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The Role of Project Management in Sustainable Growth of Technology Companies

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Abstract

Project management plays an important role in the sustainable growth of technology-based firms. However, the fundamental relationship between the project management factors and sustainable growth of the firms has not been fully discovered. This exploratory research identifies the critical project management factors that

contributing to sustainable growth of technology-based organisations. Based on literature review and demo interviews, a two-level evaluation structure is developed for further structured interview survey. Over 60 experts working in technology-based organisations are invited to the structured interview. A project management framework for organisational sustainable growth was extracted from three dimensions: personal, team and organisational levels. Furthermore, the practical implementation of these identified factors is measured by satisfaction through interview survey. The research provided researchers and practitioners of technology-based firms with an understanding of the contribution of key project management factors to organisational sustainable growth.

Keywords: Sustainable growth, project management, critical factor, factor analysis, technology-based firm

The Role of Project Management in Organisational Sustainable Growth of Technology-based Firms

Abstract

Project management plays an important role in the sustainable growth of technology-based firms. However, the fundamental relationship between the project management factors and sustainable growth of the firms has not been fully discovered. This exploratory research identifies the critical project management factors that contributing to sustainable growth of technology-based organisations. Based on literature review and demo interviews, a two-level evaluation structure is developed for further structured interview survey. Over 60 experts working in technology-based organisations are invited to the structured interview. A project management framework for organisational sustainable growth was extracted from three dimensions: personal, team and organisational levels. Furthermore, the practical implementation of these identified factors is measured by satisfaction through interview survey. The research provided researchers and practitioners of technology-based firms with an understanding of the contribution of key project management factors to organisational sustainable growth.

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Introduction

Under the increasingly fierce global competition, project managers in technology-based firms should consider not only how to achieve project objectives, but also the contribution of project management to the sustainable growth of people and organisations involved. During the whole process of the project, project management plays an extremely important part, by integrating resources and stakeholders at different stages, these including designers, engineers and operators, in achieving sustainable results (Wang et al, 2014). Unlike the other traditional firms, the technology-based organisations rely heavily on the success of various projects for their innovation, improvement and business development. Therefore, project managers should focus on not only their short-term profits, but also the impact of the project result on the long-term sustainable growth of the organisations. It's the sustainable results of projects that contribute significantly to organisational growth in the long term. In practice, project managers mainly focus on time, cost and quality, rather than the long-term impacts of the project, which can prove harmful to the sustainability of projects (Mishra et al, 2011). It is believed that the concept of sustainability has become more of practical concern at the organisational level, rather than the national or international level (Jorgensen, 2008). How to successfully deliver sustainable growth of organisations when managing projects, thus, becomes a challenge for project management professionals.

In order to better understanding of the role of project management to the organisational sustainable growth, there is a need to study how the project

management factors influence organisational sustainable growth. The concept of traditional project management emphasises the achievement of the short-term and internal project objectives, whilst sustainable project management addresses the long-term objective and wider scope of works which contribute to the organisational growth outside the project. Hence, this research sheds light on the role of project management in organisational sustainable growth and testing of the implementation of sustainable project management in practice. It firstly offers a project management framework for pursuing sustainable growth of organisations by identifying the critical project management factors. Furthermore, the implementation satisfaction and importance of these factors are evaluated and compared in order to understand the implementation effects of project management on sustainable organisational growth.

1.1 Research questions

Project management aiming for organisational sustainable growth appreciates the long-term effects of projects on people and organisation within the projects rather than solely on direct project results. The indicators to assess the organisational sustainable growth include the improvement in management skills, competence and capabilities, more environmentally friendly behaviour, better resource management on the organisational level. In this research, two levels of sustainable growth benefiting from project management, i.e. personal level and organisational level, shall be discussed. The personal sustainable growth means the competence and career prospects of the project manager and team members gained from projects. The organisational sustainable growth includes the contribution of the project management

to improving the organisation's efficiency, image/reputation, potential opportunities and management process and strengthening standardisation and best practice. In consideration of the current literature gaps, the research questions of the study are listed below:

1) What are the critical project management factors contributing to organisational sustainable growth?
2) What are the importance of these factors?
3) What are the structural framework and the role of project management in organisational sustainable growth in practice?

The following sections include literature review, research method, findings and conclusion.

2. Literature Review

2.1 Project Management and Sustainability

There are an increasing number of studies linking project management to sustainability issues, entitling project management to wider functionality. It is, however, challenging to precisely define sustainability, due to the complexity of the relevant and interlinked human natural systems (Beratan et al, 2004). When addressing sustainability in project management, a number of researchers associated sustainable project management with macro-level of environmental and social sustainability. For example, Arts and Faith-Ell (2012) discussed and compared various approaches to achieving sustainability in infrastructure projects. Brucker et al (2014) proposed a stakeholder approach to the multi-criteria analysis of projects concerning

sustainable development. They claimed that the stakeholder approach could contribute substantively to resolving societal conflicts and pursuing public good in sustainable development under specific conditions.

In the conceptual studies on sustainable project management, many earlier researchers defined it from internal environment aspects, including relationship, project team, human resources, result, communication and stakeholder management, whilst others examined it based on external aspects such as resources, waste, energy and pollution. Bossink (2007) discussed the cooperation between governmental and commercial organisations in developing innovation in sustainability by case study, where eight consecutive stages of inter-organisational innovation and 22 interaction patterns within the stages were suggested. In another research of Gibson (2006), a sustainability-centred assessment approach to project management was adopted in a case study of the mining industry. He claimed that this approach focused on durable gains and provided a successful conflict-resolving method. Labuschagne and Brent (2005) stressed the importance of product life cycle in sustainable project management and developed a sustainable assessment framework for the manufacturing sector.

2.2 Project Management to Organisational Growth

In recent years, the impact of project management on the sustainable development of project teams and organisations has also been recognised by some researchers. Guerrero and De los Rios (2012) proposed a model to promote a change in the method of learning professional competence in the project management field and its

111 subsequent certification. From the sustainable perspective, this model contains five
112 components, that is, the international context, professional competence, educational
113 programme, teaching faculty and employability. Using a meetings-flow approach,
114 Chen (2011) focused on the internal sustainability of project management, instead of
115 the influence of projects on the external environment. Based on the Delphi survey,
116 Kumaraswamy and Anvuur (2008) created a conceptual decision-making framework
117 to integrate past performance scores based on technical, sustainability and relational
118 criteria.

119 Some researches intended to give suggestions on how to achieve successful
120 sustainable project management. The conceptual research of Mishra et al (2011)
121 suggested that the ethics approach would result in project management sustainability,
122 since it would increase satisfaction, enhance customer loyalty, and create brotherhood,
123 harmony, values, trust and morality amongst the team members. Guerrero and De los
124 Rios (2012) offered a collaborative model for learning professional competence in
125 project management for sustainable development, combining scientific knowledge
126 with experience-based knowledge. Miozzo et al (2016) developed a framework to
127 elucidate how key determinants of the knowledge base of science-based firms and
128 their combinations through M&As interact and affect post-acquisition investment in
129 R&D projects. Baraki and Brent (2013) revealed that the reason for project failure
130 was the lack of structured and sustainable knowledge in sharing practice among
131 project stakeholders based on their investigations of hand-pump projects. They
132 recommended that the knowledge management, operation and maintenance and

133 project life cycle management approach were crucial to establishing a sustainable
134 institutional support system through a public private partnership.

135 In addition, a few studies attempted to identify the relationship between various
136 aspects in project management and organisational growth. Based on an interview
137 survey, Kelley et al (2011) discussed the contribution of project management to
138 organisational growth focusing on the aspect of project manager's leadership.
139 Duffield and Whitty (2015) proposed a lessons-learned knowledge model to link
140 project know-how with organisational learning, and identified that alignment of the
141 people and system elements might positively influence organisation's lessons-learned
142 process. In another research of Almeida and Soares (2014), knowledge sharing
143 between project teams was found strongly affecting organisational learning. Various
144 researches somehow indicate that relationship between project management and
145 organisational growth does exist.

146 Although project is not the sole reason for organisational growth of
147 technology-based firms, the project managers should understand how the success of
148 projects contribute to organisational growth. However, there is a lack of investigation
149 into this relationship between them, considering the long-term impacts of a project on
150 the sustainable growth of the project team and organisation

151

152 **2.3 Critical Success Factors in Project Management**

153 The identification of project critical success factors (CSF) has become an essential
154 part of research into project management since as early as the 1960s. The

155 understanding of CSF can help project managers to measure project performance and
156 outcomes and appropriately allocate project resources (Yu and Kwon, 2011; Chua,
157 1999; Cox et al, 2003). With the intention to guide strategy selection, implementation
158 and monitoring, a well-thought structured process can deliver a set of indicators that
159 create a model of the system of interests (Moldan and Billharz, 1997). In order to
160 achieve project success, the previous research suggested the importance of identifying
161 critical success factors (CSF). Research into CSF in such as construction and IT
162 projects has lasted for decades. As the benefits of project management have been
163 acknowledged by service business, research institutes, non-profit organisations and
164 public sectors, there are an increasing number of studies in relation to CSF in various
165 industry sectors. Fortune and White (2006) applied a framing device and derived 27
166 CSF examples and a Formal System Model by reviewing literature. Yu and Kwon
167 (2011) studied the critical success factors of urban regeneration projects in Korea,
168 suggested four phases of CSF in urban regeneration projects, and analysed the
169 importance of each of the CSFs.

170 The numerous studies on the success factors of project management provided
171 sufficient resources to deduct the critical factors for sustainable project management.
172 However, there is a lack of research on the CSFs for sustainable project management.

173

174 **3 Research Methodology**

175 **3.1 Development of Interview Survey Structure**

176 The CSF method is known as the most appropriate approach to dealing with the

177 human and organisational aspects of projects (Fortune and White, 2006). An extensive
178 literature review was carried out to generate CSF in project management. The articles
179 from international peer-reviewed and published journal papers was collected from
180 major academic databases including Web of Science, Elsevier, Engineering village
181 and Springer Link. The keywords used in the literature search are “sustainable project
182 management”, “organisational sustainable growth” “CSF for project management”.
183 The first round of search resulted in 1,376 articles, which was further reviewed by
184 reading the abstract, in order to specify the findings in the field of technology-based
185 firms. There were finally 80 research papers extracted from 20 journals in total. By
186 using cross-mapping among these literatures, there were 11 critical factors identified
187 for further interview survey, as shown in Table 1. The factors included leadership,
188 communication, stakeholder management, team management, objective management,
189 process control, information management, evaluation, resource management, project
190 result, innovation.

191 **[Insert Table 1 here please.]**

192 Before initiating the face-to-face interview survey, a demonstration interview with
193 five interviewees from five different technology-based firms was carried out to
194 evaluate the 11 factors, and to justify the interview survey design. Biases towards the
195 concepts of the factors were found among the interviewees during the interview,
196 where most of them would require further explanation of the connotation of the
197 factors. The experts in the demonstration interview suggested for further clarification
198 of the factors.

In order to improve the design of the interview structure, a consensus meeting was held with the participation of the five experts and two researchers. After three-round consensus, the interview structure was divided into two levels. A number of sub-factors were added under each of the factors to clarify the meaning of each factor in order that the interviewees could have a better understanding before assessing the factors. The experts agreed upon the interview structure with the confidence that it could help the interviewees further understand the underlying relationship between the factors and organisational sustainable growth. There were a total of 50 sub-factors interpreted by 50 questions proposed for the structured interview survey with the purpose of evaluating the importance of each factor. As most of the factors were qualitative in nature, their relative importance for sustainable project management was measured by a 5-point Likert scale from 1 (not important) to 5 (extremely important), as shown in Table1.

The other part of the questionnaire deals with the evaluation of the implementation of these factors in practice. The experts were asked to assess the extent to which each factor was implemented in real-life projects according to their experience by using a Likert scale from 1 (not effective) to 5 (extremely effective), as shown in Table1.

3.2 Participants' Profiles

The target participants were professionals and decision-makers involved in project management of technology-based organisations in China, including senior and junior project managers, executives and engineers. The selecting criteria for participants included 1) over 3 years' working experience and 2) having been involved in project

221 management in technology-based organisations. The basic format of the interview
222 was face-to-face structured questionnaire survey between the researchers and
223 individual interviewees. In some cases, especially those concerning large and
224 on-going projects, the interviews were carried out between the researchers and the
225 project management team, with three to four people involved, rather than individual
226 interviewees. The interviewees were asked to evaluate the importance of the factors
227 by answering each question. In some cases, they were also asked to give explanations
228 for the scoring. The questionnaire of the structured interview is shown in Appendix I.
229 Each meeting lasted for around 50 to 80 minutes, which was recorded by digital
230 recorders with the permission of the interviewees. There were 82 participants from 63
231 organisations allocated at Beijing, Shanghai and Shandong province invited to the
232 structured survey, among which 60 feedbacks were complete and valid answers. The
233 interviews were carried out from March to December 2015. The profiles of the
234 participants are shown in Table 2 below.

235 **[Insert Table 2 here please.]**

236

237 The selected interviewees came from a range of sectors including construction,
238 manufacturing, engineering consultancy, IT, transport, governmental technology
239 departments and the R&D sectors, 31% of whom were working in the consultancy
240 sector. The remainder were relatively evenly distributed among the other sectors.
241 Most of the participants were from state-owned enterprises and domestic private firms,
242 accounting for around 82% in total, whilst 8% were from foreign-invested firms.

Around 37% of the interviewees were from medium-sized firms with the number of employees ranging from 100 to 500 and 25% from small-sized firms. The other interviewees were from large and mega-sized firms, taking up around 20% in aggregate. Other institutions, such as government organisations and research institutes, accounted for 10% of the total interviewees. In China, the state-owned enterprises employ around 48% of employees and the foreign-invested firms contribute less than 10% (The National Bureau of Statistics, 2015). In addition, most of the firms in China are small to medium-sized firms. Based on the above organisational information, the sample chosen could constitute fairly appropriate representative of the technology-related sectors.

The personal profiles of the interviewees showed that the largest two groups of the respondents were junior and senior managers, representing 46% and 40% respectively. The majority (90%) of the interviewees were at management roles, whilst only 10% were technical personnel. In respect of working experience, the majority of the respondents have 3 to 15 years of experience in managing projects, accounting for 90% of the interviewees.

3.3 Data Analysis

The data analysis methods adopted in this paper include descriptive analysis and factor analysis in order to describe and identify CSF for sustainable project management. The valid 60 questionnaire feedbacks were adopted as 60 sets of input data for statistical analysis. The scores of the 50 questions were collected and

allocated under the factor groups they representing. Since the questions under the same factor group were used to evaluate the importance of the factor itself, the mean score of each group were the measure of the importance of each factor. Therefore the overall score of each factor took consideration the 60 sets of data.

In the further analysis, factor analysis method was introduced by using software SPSS--Statistic Package for Social Science to extract representative effecting factors, by which to measure the performance of a project (SPSS Inc., 1999). The process can reduce and regroup the variables identified from a large number (the 50 sub-factors) to a smaller and more critical factor set on the basis of their interrelation (also called factor loading) and can better interpret the research results (Yuan et al., 2011). In this paper, the average score of each critical factor, which considered all 60 sets of questionnaire data, is deemed as the input variable for factor analysis process.

The suitability of using factor analysis for factor extraction is commonly tested by the Bartlett test of Sphericity and Kaiser-Meyer-Olkin (KMO) test (Field, 2013). The Bartlett test is used to test if samples equal variance, whilst the KMO test is a measure of sampling adequacy that compares the magnitude of the partial correlation coefficients. The sample will be deemed as adequate for factor analysis if the value of KMO is greater than 0.5 and the Bartlett's test of Sphericity less than 0.05 (Verma, 2013). In this research, the Bartlett's test of Sphericity was significant ($p<0.001$) and the value of the KMO index is 0.924 (>0.5) indicating its suitability for factor analysis. The factor analysis which includes factor extraction and factor rotation was, therefore, conducted after the standardisation of the score set. The aim of factor

extraction is to choose the factors through principal components analysis and factor rotation is executed to make the factors more explainable (Yuan et al., 2013). The principal components were extracted based on the rule of "variance contribution rate greater than 85%", which suggested only the variables whose sum of variance is greater than 85% should be extracted. The framework for sustainable project management was developed on the basis of factor analysis.

4 Findings and Discussions

4.1 Descriptive Result

Based on the interview survey, the mean score of each factor group was calculated to represent the importance of each CSF, which was ranked accordingly as shown in Table 3 below.

[Insert Table 3 here please.]

The factor Leadership ranked as the top 1 in Table 3, entitled as the most significant factor in the sustainability of project management. The mean of this factor was 4.46 with variation of 0.46. The factor Process Control has been evaluated as the second most important factor, with an average score of 4.3.

The following factors bearing relatively high average scores were Objective, Information Management and Stakeholder Management, the scores of which ranged from 4.16 to 4.21. The least important ones among the 11 factors were Team Management and Innovation, both bearing the scores of below 4 points.

309 The quantitative part of interview data have been analysed by importance
310 ranking and factor analysis. The qualitative data were used to have a better
311 understanding of the connection among different groups of factors and the
312 fundamental reasons for the interviewees' evaluation of the factors.

313 During the interview survey, a senior manager specified that, "…leadership
314 development is important for project managers to gain experience in managing people
315 and dealing with changes…" An executive mentioned "Leadership is critical to
316 personal growth of the management personals in a project…" In previous research,
317 it has been found that the project manager's leadership had the most critical influence
318 on organisational growth (Kelley et al, 2011).

319 The second most important factor as shown in Table 3 was Process Control. It
320 was explained by several interviewees that various process control tools and
321 documents provided valuable records for organisations to learn from previous project
322 experience. In the research of Zarina et al (2014), project procedure was identified as
323 a critical factor in the success of a project.

324 The third significant factor was Communication according to the interview
325 survey result. The communication skill of the project manager has a critical impact on
326 the essentials of project management (Zulch, 2014), contributing to the performance
327 of a project. As commented by an executive in one interview, who gave 5 points
328 (extremely important) to communication, "…good communication with clients from
329 the public sector can increase the accuracy of results and enhance clients' satisfaction.
330 Therefore, it may bring potential opportunities to the firm". Another manager said

during his interview that communication with various stakeholders in construction projects is, "…the best way to train a project manager to gain management competence in projects".

Another three factors, Information, Resource management and Stakeholder management, were given fairly equal scores based on their importance to organisational sustainable project management. The contribution of information management to sustainable project management lied in 'the share of experience and transfer of knowledge within organisations', according to some interviewees. The principle of information management was knowledge sharing which strongly affects organisational learning (Almeida and Soares, 2014; Duffield and Whitty, 2015). The obvious benefit of good resource management was cost saving, as mentioned by a junior manager. Previous studies have deemed the human factor as a significant element in determining the success of a project (Paulinus et al.,2014; Shahhosseini,2011;Yang et al., 2011). Stakeholder management has been given a relatively high score by some of the interviewees. Two interviewees explained the reasons, "…good management of stakeholders can help avoid unnecessary cost effectively in every stage of the projects" ; "…the satisfaction of stakeholders, such as clients and suppliers, can help the company keep long-term relationships with them…"

The role of Evaluation was also stressed by a number of interviewees. Numerous evaluations at different project stages and project results "would help managers review the accuracy of their original schedules and improve their planning skills in

353 future projects… ". The project result "is directly linked to the satisfaction of the
354 clients and final users. The project result is also linked to reputation and the image of
355 the organisation; as an executive stated, "…a bad project result is harmful to the
356 company reputation and image, and therefore affects the long-term benefit of
357 firms…"

358 According to the ranking results of importance, the least important factors are
359 Team Management and Innovation. There were four interviewees who expressed their
360 concern that innovation was commonly associated with risks, which might have a
361 negative influence on the project result and consequently affect the career
362 development of the project managers.

363

364 **4.2 Factor Analysis**

365 The initial factor analysis indicated that the number of main components which
366 could be extracted from the factors was four. Their variance contribution rate was
367 86.625% (>0.85), suggesting that four components could be representatives in
368 describing the whole data set. The 11 factors were then regrouped into four
369 components using factor loading. The extraction principal interprets that the
370 component based on factor loading whose value is greater than 0.5 being regarded as
371 significant (Pallant, 2007). The factor loading is the correlation coefficient between
372 the variable and extracted components, which indicates the factor's contribution to the
373 component. Based on the contribution of each factor, four principal components were
374 extracted and displayed in Table 4.

375 **[Insert Table 4 here please.]**

376

377 The first group in Table 4, Component 1 – Project manager included three
378 factors: Process Control, Information Management and Communication. These factors
379 related to sustainable growth from the project manager's aspect. Thus, this component
380 could be termed Project Manager. The variance contribution of this component was
381 67.51%, being the most significant among all the components.

382 The second group, Component 2 – Project team had four aspects: Objective,
383 Resource Management, Evaluation and Team Management, which were associated
384 with the initial work of projects. At the initial stage of a project, clear goals must be
385 set followed by an overall assessment. Team management was an essential part of
386 projects in order to achieve the goal of optimal performance. Component 2 was, thus,
387 termed Project Team. It ranked the second of the four components with the variance
388 contribution being 7.41%.

389 Component 3 contained project result, Innovation and Stakeholder Management,
390 which were relevant to the additional performance of the project. Project result, as an
391 uncontrollable factor, reflected the performance of a project. Innovative ideas and
392 good stakeholder management were two auxiliary aspects that can improve a project's
393 performance. Consequently, this component could be summarised as Challenge
394 Control, the variance contribution of which was 6.99%.

395 Component 4 covers only one factor—Leadership. In the importance ranking
396 analysis of CSFs, the factor, Leadership, had the highest score, which indicated that it

played the most important role in sustainable project management. The variance contribution of this component was 4.62%, the lowest of all components indicating a high consistency in the interviewees' evaluation of this factor.

The four components represented different degrees of relevance of project management factors to the organisational sustainable growth. Although they did not cover all factors for all types of projects and sectors, these components were interpretable and can be considered as representatives of the critical project management factors for organisational sustainable growth in technology-based organisations.

4.3. Building a Project Management Framework for Organisational Sustainable Growth

Factor analysis produced a four-component structure for the CSFs and the 11 factors were regrouped into four components according to their correlation. Specifically, the four components were 1) Project Manager, 2) Project Team, 3) Challenge Control and 4) Leadership. The two components bearing the highest importance were Leadership and Project Manager. The two factors indicated the close relationship between the skills of project managers and sustainable development of the organisation. Component 2 - Project Team was related to project team sustainability. Component 3 - Challenge Control was associated with sustainability from the organisational aspect, as it would affect such aspects as corporate efficiency, reputation and potential business opportunities.

The analysis based on both the quantitative and qualitative data provided a project management framework for organisational sustainable growth, which contains three dimensions, that was, Project manager, Project team and Organisation, as shown in Figure 1 below. The factors that were grouped at the personal level were ranked on top of the importance list, indicating that project manager plays the most significant role in organisational sustainable growth.

[Insert Figure 1 here please.]

This framework gave a clear idea of the relationship between project management CSFs and organisational sustainable growth of technology-based firms. Therefore, the sustainable project management can be evaluated from the three dimensions: project manager, project team and organisation. Each of the dimension include several CSF, which contribute to the success of each dimension. For example, the Project Manager dimension includes leadership process control, information management, communication skills. These four factors are the key for the sustainable growth of project managers, which in the long term would contribute to organisational growth. In the Project Team dimension, four CSF – objective, resource management, evaluation, teamwork management contribute to the development of the project team, which in turn will benefit the organisational growth. The Organisation dimension involves three CSF, which are project result, innovation and stakeholder management. It is the combination of all the CSF within the three-dimension groups contribute to the different level of sustainable development of organisation.

In order to achieve sustainable growth of organisation, project management

441 practitioners should address all CSFs in three management dimensions. One possible
442 solution is to strengthen education and training to team members, project managers
443 and organisation leaders. Another solution is to establish a project management
444 performance assessment system based on the above-mentioned project management
445 framework. The assessment results of project management can assist in identifying
446 best practices and benefit practitioners.

447 **4.4 Implementation Satisfaction Evaluation**

448 In the extended interview survey, the implementation satisfaction of above
449 mentioned factors was also derived from the average scores of the answers from the
450 60 questionnaires. The mean of importance and satisfaction of each factor are listed in
451 Table 5, where the last column Difference represent the gap between the importance
452 and satisfaction of each factor.

453 **[Insert Table 5 here please.]**

454 The factors in Table 5 are ranked by the difference between the importance and
455 satisfaction. The satisfaction of implementation indicates the experts' evaluation on
456 the extent to which a factor has been implemented in real projects based on their
457 experience. Compared to the scores in the "importance assessment", the average
458 scores in the implementation satisfaction evaluation were significantly lower, and the
459 differences can range from 0.73 to 0.92. The ranking of the factors in implementation
460 satisfaction evaluation could not correspond to that in the importance assessment. The
461 comparison between implementation satisfaction results and importance assessment
462 results is shown by the radar chart in Figure 2.

[Insert Figure 2 here please.]

It can be seen that almost all the comparatively important factors were given relatively high satisfaction, except for the factor Communication. The communication throughout various projects have not been paid enough attention in practice as it should be in theory. The other factors showing big gap between the importance and satisfactions are team management, evaluation, and leadership, indicating large room for improvement in practice.

The top two significant factors, Leadership and Process Control, which were thought most highly of in the importance assessment, have now been given the highest scores on implementation satisfaction. It suggested that they are the factors that were implemented to the highest degree in project management practice.

Stakeholder Management, which was ranked as the seventh important factor, nevertheless, has been ranked as the second in implementation satisfaction evaluation. Given the management cultural background of Chinese society, where relationship (Guan Xi) has been paid great attention in working environment, it is not surprising to see this result.

The most distinctive results between the two sets of assessments appear in the factor, Communication, with the score of 0.92 in implementation satisfaction evaluation and the score of 3.36, which ranked the third, in importance assessment. The most mentioned complaints were ineffective bottom-up communication system and open communication atmosphere within project team. It shows that although the experts acknowledged the importance of Communication in sustainable project

485 management, its implementation in practice is unsatisfactory.

486 The least satisfying factors seemed to be Team Management and Innovation, which
487 were given the lowest scores in the implementation satisfaction evaluation. As
488 mentioned by an interviewee that "adopting new technology during project process
489 requires extra time and training cost, therefore are not welcomed in those
490 resource-restricted projects". The experts showed their unwillingness to take
491 challenge in project management, which might be caused by time and cost limitation
492 of projects. On team management aspect there are interviewee suggested that team
493 member training and coordination should be strengthened, which were sometimes
494 ignored in project management, especially in small projects. There are still rooms for
495 project practitioners to pay more attention to these two factors in future practice.

496 **5 Conclusions and Recommendations**

497 This research intended to explore the relationship between project management
498 factors and organisational sustainable growth of technology-based firms. The
499 importance of project management factors was evaluated by means of a structured
500 interview survey in which experts in the technology-related sectors were invited. The
501 results disclosed that Leadership, Process Control and Communication played the
502 most important roles in the sustainability of project management, while Team
503 Management and Innovation were deemed to be less significant among the 11 factors.
504 The factor analysis then indicated that the factors could be allocated into four
505 components, namely, Project Manager, Project Team, Challenge Control and
506 Leadership. Further analysis on qualitative data from the interview survey revealed

that these components belong to three aspects of organisational sustainable growth, being Project Manager, Project Team and Organisation. Based on the results, a project management framework has been established for technology-based organisations pursuing sustainable growth. The implementation satisfaction evaluation of the factors based on real practice was carried out in order to compare the results with those of the "importance assessment". Significantly distinctive results were found in all factors, although most of the ranks in the two evaluations were consistent with the exception happened in the factor, Communication, which deserved more adequate attention in practice. The least satisfactory factors in practice were found to be Team management and Innovation, whilst they were also given the least importance by experts.

Further studies on a wider scope were recommended for future researchers. This exploratory research adopted structured interview survey method rather than questionnaire survey, Interview with the experts enabled the researchers to further explain the relatively new concept involved in the research and kept consistency of understanding of different respondents. However, the disadvantage of interview survey was time-consuming, which constrained the number of respondents. It is recommended for future research to adopt questionnaire survey to enlarge the sample size, so that the influence of firm type and sectors on the results can be discussed with adequate data.

The interview survey in this research was carried out in China, therefore the results might be limited to certain extent. In particular, the reasons for Team Management and Innovation being scored lower by the interviewees should be further investigated

529 in the future.

530

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Table 2.Participants profile

Organisational Information				
Organisation type	Government-owned firms	Private-owned firms	Foreign investing firms	Others
	42%	40%	8%	10%
Sectors	Consultancy	Manufacture	Construction	Government
	31%	11%	22%	17%
	IT	Transport	R&D	
	9%	4%	6%	
Employees	<100	100-500	500-2000	>2000
	25%	37%	20%	18%
Personal Information				
Status	Junior manager	Senior manager	Engineers	Executive
	46%	40%	10%	4%
Work experience	3-5 years	5-10 years	10-15 years	>15 years
	38%	32%	20%	10%

Table 3.The average importance of factors

Rank	CSF	Mean	Variance
1	Leadership	4.46	0.46
2	Process control	4.30	0.35
3	Communication	4.27	0.54
4	Objective	4.21	0.30
5	Information	4.20	0.56
6	Resource management	4.19	0.54
7	Stakeholder management	4.19	0.47
8	Evaluation	4.18	0.38
9	Project result	4.16	0.75
10	Team management	3.99	0.50
11	Innovation	3.83	0.53

Table 4 Rotated component matrix

Component		1	2	3	4
1 Project manager	Process control	0.851			
	Information management	0.725			
	Communication	0.710			
2 Project team	Objective		0.881		
	Resource management		0.593		
	Evaluation		0.591		
	Teamwork management		0.575		
3 Challenge control	Project result			0.885	
	Innovation			0.588	
	Stakeholder management			0.508	
4 Leadership	Leadership				0.868

Table 5. The difference between importance and satisfaction of factors

Factor	**Importance**	**Satisfaction**	**Difference**
Communication	4.20	3.10	0.92
Team management	4.02	3.19	0.88
Evaluations	4.07	3.33	0.88
Leadership	4.33	3.53	0.83
Process control	4.39	3.47	0.79
Information	4.07	3.42	0.79
Resource management	3.75	2.87	0.76
Objective	3.75	3.22	0.74
Stakeholder management	4.07	3.42	0.72
Project result	3.93	3.34	0.70
Innovation	3.90	3.21	0.63

Table 1. Development of survey questions

Factors	Code	References
Leadership		Hwang and Ng 2013; Shepley 2010; Li et al 2011; Gushgar et al.(1997); Edum-Fotwe and McCaffer (2000); Odusami (2002); Ngowi 1998; Scott-Young and Samson (2008); Kissi et al 2013;
1 Good understanding of expectations of Client and other stakeholders	S5.1	
2 Managers' leadership skills	S5.2	
Communication		Shen et al. 2007; Puig et al 2014; Arts and Faith-Ell 2012; Baraki and Brent 2013; Lu and Yuan 2010; Gibson 2006; .Beratan et al 2004; Li et al 2011;
1 Good communication with external stakeholders	S1.1	
2 Establishing top-down and bottom-up communication system	S1.2	
3 Open communication atmosphere within project team	S1.3	
Stakeholders management		Shen et al. 2007; Larsson 2003; Fernndez-Snch and Rodrguez-Lp 2010; Mishra et al 2011; Whang and Kim 2014; Yuan 2013; Arts and Faith-Ell 2012; Hwang and Ng 2013; Baraki and Brent 2013; Lu and Yuan 2010; Vinodh and Rathod 2010; Shen et al 2010; Kumaraswamy and Anvuur 2008; Gibson 2006; .Beratan et al 2004; Xu et al 2011; Enshassi 1997; Ball 1999; Shepley 2010; Liu et al 2006; Plaut et al 2012; Bogenstatter 2000; Lutzkendorf et al 2011; Dammann and Elle 2006; Feigeet al 2011; Shi et al 2013; Bartlett and Howard 2000; Farmer and Guy 2010; Ngowi 1998; Wang et al 2010; Li et al 2011;Schepper et al 2013; Eskerod et al 2014;
1 Identifying all stakeholders and their needs	S11.1	
2 Tracking personal changes of all stakeholders	S11.2	
3 Motivating suppliers	S11.3	
4 Quality control over suppliers and vendors	S11.4	
5 Integrating stakeholders' needs into project plans	S11.5	
6 Fulfilment of stakeholders' expectations	S11.6	
Team management		Shen et al. 2007; Hakkinen and Belloni 2011; Cole 1999; Puig et al 2014; Arts and Faith-Ell 2012; Hwang and Ng 2013; Baraki and Brent 2013; Lu and Yuan 2010; Vinodh and Rathod 2010; Shen et al 2010; Kumaraswamy and Anvuur 2008; Ball 1999; Shepley 2010; Li et al 2011; Scott-Young and Samson 2008; Kissi et al 2013; Zou et al
1 In selection of new members, identifying and classifying their abilities and needs	S9.1	
2 Team coordination	S9.2	
3 Employee survey and using the survey results	S9.3	
4 Planning training programme for team members, based on client feedback	S9.4	
5 Task delegation based on members'	S9.5	

competence		2013; Yun et al 2015;
6 Promotion prospect for team members	S9.6	
7 Self-involvement of employees	S9.7	
8 Fair equality of opportunity for team members	S9.8	
Objective management		Plessis 2005; Cole 1999; Fernndez-Snch and Rodrguez-Lp 2010; Whang and Kim 2014; Puig et al 2014; Yuan 2013; Arts and Faith-Ell 2012; Hwang and Ng 2013; Vinodh and Rathod 2010; Shen et al 2007; Shen et al 2010; Kumaraswamy and Anvuur 2008; .Beratan et al 2004; Xu et al 2011; Shepley 2010; Bogenstatter 2000; Glaumann et al 1999; Fawcett et al 2012; Wang et al 2010;
1 Establishment of specific, reasonable and easily understood project objective	S6.1	
2 Setting sub-objectives for those involved in the project under the overall project objective	S6.2	
3 Ensuring each stakeholder understands its sub-objectives	S6.3	
4 Letting members know other peoples' sub-objectives and progress	S6.4	
Process control		Fernndez-Snch and Rodrguez-Lp 2010; Puig et al 2014; Yuan 2013; Hwang and Ng 2013; Lu and Yuan 2010; Shen et al 2010; Kumaraswamy and Anvuur 2008; .Beratan et al 2004; Fawcett et al 2012; Bartlett and Howard 2000; Lacasse 1999; Yun et al 2015;
1 Managers actively checking the project progress	S7.1	
2 Risk management ability	S7.2	
3 Regular checking on process against contract	S7.3	
4 Critical path analysis used for process control and optimisation	S7.4	
5 Balancing time, cost and quality	S7.5	
Information management		Shen et al. 2007; Hakkinen and Belloni 2011; Mishra et al 2011; Whang and Kim 2014; Arts and Faith-Ell 2012; Hwang and Ng 2013; Baraki and Brent 2013; Lu and Yuan 2010; Plessis 2001; Jensen and Gram-Hanssen 2008; Shi et al 2013; Lacasse 1999;
1 Complete and reliable data recording mechanism	S3.1	
2 Establishing database for suppliers and experts information	S3.2	
3 Summarising and recording best practice and sharing results	S3.3	
4 Standardised documents and codes	S3.4	
5 Impact of market price trend	S3.5	
Evaluation		Fernndez-Snch and Rodrguez-Lp 2010; Puig et al 2014; Yuan 2013; Hwang and Ng 2013; Baraki and Brent 2013; Vinodh and Rathod 2010; Shen et al 2010; Enshassi 1997; Plessis 2001; Meins et al 2010; Rwamamara and Simonsson 2012; Tam et al 2012; Plaut et al 2012;
1 Under budget	S2.1	
2 Establishing motivation mechanism	S2.2	
3 Post project evaluation	S2.3	
4 Cutting red tape (reducing complex management processes)	S2.4	
5 Appreciating team image	S2.5	
6 Measuring client's satisfaction after	S2.6	

completion 7 Regular checking, assessing and testing project progress	S2.7	Lutzkendorf et al 2011; Gomes et al 2005; Fawcett et al 2012; Feige et al 2011; Varnas et al 2009; Farmer and Guy 2010; Lacasse 1999; Wang et al 2010; Li et al 2011;
Resource management 1 Financial management 2 Effective use of capital investment 3 Energy and resource saving policy 4 Understanding of relative social, legal, environmental background and technical information of the project	 S10.1 S10.2 S10.3 S10.4	Cole 1999; Plessis 2005; Shen et al. 2007; Konig and Cristofaro 2012; Fernndez-Snch and Rodrguez-Lp 2010; Puig et al 2014; Hannan and Sutherl 2014; Hwang and Ng 2013; Lu and Yuan 2010; Vinodh and Rathod 2010; Shen et al 2010; Ball 1999; Shepley 2010; Liu et al 2006; Meins et al 2010; Plaut et al 2012; Bogenstatter 2000; Glaumann et al 1999; Gomes et al 2005; Burnett et al 2013; Bartlett and Howard 2000; Lacasse 1999;
Project result 1 Productivity 2 Profit and loss achievement 3 Willingness of team members to work in the team again	 S8.1 S8.2 S8.3	Yuan 2013; Hannan and Sutherl 2014; Hwang and Ng 2013; Shen et al 2010; Jensen and Gram-Hanssen 2008;
Innovation 1 Optimising project management according to stakeholders' feedbacks 2 Experiencing challenges or innovation in project 3 Adopting new technology and software for project management	 S4.1 S4.2 S4.3	Kaatz et al 2006; Hakkinen and Belloni 2011; Hwang and Ng 2013; Tam et al 2012; Cole 1999; Konig and Cristofaro 2012;Shen et al 2007; Gibson 2006; Fernndez-Snch and Rodrguez-Lp 2010; Puig et al 2014; Yuan 2013; Arts and Faith-Ell 2012; Baraki and Brent 2013; Lu and Yuan 2010; Shen et al 2010; Plaut et al 2012; Dammann and Elle 2006; Gomes et al 2005; Shi et al 2013; Lacasse 1999; Li et al 2011

Note: Importance Measurement scale = 1-5, where 1 = Not important for sustainable project management and 5 = Extremely important for sustainable project management

Implementation satisfaction measurement scale = 1-5, where 1 = Not satisfied and 5 = Fully satisfied.

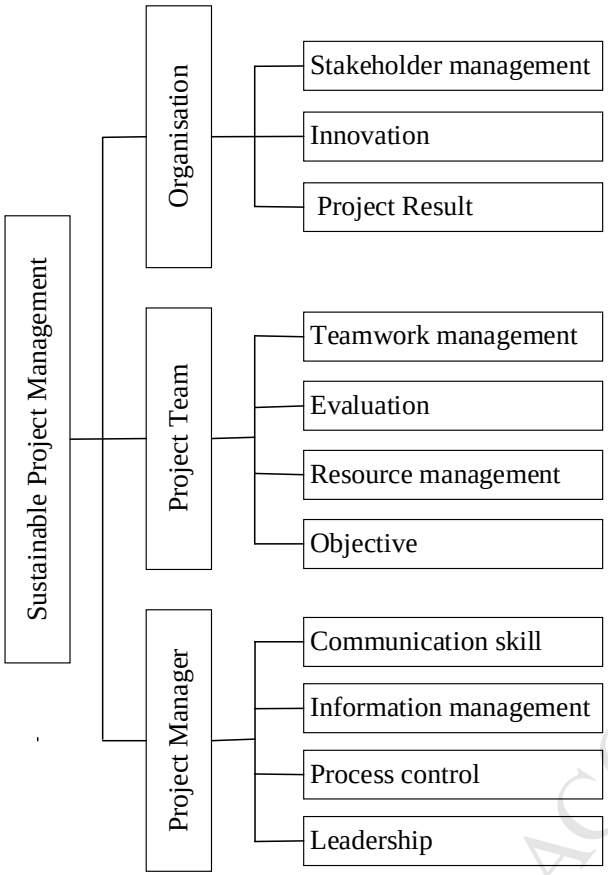

Figure 1. The structure of sustainable project management

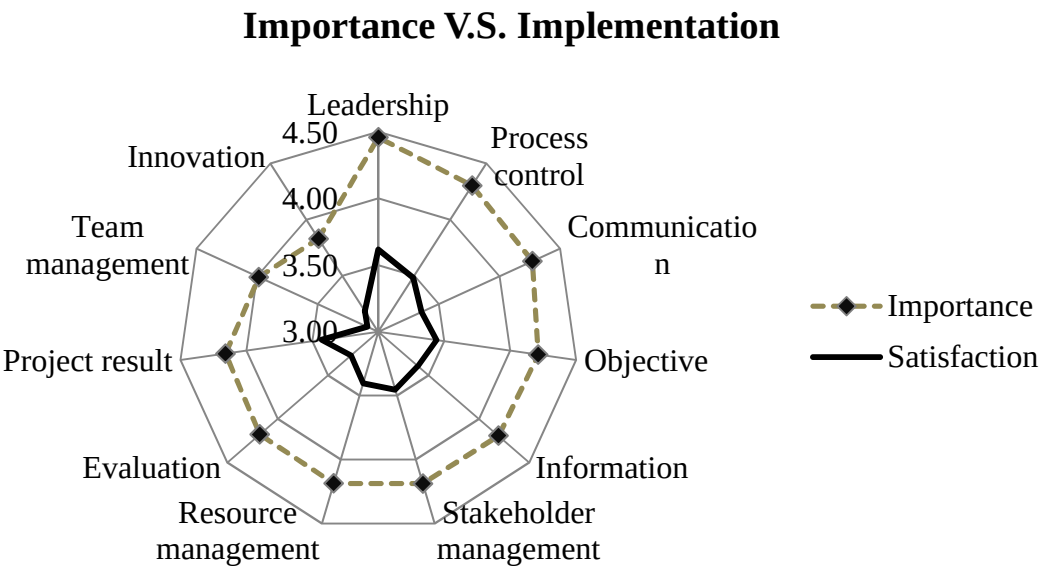

Figure 2. Comparison of Factor Importance and implementation satisfaction

Highlights

(1) This exploratory research discussed the role of project management in orgnisational sustainable development for the first time, contributing to current literature of project management.

(2) A framework of three levels structure for the critical project management factors for organisational sustainable growth was established.

(3) The implementation satisfaction of the critical project management factors for orgnisational sustainable growth was compared with their importance. Suggestions for improvement were given, which are valuable for project management practitioners.