A Study of the Structure of IT Project Team

For Developing a More Efficient Team

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***Abstract*—The industry of IT is an important service section in the macro economy. This study evaluated the efficiency of IT teams and carried on a series of effective measurements for IT projects. We are interested in two aspects that are team structure and human factors of IT project team. Based on a live project supported by Xishanju, a sub company of Jinshan Software Corporation, we did some research by qualitative research and questionnaire. After the data had been collected and analyzed, we had made some conclusions about three aspects including the team scale, organization types and team roles, and project manager competences.**

Keywords—project management;human factor; team structure

I. INTRODUCTION

The industry of IT is an important service section in the macro economy. It is project-oriented. In all the changeable factors that affected the IT projects, the project team itself would be ignored easily, which should be the most important factor that needed to be paid more attention than others. Studies revealed that the projects failed because the project manager had not built a strong team [1]. On the other side, due to the fact that the IT industry mainly relies on knowledge and manpower, it is obvious that the most important capital of IT projects is the team's member. A project team can add values to the individual effort. But they are not free because they require time and skills to deliver the worthwhile performance. Creating a project team is an investment that deserves a conscious decision [2]. One of the most important steps of an IT project is to build the team carefully. Building a proper IT project team doesn't always happen because it is not easy to deal with some problems such as the skills of team members and the requirements for the project. So it is important for managers to consider what kind of people the project needs exactly. You will not usually be in a position that could select all the members of your team from everyone available on the external labor market [3]. Because of the difficulty of measuring the values of human factor, it is easy for the managers to neglect the impact of the project teams. Therefore, the IT enterprises are inevitably facing this important problem of team management for their project teams. It is the people who are the key to the success of any IT implementation within any organization. Without proper consideration of the people issues, a project will fail. So, it is essential to study the typical team management questions in IT projects, and explore the corresponding strategies.

How do the structures of IT project team affect the effectiveness and success of a project? To solve the team-building problem of IT project management, this study evaluated the efficiency of IT teams and put forward a series of effective measurements and referenced measurements for IT projects. The factors that affect the team's performance fall into five broad categories [4]. The major objectives of the study are focused on following.

1. Study the IT project background and find out crucial factors of IT project team.
2. Collect the existing perceptions and the structures of an IT project teams.
3. Analyze the relationship between success and team structures.
4. Evaluate the efficiencies of different team structures.
5. Recommend some efficient measurements and structures for the management of project teams.

II. LITERATURE REVIEW

There are several types of projects defined according to scale, number of team, duration. Hughes says that IT projects are projects that implement technology applications within organizations. These are technical also involve changing the organization in some ways [5]. Schwalbe states that IT project management is the project management applying in the field of IT. Schwalbe also describes this as information technology projects involve using hardware, software, and/or networks to create a product, service, or result [6]. Cadle and Yeates group IT projects into nine broad types: software development,

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package implementation, system enhancement, consultancy and business analysis assignments, systems migration, infrastructure implementation, outsourcing, disaster recovery, smaller IT projects [7]. Beise et al note that technologies are now continually important that enable and improve the communication for project managing and executing [8].

Team-building and Structure

The first thing in a team is the team scale. As Brooks presented that "The number of people with mutual communication and cooperation influences the development cost, because the main parts of cost are communication and interchange as well as negative effects from correcting communication" [9]. There are mainly three factors: proximity of team members, effort and communication, which would affect the software project team scale, concluded by Hoegl, at el [10]. The scholar of organizational behavior, Armstrong, indicated that the optimal model of software project team was between 6 and 14 people [11]. It was an empirical result because there was no quantitative analytical method.

Project managers need the support from different fields or departments. A team in an IT project is usually a collection of specialists with a requirement to work together towards a common goal. But Bohlen suggests that "Specific team members are not always a project manager's person of choice" [12]. Haigeh also holds the similar opinion: "Because of the nature of IT projects, the members of a project team come from some various areas and own some different skills." It is very difficult for the IT project manager to build and lead the project teams with these specialized positions [13]. Therefore they need some kinds of structures linking them to the rest of the business. The structure should also help their internal operation [14]. The selection of structure is important. The choice as Maylor said should refer to the critical objectives of each project that an organization is undertaking. He also outlined four options which were functional organization, lightweight project organization, heavyweight project organization and project organization. But there are additional factors to be considered. Widely used in information technology areas, many organizations are becoming increasingly projectized in structure, with cross-functional groups of people, whose knowledge, skills, and experiences are complementary and focused on a time-dependent set of deliverables [15]. There are mainly two ways of team building which are involving everyone from the beginning to the completion and incrementally putting team players in as needed [16]. Three types of organizational structure for software project teams provided by Ambler are more suitable for the IT-related team now. These are vertical teams composed of generalists, horizontal teams composed of specialists, and hybrid teams made up of both generalists and specialists.

Before developing a team, the essential work is the analysis of the role. As Armstrong described that role analysis was to find out what people were expected to achieve the work with the capacity and skills to meet these expectations [17]. Belbin claimed nine kinds of team roles which were shaper, plant, coordinator, monitor evaluator, resource investigator, implementer, team worker, completer finisher, specialist [18]. These roles can be considered in almost every team. For IT project team, effective teams are made up of members fulfilling a variety of roles including analyst, architect, database administrator, designer, operations/support engineer, programmer, project manager, project sponsor, quality assurance engineer, requirements analyst, subject matter expert (user), tester. It is important that the relationship between roles and organizational types, because it is important to consider about the nature of the people that you have been available to you.

There are several standard measurements of success from different views:

6. From risk: Risk-based team performance metric, technical risk, cost risk and schedule risk.
7. From schedule: Effective teams are more flexible and accept many schedule changes, but reduce total cost of these changes.
8. From satisfaction: Quality of clients' requirements.
9. From IT project: Team efficiency reflects the technical effect and human IT infrastructure capabilities [19].

Successful information technology projects involve four vital elements [20]:

1. Management executives involved in the project.
2. Project managers with IT skills and leadership.
3. Skilled and experienced project team member.
4. Project control and reporting.

In conclusion, five critical factors for success of IT project team identified are [21]:

1. Technical performance.
2. Efficiency of execution.
3. Customer satisfaction.
4. Personal growth.
5. Manufacturability and business performance.

Human Factors of IT Project Team

Project manager is the crucial role in a project team. Project managers are that they are handed a team, an imperfect structure and told to get on with it. Project manager seems to have the right to select what should be included in the project, but in fact, the team is more likely to be inherited rather than designed. An effective project manager should have the ability to influence clients and other organizational stakeholders, especially the team members. That means one important characteristic of project managers is Leadership. Leadership is able to affect the project team performance and affect effectiveness of project manager [22]. Quality and quantity of project members' work performance are the critical areas of project managers. One requirement for the team leader is a certain level of competence in the operational details of the team task [23]. But leader is not possible to have all abilities

so he must rely on team members to achieve goals. The leader provides feedback and encourages members. Therefore the team leader should be cautious about his leadership style. Lacking other members' respect may create barriers for teamwork. Project manager's role has three major components: management, leadership, individual skills and attitudes. In the past, the studies about IT project management mainly focused on the standardization process problems about the project management. Until recently, project managers' leaderships and team management skills become to catch attentions. IT project managers often take on three roles: leaders, managers and IT executives. Project managers need the project management knowledge and skills to develop teams and organization, while they also stay in a technical role.

Team management is the epitome of hymnology in management Theory, organizational development and social psychology. There are mainly four models managers' assumptions about people [24]:

1. Rational-economic model based on economic theories of Adam Smith, which pursuit of people's own interests to maximize the gain is the main incentive.
2. Social model, which states people are mainly motivated by social needs for personal relationships.
3. Self-actualizing model based on Maslow's theory of human needs, which states the main motivator is the self-fulfillment.
4. Complex model, which states that it is complex to understand people's motivation with many work interrelated factors.

III. METHODOLOGY

This research project has been formatted in conjunction with a live consultancy project for the organization, Xishanju. The product of the consultancy project is a new website, the structure of the project team will be looked at in this research project in relation to how the project team is brought together to maximize efficiency. This research aims to understand the phenomena in each project team. It is a qualitative research. As Silverman says, the main strength of qualitative research is its ability to study phenomena which are simply unavailable elsewhere [25]. The project team is constituted of four members including the key role, project manager, who takes the overall management of the project and is in charge of the project team. This research is going to discover the structures and cases in project teams so that it can help the project manager to figure out the problems of team-building and develop a more efficient team.

Research Design

For the research about the structure and efficiency of IT project teams, the observation and experiment are effective ways to investigate and can provide more useful information. However, they are infeasible because of time-consuming reason that researchers need to become part of the group. Each team has their unique case. The qualitative research results in detailed qualitative data. In this research, about unique team cases, the methods used in relation to it for this study are: interviews and questionnaires. In terms of investigating the existing teams, questionnaire is acceptable but not perfect because it would not be very effective unless the quantity of respondents is very large and it is not very available to investigate many IT project teams. Questionnaire is also used to investigate people's opinion with relevant experiences. These methods provide the implications regarding how team members review the project team and how efficient the project team is. Xishanju is a local and social enterprise. Although the related project for Xishanju is not large, it is providing a suitable case of IT project team for the research.

Methods for Data Collection

The research had been carried out by two surveys. Firstly, the first survey, 20 members in different teams were chosen to do the questionnaires in order to collecting enough team cases in a short time and then 2 or 3 interviewees were chosen to provide the specific opinions or viewpoints based on the their completing of questionnaire1. Secondly, the second survey, some factors including the team roles and project manager's competences were investigated by questionnaire or card sorting with at least 30 samples. It is a good approach to gather in-depth attitudes, beliefs, and anecdotal data from individual patrons [26]. It is also a suitable tool to explore the problems in a project team. In addition, questionnaires and card sorting were assistive techniques except interviews. To those who may not have time for an interview, questionnaires enable respondents to take their time and state their feelings alone and anonymously. Budhwar describes card sorting is an interview-based technique to show how individuals categories concepts within a particular knowledge domain [27]. During the research, participants sometimes didn't have specific notions. Card sorting can spark their ideas about some questions.

The information collected from the questionnaire included personal attitudes and opinions about teams. The data about the project team efficiency could be observations, images, computer files, forms, recordings or experiences. It would be more descriptive rather than numerical and more qualitative rather than quantitative. There were four steps during interview: taking notes, sound recording, taking pictures and obtaining files or including questionnaires and card sorting.

In the two surveys, target respondents come from two or three members of interviews and about 20 team members of questionnaires from different IT project teams, and 30 participants of questionnaires.

Methods for Data Analysis

The data from the research would be qualitative mostly. The methods suitable for analysis are interpretations of interviews and case studies, content analysis, data presentation and statistical tests, taxonomy, typology, matrix/logical analysis, analysis software such as Excel and SPSS.

Ideally, it would provide more accurate results with all these methods, but due to the time limitation, only four methods had been chosen, including the important one – interpretations of the interviews. Eysenck pointed out that the interviewers should adopt a non-judgment approach to

interpret or handle the problems like most people may provide socially desirable rather than honest answers to personal questions [28]. This problem would be very likely happened in this research. To some extent, project group members will be influenced by their subjective thought unconsciously. The researcher will, on side, correct participants' thinking during the interviews and on the other side, interpret their answers with a non-judgment way to analyze more accurate information. Also, some software can support the analysis with taxonomy and typology methods.

IV. CONCLUSION

Team scale

Ideally without the consideration of resource, the most efficient team scale is as big as possible. This study of team scale combines with three aspects which are human nature, input-output ratio and the unique situation for IT-related team.

A smaller team can build a sense of responsibility. Every team member would be more self-consciously aware of their own responsibilities and their influences to the team. Small team is a more transparent group that team members can monitor each other easily. Therefore, due to their hard work, success in a smaller team can bring much more satisfaction to the team members. What is more, small team provides more opportunities of communication for team members. Even a few minutes talk or a similar idea can enhance the collective sense of 'we-feeling'. While in a larger team, people are easier to come up with the ideas that 'I won't affect much in this team' or 'It is hard to identify what I contribute'. It will lead to the effort problem that is average degree of hard working in small team is higher than that in larger team. Effort problem is part of the input-output problem. Another part is related to the uniqueness of IT project about the IT developer as Haigh said that every IT technicians could not understand each other [29]. Although many developers can quicken the development, the rate of investment and outcome is low because of the highest efficiency by only one developer. Big project needs large team scale, but as the increasing of the team scale, the probability of making mistakes would be reduced which is a big problem for small teams.

TABLE I. SMALL TEAM AND BIG TEAM

Small team: (Benefits)	**Big team: (Benefits)**
Sense of responsibility	Suitable for big project or complex technical requirement
Sense of satisfaction	Speed of development
Sense of fairness	Low probability of making mistakes
Sense of cooperation	Low degree of effort (average)
Strong 'we-feeling'	
Efficiency by few developer	

Organisational types and team roles

According to three types organizational structure (vertical, horizontal and hybrid team) provided by Ambler, this research shows that there are very few horizontal IT project teams nowadays. Vertical type can create efficiency for small scale teams and big teams are suitable to build hybrid teams. There are also many factors influencing team structure to consider, such as the feasibility of budget or schedule, the difficulty of the technical requirements and the learning ability of key roles

TABLE II. IMPORTANCE OF ROLES FROM HIGH TO LOW

High			**Low**
Project manager	Developer Quality assurance engineer Tester Requirement Analyst Architect	Database administrator Designer Technical co-ordinator Operations/support engineer Client liaison	Team representative Subject matter expert (user)

The ambiguous role, project sponsor, will influence the team efficiency or not still needs to be identified from further research. The research also demonstrates that in a software-based project, it needs full consideration about the role: 'software architecture' in every specific team. A particular role of architect makes the team more efficient. But due to specific team situations, resources, requirements or limitations, every team should carefully consider the work of architecture and assign proper members.

Project manager's competences

Project manager is a key role influencing the team efficiency. Leadership is able to affect the project team performance and affect effectiveness. In conclusion, in order to develop an efficient IT project, personality is the most important factor for project manager no matter with or without technical expertise. Project manager with a magnetic personality, including strong desire for achievement, self-confidence and strong learning ability, sense of fairness, proper technical expertise and sense of perspective, can lead the project team with more sense of cohesion. Additionally, more technical expertise a project manager has, more power he can lead the team. Interpersonal skills and strain capacity are also very important.

Rank: Personality＞Interpersonal skills＞Strain capacity

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