficult to achieve high level of teamwork quality without achieving good level of cohesion. This is due to the fact that leading multiple projects simultaneously may cause destruction and delays since multiple project managers share their time among several projects, being dragged to different meetings, suffer workload stress, etc. Hence, team members commitments and team spirit are important to achieve high level of team cohesion, which will lead to successful project management.

3. Methodology

The objective of this research is to identify the impact of teamwork quality on project effectiveness using quantitative research methods and a survey questionnaire. In the survey questions, a Likert scale ranging from 1 to 7 (1 = strongly disagree and 7 = strongly agree) was used to rate teamwork quality, and a scale ranging from 0% to 100% (0%-20% = weak and 80%-100% = strong) was used to rate project performance. Residual analysis regression was performed to empirically test the hypotheses.

Hypothesis

To verify whether teamwork quality affects project performance in a multiple-project management setting, it is very important to assess the "communication" variable, leading to the following hypothesis:

Hypothesis H1*: The project team's communication will positively impact project performance in a multiple-project management setting in the oil and gas industry.*

The coordination variable is a vital factor in teamwork quality; therefore, it must be tested, leading to the following hypothesis:

Hypothesis H2*: The project team's coordination will positively impact project performance in a multiple-project management setting in the oil and gas industry.*

Balance of member contributions variable is important factor in teamwork quality which leads to the following hypothesis:

Hypothesis H3*: The project team's balance of member contributions will positively impact project performance in a multiple-project management setting in the oil and gas industry.*

Mutual support is an essential factor of teamwork quality that leads to the following hypothesis:

Hypothesis H4*: The project team's mutual support will positively impact project performance in a multiple-project management setting in the oil and gas industry.*

Effort is a vital factor of teamwork quality that leads to the following hypothesis:

Hypothesis H5*: The project team's effort will positively impact project performance in a multiple-project management setting in the oil and gas industry.*

Finally, cohesion is also an important variable of teamwork quality that leads to the following hypothesis:

Hypothesis H6*: The project team's cohesion will positively impact project performance in a multiple-project management setting in the oil and gas industry.*

Figure 1 presents a hypothesized model of the impact of teamwork quality on project effectiveness in a multiple-project management setting.

3.1 Questionnaire Design and the Sample

The questionnaire is divided into three parts: demographic questions, measurement of the teamwork quality construct and measurement of the project effectiveness construct in terms of project performance. Podsakoff *et al.* suggest using common method bias as one of the recommended procedural remedies by separating the measurements in the questionnaire into separate parts (Podsakoff, MacKenzie, Lee & Podsakoff, 2003)**.** Hence, the questionnaire

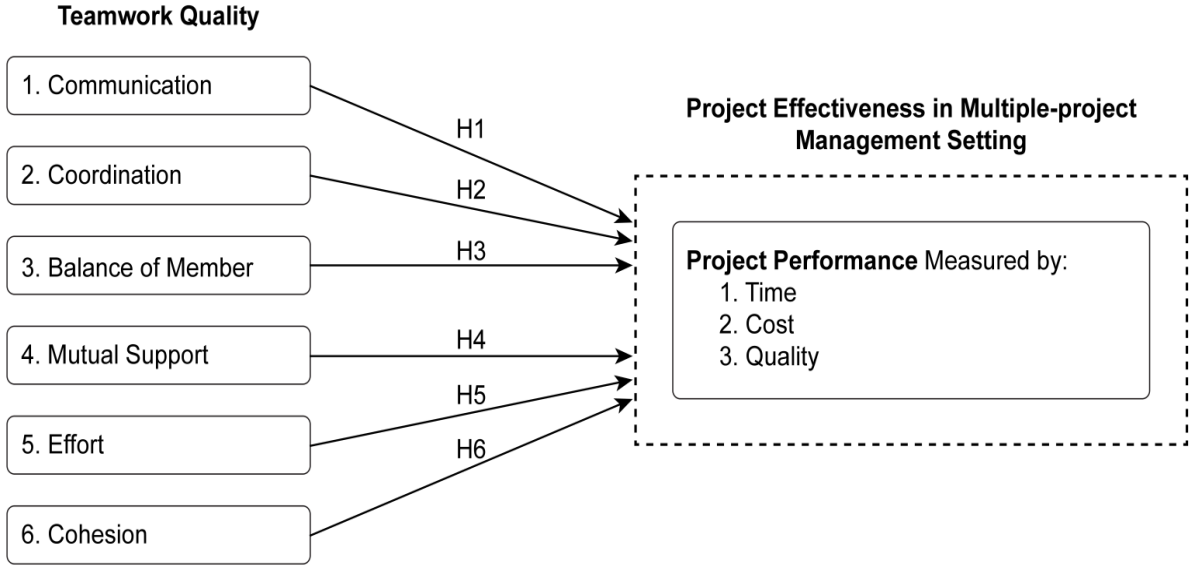

Figure 1 presents a hypothesized model of the impact of teamwork quality on project effectiveness in a multiple-project management setting.

was designed to enhance methodological separation of measurements. The first part of the questionnaire is the demographic section and asks questions regarding the number of years of experience as a multiple-project manager, the number of multiple projects managed simultaneously, and the number of project teams led, among others. The second part of the questionnaire measures the teamwork quality construct in terms of the six factors: communication, coordination, the balance of member contributions, mutual support, effort and cohesion. It consists of a set of questions addressing each teamwork variable. The third part of the questionnaire evaluates the project effectiveness construct by measuring project performance in terms of time, cost and quality. In the third part of the questionnaire, a rating scale ranging from 0% to 100% was used, and each variable of the project performance construct was probed with a set of questions.

A pilot test including 30 respondents (experts from the oil and gas industry, i.e., managers, directors, consultants, and specialists, in addition to experts in project management and scholars) was performed. The questions were then refined, and the number of questions was reduced from 55 to 45 based on the data collected from the experts. After pilot testing, data were collected from the respondents using the convenience sampling method. The reason of using convenience sampling because respondents (i.e. multi-project managers) were extremely busy managing multiple projects, therefore, random sampling will not lead to sufficient retuned surveys for proper statistical analysis. On the other hand convenience sample is very easy to carry out and quick to collect data. The main risk of this type of sampling is bias i.e. findings may not be generalized for the sample of the population. However, this is discussed further in the limitation section. To conduct the survey, participants from 13 major oil and gas companies worldwide were contacted since the researcher works in the oil and gas industry and has some interactions with them. The survey participants were selected from among project managers, project team leaders, project senior engineers, project management specialists and project consultants. The survey was sent only to those who had led multiple projects, i.e., two or more projects simultaneously. However, the "project manager" title may differ from one company to another; for instance, in some oil and gas companies, project managers are called team leaders, senior engineers, specialists or

consultants. However, this study targeted the multiple-project manager category to help such managers manage simultaneous multiple projects effectively, regardless of their job titles. The questionnaire was designed using SurveyMonkey, and all of the information collected was highly confidential and secure. The respondents were contacted via email, and the survey was sent through a hyperlink provided by SurveyMonkey. The respondents had to complete 45 questions online, which take roughly 15 minutes to complete. The survey was flexible enough so that a respondent could leave it open and come back to complete it at a later time. The author works in the oil and gas industry; hence, she has connections with many oil and gas companies worldwide, which facilitated collecting responses from this busy category of managers who manage multiple projects. Of the 200 questionnaires that were sent to respondents (i.e., multiple-project managers within oil and gas industry), 184 were returned, and of these, 45 were incomplete and, thus, eliminated. As a result, 139 responses were analyzed.

The demographic section of the survey revealed that 28% of the multiple project managers had 10-15 years of experience in project management, 19% had 15-20 years, and 17% had over 25 years of experience. A total of 22% of multiple project managers had 10 years of experience in managing multiple projects simultaneously, and 10% had 5 years of experience in managing multiple projects simultaneously. Additionally, 39% of the respondents have managed two projects simultaneously, 24% have managed three projects, and 13% have managed five projects simultaneously. Finally, 50% of the respondents have managed more than one project team, whereas the other 50% have managed only one project team. All project managers who lead multiple projects simultaneously were considered in this study i.e. all who lead single or multiple project teams.

3.2 Constructs and Measurement

Teamwork quality is one of the main constructs investigated in this study. It is represented by six independent variables in this study, and each variable is tested separately against the dependent variable. The six independent variables are as follows: communication, coordination, the balance of member contributions, mutual support, effort and cohesion. The dependent variable, project effectiveness, is represented by project performance in terms of time, cost and quality. The questions used to measure these constructs were developed based on previous studies (Patanakul, 2013) and (Hoegl & Gemuenden, 2001). Multiple items/questions were used to measure each construct (see Appendix 1). Multiple-project managers in the oil and gas industry answered the survey questions; hence, based on their perceptions, multiple-project managers evaluated the independent and the dependent variable items.

3.3 Reliability and Validity

A reliability test is conducted to assess all of the constructs using Cronbach's alpha. The Cronbach's alpha values for all of the variables exceed 0.70 (see Appendix 1). When measuring reliability via Cronbach's alpha, values exceeding 0.70 correspond to good statistical results (George & Mallery, 2013). Statistically, any value of Cronbach's alpha that falls between 0.60 and 0.70 is considered acceptable. The Cronbach's alpha values for the effort and the balance of member contributions variables are relatively poor. The total reliability value (i.e., Cronbach's alpha) of this study is 0.892, which is a good result. The highest mean value is observed for the cohesion variable (37.6 with a variance value of 20.7), whereas the lowest mean value is found for the variable of the balance of member contributions (5.5 with a variance value of 1.1) (see Appendix 2). The corrected item-total correlation coefficients for all the items are also shown in Appendix 2. Table 2 provides the descriptive statistics for the study variables. The mutual support variable has the highest mean, 5.8, with a standard deviation of 0.77. Therefore, mutual support is identified as the variable with the greatest effect on the dependent variable. In contrast, the project performance variable, which was rated in the questionnaire as a percentage on a scale ranging from 1 to 5, has the lowest mean value: 4.34 with a standard deviation of 0.642; thus, it has the least effect on the independent variable.

Table 2. Descriptive Statistics using Mean and Standard Deviation

Variable	Minimum	Maximum	Mean	S. D.
Communication	1	7	5.405	1.005
Coordination	1	7	5.025	0.851
Balance of Member Contributions	1	7	5.507	0.964
Mutual Support	1	7	5.808	0.765
Effort	2	7	5.695	0.883
Cohesion	2	7	5.388	0.642

Project Performance	1	5	4.344	0.642

Note: N = 139 ; All calculations performed using SPSS Version 23.

According to the data shown in Table 3, high correlations exist between all of the variables, which is an encouraging result because almost all of the items have correlation coefficient values that are relatively strong at the given p-value level. The relationships between the study variables are analyzed using Pearson's correlation coefficient (see Table 3), and the results show strong correlations between most of the study variables. Nevertheless, a moderate correlation

Table 3. Correlation Analysis and Pearson Method

Dimensions	Communication	Coordination	Balance of Member Contributions	Mutual Support	Effort	Cohesion
Coordination	0.559**					
Balance of Member Contributions	0.527**	0.437**				
Mutual Support	0.569**	0.464**	0.550**			
Effort	0.374**	0.387**	0.321**	0.365**		
Cohesion	0.575**	0.486**	0.415**	0.415**	0.569**	
Project Performance	0.213**	00.141	0.172*	0.232**	0.335**	0.181*

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed)

is found between cohesion and coordination and project performance. However, no significant correlation between coordination and project performance exists because its p-value is greater than 0.05.

Confirmatory factor analysis (CFA) is also applied to assess the validity of this study (see Appendix 1). The Varimax rotation method is used to test the adequacy of the sampling. The results (see Appendix 1) show that all of the items have eigenvalue loadings exceeding 0.4 (Ferketich, 1991), indicating high consistency between the items of the questionnaire. The results also emphasize the validity of the items in reflecting their related variables. The Kaiser-Meyer-Olkin value, which measures the adequacy of the sampling, is 0.815 (exceeding the threshold: 0.6) (Appendix 1). In addition to the validity test, the survey questionnaire was also separated into individual sections, as noted above, i.e., demographic questions, the teamwork quality measure and the project effectiveness measure, to provide psychological separation of the survey for the respondents to reduce biases (Podsakoff, MacKenzie, Lee & Podsakoff, 2003).

4. Results and Analysis

The sample size of 184 was then reduced to 139 responses after filtration and elimination of uncompleted questionnaires, then were analyzed using SPSS version for the study data by applying multiple regression analysis (George & Mallery, 2013)**.** Statistical assumptions were also tested prior to running the analysis, and all of the variables were found to satisfy the assumptions of normal distribution, homogeneity of variance and independence of observations.

The study statistics showed that all teamwork quality sub constructs were significant showing the following cronbach's alphas: communication 0.770, coordination 0760, balance of member contributions 0.673, mutual support 0.788, effort 0.599 and cohesion 0.707.

The multiple regression analysis measures the associations between project performance, as the dependent variable, and the independent variables of teamwork quality (communication, coordination, the balance of member contributions, mutual support, effort and cohesion). According to the results presented in Table 4, the null hypothesis for "coordination" and "balance of member contributions" cannot be rejected at the 0.001 level, (i.e., the coordination and balance of member contributions variables have no effect on project performance). Hence, communication, mutual support, effort, and cohesion are significant and affect the dependent variable, project performance. However, cohesion is negatively related to project performance because the beta coefficient value is -0.573.The negative

relationship between cohesion and project performance is justified particularly in the oil and gas industry, this is due to many project team members are coming from different part of the work to work in the remote offices in order to accomplish projects. Such team members are influenced by their own culture, which is different from where

Table 4. Multiple Regression – Model A (Before elimination of outliers based on residual analysis approach)

Dimensions	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	1.298	0.567		2.287	0.024	0.176	2.42		
Communication	0.316	0.087	0.335	3.633	0	0.144	0.487	0.453	2.208
Coordination	0.04	0.095	0.032	0.419	0.676	-0.148	0.227	0.668	1.496
Balance of Member Contributions	0.138	0.082	0.138	1.686	0.094	-0.024	0.3	0.577	1.734
Mutual support	0.398	0.099	0.313	4.03	0	0.203	0.594	0.64	1.564
Effort	0.362	0.083	0.355	4.358	0	0.197	0.526	0.582	1.718
Cohesion	-0.745	0.111	-0.573	-6.702	0	-0.965	-0.525	0.528	1.896

Note: N = 139, R Square = 0.491, Adjusted R Square = 0.468, Std. Error of the Estimate = 0.60594, F-test = 21.257 (p-value < 0.001)

a. Dependent Variable: project performance

they work, moreover, interpersonal relationships between team members coming from different part of the world and different cultures make project team members reluctant to stay connected with the team strongly. As a result project team members try to do their best individually to show their capability delivering project's goal within time and budget. According to Table 4, the R^2 value of the regression model is 0.491. Thus, the independent variables explain only 49% of the dependent variable which is not a satisfying result due to many distortions that they could happen because of respondents not understanding the survey questions clearly or by quick wrong answers due to managers lack of time to complete the survey.

A residual analysis is then applied to the above results of the multiple regression analysis in order to improve and filter the results by omitting the outliers, which frequently occur in real data and cause distortion. To further sharpen the results, residual analysis is implemented. It is also applied to examine the difference between the observed value of the dependent variable, project performance, and the predicted variable (see Table 5). According to Table 5, in terms of absolute value, the studentized deleted residual values for both the minimum and the maximum (-3.656 to 3.824) were greater than 3, indicating the presence of at least two outliers in the dependent variable, project performance (Erford, 2015; Abbott, 2010). The outliers can be identified by selecting cases that satisfy the following condition: |stud. deleted residual| > 3.00 [37] and (Abbott, 2010). Furthermore, if the maximum value of Cook's distance > 1.00, then at least one influential data point exists. In Table 5, the maximum Cook's value is 1.581, which indicates the existence of influential data points that must be eliminated

Table 5. Residual Analysis before elimination of outliers

Dimensions	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.916	5.820	4.640	0.583	139.000
Std. Predicted Value	-2.960	2.025	0.000	1.000	139.000
Standard Error of Predicted Value	0.067	0.409	0.127	0.048	139.000
Adjusted Predicted Value	2.012	5.852	4.634	0.616	139.000
Residual	-2.031	1.629	0.000	0.593	139.000
Std. Residual	-3.352	2.688	0.000	0.978	139.000
Stud. Residual	**-3.496**	**3.641**	**0.004**	**1.026**	**139.000**
Deleted Residual	-2.210	2.989	0.006	0.660	139.000

Stud. Deleted Residual	**-3.656**	**3.824**	**0.004**	**1.039**	**139.000**
Mahal. Distance	0.687	61.801	5.957	6.777	139.000
Cook's Distance	**0.000**	**1.581**	**0.019**	**0.135**	**139.000**
Centered Leverage Value	0.005	0.448	0.043	0.049	139.000

The residual values must fall within a valid accepted range between the minimum and the maximum (Lance, 1988). Thus, in total, only 11 outliers are omitted based on the residual analysis. Table 6 shows the maximum and minimum ranges of the stud. deleted residual after eliminating the outliers, which clearly indicates that the stud. deleted residual falls within the acceptable range (-2.384 to 2.199); additionally, Cook's Distance is within the acceptable range (0.00 to 0.061). See Figure 2 for more details confirming that all data satisfy the condition of |stud. deleted residual| > 3.00.

Table 6. Residual Analysis after elimination of outliers

Dimensions	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.763	5.959	4.662	0.663	129
Std. Predicted Value	-2.864	1.955	0	1	129
Standard Error of Predicted Value	0.052	0.232	0.102	0.036	129
Adjusted Predicted Value	2.72	6.013	4.664	0.666	129
Residual	-1.056	0.991	0	0.451	129
Std. Residual	-2.285	2.145	0	0.976	129
Stud. Residual	**-2.339**	**2.165**	**-0.002**	**1.002**	**129**
Deleted Residual	-1.106	1.01	-0.002	0.475	129
Stud. Deleted Residual	**-2.384**	**2.199**	**-0.002**	**1.007**	**129**
Mahal. Distance	0.653	31.432	5.953	5.351	129
Cook's Distance	**0**	**0.061**	**0.008**	**0.011**	**129**
Centered Leverage Value	0.005	0.246	0.047	0.042	129

a. Dependent Variable: project performance

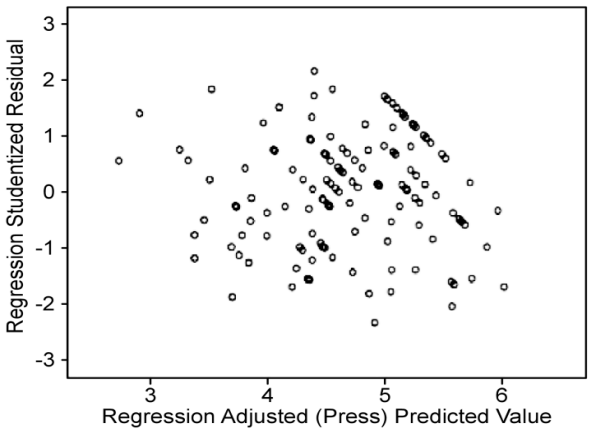

Figure 2

Multiple regression analysis is applied again after the residual analysis is performed (see Table 7). The R^2 value improved to 0.68 after the outliers were omitted. There were precisely 11 eliminated outliers (i.e., 11 eliminated survey responses), and thus, the sample size was N = 128. Therefore, the independent variables explain 68% of the dependent variable. Table 7 also clearly shows that the p-values of the independent variables (coordination and the balance of member contributions) improved and is less than or equal to 0.01, indicating that they are significant. Finally, all six independent variables (communication, coordination, the balance of member contributions, mutual support, effort and cohesion) are significant. In other words, the six variables of the independent construct (teamwork quality) significantly affects the dependent variable, project performance. Since the teamwork quality factors were significant, then considering strengthening team collaboration (i.e. teamwork quality) in a multi-project management setting, enhances projects performance within the oil and gas industry.

Table 7. Multiple Regression – Model B (After elimination of outliers based on residual analysis approach)

Dimensions	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	-0.462	0.514		-0.900	0.370	-1.479	0.554		
Communication	0.351	0.074	0.328	4.747	0.000	0.205	0.497	0.545	1.837
Coordination	0.267	0.082	0.184	3.274	0.001	0.106	0.428	0.819	1.221
Balance of Member Contributions	0.272	0.072	0.249	3.754	0.000	0.129	0.415	0.589	1.699
Mutual support	0.316	0.082	0.258	3.851	0.000	0.154	0.479	0.576	1.736
Effort	0.358	0.068	0.349	5.256	0.000	0.223	0.493	0.588	1.699
Cohesion	-0.718	0.086	-0.529	-8.336	0.000	-0.889	-0.547	0.643	1.556

Note: N = 128, R Square = 0.684, Adjusted R Square = 0.668, Std. Error of the Estimate = 0.46193, F-test = 43.954 (P-value < 0.001)

a. Dependent Variable: project performance.

5. Discussion and Conclusion

This research yields important findings for project management in general and for multiple-project managers in particular. This study is among studies conducted to support the managerial level in project management in the oil and gas industry in particular. Previously, many studies have been conducted to help the managerial level in project management perform effectively while leading projects. However, most were performed to help single-project managers, whereas not many studies were conducted to help multiple-project managers manage their project effectively. Furthermore, several previous studies investigated the impact of teamwork quality on project success from software project teams perspective (Hoegl and Gemuenden, 2001; Hoegl et al., 2003; Hoegl et al., 2004; Janz, 1999; Li et al., 2010; Ryan and O'Conner, 2009; Vinod et al., 2009 Lindsjørn et al., 2016). However, this study focus on the managerial level rather than the team level in a multiple project management setting.

Some key drivers of effectiveness in managing multiple projects have been identified in previous studies. The present study further investigates additional key drivers of effective management in managing multiple projects. Therefore, teamwork quality warrants investigation.

First, teamwork quality is defined as team collaboration, which is represented by six facets: communication, coordination, the balance of member contributions, mutual support, effort and cohesion. Teamwork quality is related to project effectiveness, which is defined by project performance in terms of time, cost and quality. The six facets of teamwork quality are measured separately and one at a time against project performance, and all are found to be significant because teamwork quality has a measurable impact on project performance in a multiple-project management setting. The empirical results of this study show that teamwork quality is significantly related to project performance in general and to project success in particular in a multi-project management setting within the oil and gas industry.

The study findings showed that mutual support has the highest cronbach's alpha of 0.788, followed by communication 0.770, then coordination 0.760, which means the most significant variable is mutual support. The three variables mutual support, communication and coordination have relatively close values of cronbach's alpha, and this means that these are the most significant factors of teamwork quality. While effort factor is the least significant factor of teamwork quality with cronbach's alpha of 0.599.

The results also respond to the six hypotheses of this study and indicate that teamwork quality affects project performance, but the most variables affecting project performance are mutual support, communication and coordination, while effort, balance of member contributions and cohesion are the least affecting variable of teamwork quality.

The findings of this study should help multiple-project managers in the oil and gas industry shift their focus to the teamwork quality among team members, which will help maintain high team collaboration and positively impact their project performance. In other words, high team collaboration gives rise to successful project performance, i.e., the completion of the project within the schedule, budget and quality constraints. Maintaining high levels of collaboration among project team members will positively reflect on the manager's performance. By contrast, low teamwork quality will negatively impact project performance, which will then reflect on the performance of multiple-project managers. However, this study's findings can be generalized for the multiple-project management setting in the oil and gas industry. Generalizing this study finding to other settings should be done with caution.

However, this study was conducted using a random sample size and relatively short and easy survey questions, Thus, the response return rate was good, and major oil and gas companies worldwide participated in this study.

6. Contribution and Managerial Implications

Many project management studies contribute to single-project management setting, while this study among studies that focused on multiple project management setting, and hence it provides theoretical contributions as well as managerial implications.

The study provides an understanding of multiple project management setting to project management researches. The study investigates the impact of teamwork quality factors which are: communication, coordination, balance of member contributions, mutual support, effort and cohesion on project effectiveness in terms of project performance from project managers perspectives only. Teamwork quality factors may have been studied by researchers earlier but not in multiple project management context or only from project team perspective. Thus the results of this study should encourage researchers to develop more frameworks that help multiple project managers to be more effective. Moreover, identifying significant factors provides multiple project management practitioners with beneficial key driver of how to enhance the effectiveness of project performance through managing multiple projects simultaneously.

The results of this study provides also a good start for investigating similar factors on a multiple project management level.

This study also highlights that multiple project managers should have special leadership style to be able to manage multiple tasks and multiple teams.

The implication of this study is obvious; it implies that it would difficult to manage multiple projects without considering team collaboration (i.e. teamwork quality factor). In addition to the contribution of teamwork quality competency to project performance, practicing this competency by multiple project managers enhances their managerial capability and develops their career. In other words, multiple project managers should track and evaluate each team member through probation period of say 100 days to ensure that they meet the requirements of teamwork. This could be done by supervising their collaboration and interaction with other team members to accomplish a task. The evaluation then could be used to find the gaps for each team member within the six factors of teamwork quality. This will help multiple project managers set the right training for their team members in orders to enhance the required skills which will eventually improves the performance of the projects they are leading simultaneously. The fact that mutual support, communication and coordination factors are the most significant variables suggests that multiple project managers should focus particularly on fostering these variables to enhance managing multiple projects.

7. Limitations

The limitations of this study include, firstly, convenience sampling was implemented due to time commitments required from the respondents as they have critical job and limited time to manage multiple projects simultaneously, in addition to managing oil and gas multi billion dollar projects, multi-project managers often suffer stress and lack of time to complete critical tasks. Therefore convenience sampling was suitable for this research with oil and gas

industry for multi-project managers settings. Hence, generalizing the research findings to other industry or settings may be done with caution. It is recommended to implement random sampling method in future researches in order to minimize the risk of low survey returns.

Secondly, the survey was completed by only multiple-project managers in the oil and gas industry. Thus, the answers to the survey were based on project managers' perceptions. Although multiple-project managers are titled differently in different organizations (i.e., the sample involved not only project managers but also specialists who manage multiple projects, consultants, project management experts, team leaders and senior projects managers), it would be preferable to also include directors and customers in future studies in order to avoid single-source method. However, the multiple-project managers who participated in this study had sufficient expertise and knowledge to answer the questions. Because the survey questionnaire targeted specific respondents from a particular managerial level, and it was sent only to this category as it is the objective of this research to help this category manage multiple simultaneous projects effectively due to their workload and job stress. Moreover, in the project management field, it is very common to use single-source data, especially when targeting specific respondents or a specific category. Although it was not the author's intention to reduce the impact of response bias by using single-source data, the information provided in this study are less subjective than many single source methodology used in social studies surveys that are sometimes affected by the bias of this method. Hence, the subjectivity of this study is less than expected. However, care must be used when generalizing this study's findings to other settings.

Thirdly, the study is effectively looking into the quality of project management process through evaluating the project performance by the outcome of iron triangle (time, cost and quality). There are number of processes in project management field. However, this study selected to look at the "management style" attribute in the project management process that affect directly the quality of teamwork and team collaboration and as a result, teamwork quality impact the project performance.

Fourthly, the author would like to drive reader's attention that project managers selected for this study are of various types and levels. Hence, the limitation of upwards/bottom-up responses were not considered in this study, which may lead to difference in views on the level of teamwork quality in a project. Therefore, it is recommended to consider upwards/bottom-up responses for future studies.

Finally, previous studies investigated the factors that impact project effectiveness from the project and project manager perspectives. This study investigated teamwork quality as a new factor affecting project effectiveness. Thus, there are ample knowledge gaps regarding the other factors that may impact the effectiveness of managing multiple projects. It is recommended to investigate and identify more factors that may affect the effectiveness of managing multiple projects.

8. Future Research

Because of the potential limitations of this study, further studies are recommended. Additionally, because of the limited number of studies performed in the multiple-project management setting, it would be worth investigating other factors that may impact project effectiveness. One possibility that could be the subject of a future investigation is cultural factors, which may affect teamwork quality. Cultural factors can affect the degree of collaboration between team members, in turn influencing the total teamwork quality and project performance. Furthermore, team autonomy also contributes to the development of teamwork quality and provides additional independency in team members' work and decision-making.

APPENDIX 1

TABLES PRESENTING VARIABLES WITH THE ASSOCIATED SURVEY QUESTIONS AND THEIR RELIABILITY RESULTS

Teamwork Quality Construct

Independent Variable	**(Questions/ Items)**	**Cronbach's Alpha**	**Conformity Factor Analysis (PCA using Varimax Rotation) Factor Loading***

Communication	1. Team members communicate directly with each other 2. Project information is shared openly by all team members 3. Timely information is received by the project team from other team members 4. The information received by the project team between team members is precise	0.770	0.658 0.727 0.852 0.780
Coordination	1. The work performed for the projects in subtasks is closely harmonized 2. The goals of the subtasks are clear to the team members 3. Subtask goals are accepted by all team members	0.760	0.564 0.726 0.863
Balance of Member Contributions	1. The team recognizes the strengths and weaknesses of individual team members 2. Team members contribute to the achievement of the team's goals according to their own specific strengths and weaknesses	0.673	0.902 0.807
Mutual Support	1. Team members help and support each other to the best of their ability 2. Discussions and controversies are conducted constructively 3. The suggestions and contributions of team members are respected 4. The suggestions and contributions of team members are discussed and further developed 5. Team members are able to reach consensus regarding important issues	0.788	0.804 0.681 0.716 0.675 0.663
Effort	1. Team members make the project their highest priority 2. Team members contributed great effort to the project	0.599	0.879 0.765
Cohesion	1. Being part of the project is important to the team members 2. Team members are strongly attached to the project 3. The projects are important to the team 4. All team members are fully integrated in the team 5. Personal conflicts exist in the team 6. Team members stick together 7. Team members feel proud to be part of the team 8. Every team member feels responsible for maintaining and protecting the team	0.707	0.511 0.686 0.826 0.548 0.852 0.449 0.603 0.606

Project Effectiveness Construct

Dependent Variable	**(Questions/ Items)**	**Cronbach's Alpha**	**Factor Loading***

Project Performance	1. All of my projects are completed within schedule/time 2. All of my projects are completed within budget/cost 3. All of my project deliverables are met according to the scope of the work, project specifications and company standards/best quality 4. All of my project products meet the customer's expectations 5. All of my customers are highly satisfied	0.829	0.841 0.830 0.729 0.868 0.846

All Constructs	**(Questions/ Items)**	**Cronbach's Alpha**
1. Teamwork Quality **2. Project Performance**	All Questions / All Items	0.892

*Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.815, Rotation Sums of Squared Loadings (Cumulative %) = 70.354

APPENDIX 2
RELIABILITY ANALYSIS FOR EACH SURVEY ITEM

VARIABLE	**Scale Mean if Item Deleted**	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
COMMUNICATION	**16.157**	**9.220**	**0.572**	**0.770**
COM1	15.881	9.586	0.512	0.745
COM2	15.940	8.750	0.612	0.692
COM3	16.503	8.398	0.676	0.655
COM4	16.305	10.147	0.489	0.755
COORDINATION	**11.152**	**4.162**	**0.591**	**0.760**
COO1	11.278	4.162	0.598	0.669
COO2	11.106	3.882	0.594	0.676
COO3	11.073	4.441	0.582	0.688
BALANCE OF MEMBER CONTRIBUTIONS	**5.510**	**1.135**	**0.535**	**0.673**
BAL1	5.662	0.772	0.535	.
BAL2	5.358	1.498	0.535	.
MUTUAL SUPPORT	**23.264**	**8.730**	**0.574**	**0.788**
MUT1	23.265	8.983	0.510	0.766
MUT2	23.384	8.665	0.525	0.763
MUT3	23.046	8.538	0.723	0.703
MUT4	23.411	7.684	0.611	0.735
MUT5	23.212	9.781	0.501	0.769
EFFORT	**5.656**	**1.070**	**0.446**	**0.599**

EFF1	5.848	0.770	0.446	.
EFF2	5.464	1.370	0.446	.
COHESION	**37.625**	**20.695**	**0.438**	**0.707**
COH1	36.967	19.406	0.591	0.628
COH2	37.285	20.232	0.534	0.643
COH3	37.185	20.979	0.497	0.654
COH4	37.556	18.448	0.607	0.618
COH5	39.722	24.042	-0.049	0.808
COH6	37.563	23.301	0.159	0.716
COH7	37.265	19.129	0.619	0.622
COH8	37.457	20.023	0.549	0.640
PROJECT PERFORMANCE	**17.372**	**6.872**	**0.657**	**0.829**
PER1	17.861	5.974	0.576	0.832
PER2	17.510	6.705	0.585	0.810
PER3	17.152	6.983	0.714	0.775
PER4	17.093	7.618	0.705	0.789
PER5	17.245	7.080	0.706	0.778
ALL ITEMS				**0.892**

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