

CRITICAL FACTORS FOR SUSTAINABLE PROJECT MANAGEMENT IN PUBLIC PROJECTS

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ABSTRACT

Public projects have large and long-term impacts on social, economic and environmental sustainability to a nation. During the project whole life, project management plays an important role by integrating resources and stakeholders in different stages, such as designers, engineers and operators, to achieve sustainable project results. This exploratory research intends to identify critical factors for sustainable project management. 11 factors are generated for further analysis. Interview surveys are then used to define the importance of the factors. Around 60 experts from both the public and the private sectors who are involved in public projects were invited to structured interviews. The result shows the different importance of sustainable project management indicators in public projects, which can facilitate the researchers and practitioners in sustainable project management.

Keywords: Sustainability, Sustainable project management, critical factor, project management

INTRODUCTION

Climate change issue has affected all sectors in both developed and developing countries. The construction industry was among the biggest carbon emitter, which received increasing pressure in implementing sustainability (Wang et al, 2010). Sustainability implies methods and techniques in the process of implementing construction projects that involve less harm to the environment (Ruggieri et al, 2009). The concept of sustainability has become more operational at the organisational level, instead of national and international level discussed earlier (Jorgensen, 2008). In practice project managers mainly focus on time, cost and quality rather than long-term impacts of the project, which is of harmful to sustainability of projects (Mishra et al, 2011). Public projects have larger impacts on long-term social, economic and environmental impact to a nation (Wang et al, 2014a). How to successfully deliver sustainability of public projects becomes a big challenge for project managers. This research shed a light on the critical factors for sustainable project management in public projects.

SUSTAINABILITY AND PROJECT MANAGEMENT

Sustainability in Industries

Many researchers have discussed sustainability issues in the construction industry, for example in sustainable design (Tibi, 2012; Whang and Kim, 2014), renewable energy technology for buildings (Badescu and Sicre, 2003), sustainable building materials (Toman et al, 2009). Sustainable building design could reduce the influences of the long-lasting buildings to environment over the buildings' whole lives (Wang et al, 2010). Berggren (1999) reviewed the contribution of the Swedish construction industry to sustainable development by changing from command-and-control to market driven environmental protection. Based on literature review, interviews and case studies, Hakkinen and Belloni (2011) examined the barriers and drivers for sustainable building, and identified the barriers as steering mechanisms, economics, lack of client's understanding, process and underpinning knowledge. In a case study, Bossink (2007) discussed the cooperation between governmental and commercial organizations to develop innovations in sustainability. They discovered eight consecutive stages of inter-organisational innovation and 22 interaction patterns within the stages. Shen et al (2010) addressed the challenges of undertaking project feasibility study in line with sustainable performance of project. Kasim et al (2013) conducted a conceptual research on innovative and sustainable governance model for food industry in an agribusiness project in Malaysia, in order to assist decision making in sustainable development.

Sustainability of Project Management

The role of project management in sustainable development has also draw the attention of some researchers recently. Labuschagne and Brent (2005) stressed the importance of product life cycle in sustainable project management and developed a sustainable assessment framework for manufacture sector. Gibson (2006) examined a sustainability-centred assessment approach to project management in a case study of mining industry, and claimed this approach focused on durable gains and provided a base for successful conflict resolution. Brucker et al (2014) proposed a stakeholder approach to multi-criteria analysis of projects in sustainable development. They claimed the stakeholder approach could contribute substantively to solve the societal conflicts and the pursuit of the public good in sustainable development under specific conditions. Jos and Faith-Ell (2012) discussed and compared various approaches for delivering sustainability in infrastructure projects and concluded that the combined approach of green procurement, partnering and sustainable declaration could improve sustainable performance beyond the formal decision-making phase of infrastructure projects.

Some research explored impact of project management on a sustainable development of the project team and project management organisations. Chen (2011) focused on the internal sustainability of project management instead of the influence of projects on external environment. He presented a meetings-flow approach to client side sustainable project management process. From the viewpoint of sustainable relation management, Kumaraswamy and Anvuur (2008) proposed a framework to select sustainable teams for PPP projects. In another case study, Beratan et al (2004) suggested sustainability indicators acting as a communicative tool to assist a bridge building project. They claimed that indicators of resilience should be selected to monitor and assess increasing resilience in positive organisms and reduce resilience among those organisms that constrain sustainability.

Guerrero De los Rios (2012) proposed a collaborative model to introduce learning professional competence in project management for sustainable development. The model integrated scientific knowledge and expert and experienced knowledge. The conceptual research of Mishra et al (2011) predicted that the ethics approach would result in sustainability of projects, as it would increase satisfaction and customer loyalty, create harmony, brotherhood, trust, values and morality among the team members. By using literature review and interview survey methods, Hwang and Ng (2013) examined the critical knowledge and skills of project managers in deliver green construction. They believed these skills were necessary for project managers to respond to project-related, plan-related, client-related, project team related, labour-related and external challenges. Based on investigations on hand pump projects, Baraki and Brent (2013) discovered the reason for project failure was a lack of structured and sustainable knowledge sharing practices among stakeholders. They suggested that the operation and maintenance, knowledge management and project life cycle management approach were crucial in order to establish a sustainable institutional support system through a public private partnership. Pietrosevoli and Monroy (2013) evaluated the relationship between knowledge management and sustainable construction and their impact to achieve sustainable goals. They deemed that knowledge management as basic strategy learning from success and failures obtained in previous projects to improve the performance of renewable energy projects.

Project Success Factors and Sustainable Indicators

A thoughtful process can deliver a set of indicators that constitute a model of the system of interest, in order to guide strategy selection, implementation and monitoring (Moldan and Billharz, 1997). The study on project critical success factors has become an important aspect of project management since 1960s. In order to achieve project success, the earlier researches suggested identifying critical success factors (CSF). The identification of CSF can help the project managers to measure project performance and outcomes and correctly allocate project resources (Chua, 1999; Cox et al, 2003; Yu and Kwon, 2011). The research on CSF in construction and IT industries has been carried out for decades. Recently, project management has gained its popularity in service business, research institutes, non-profit organizations and public sectors

There are a large number of researches on CSF for project management in various industry sectors. For example, Adadzie et al (2008) revealed four clusters of factors as environmental-impact, customer satisfaction, quality and cost and time for mass hous building projects in developing countries. Daniel(1961) found a relationship between CSF and the 'management information crisis'. Rockart (1979) introduce CSF method and identify CSF in nine dimensions and give more detailed explanation of CSF. Yu and Kwon (2011) suggested four phases of CSF for urban regeneration projects in Korea. Fortune and White (2006) reviewed 63 publications and concluded 27 CSF from literature. The survey of Cooke-Davies (2002) identified 12 success factors for projects on the non-people related factors. On the contrary, Belout and Gauvreau (2004) studied the human resource management factors on project success. Fortune and White (2006) used formal system model as a framing tool to study project CSF, which was said to perform better than the checklist approach. Ika et al (2012) identified five CSFs for World Bank projects, including monitoring, coordination, design, training and institutional environment.

More recently, there is an increasing number of researches on sustainable indicators for projects. Puig et al (2014) identified environmental performance indicators for sustainable port development by using literature review and interview surveys. They grouped the indicators into three categories, which were management performance, operational performance and environmental condition. Considering both the environmental and social aspects, Yuan (2013) suggested 30 key indicators to assess the effectiveness of waste management in construction industry. Fernandez-Sanchez and Rodriguez-Lopez (2010) provided a method to identify sustainability indicators for infrastructure projects in Spain. They applied risk management standards to generate 30 sustainable indicators in three dimensions - environment, social and economy. Jasch and Lavicka (2006) analysed the financial effects of the sustainability performance indicators in the pilot projects and discovered two cost drivers are purchase cost of non-product output and lost work-days.

Sustainability is difficult to define due to the complexity of interlinked human natural systems (Beratan et al, 2006). Some defined sustainable project management from internal environment aspects include relationship, project team, human resources, result, communication, stakeholder management, whilst others are based on external aspects such as resource, waste, energy, pollution. Previous researches regarding project management concentrate mostly on project's sustainability on external environment. There is a lack of research on the assessment indicators for internal sustainability of project management considering the long-term impacts of project on sustainable development of project team and the organisation.

RESEARCH METHODOLOGY

Interview survey design

The sustainable project management in this research indicates the benefit from a project accrue to 1) personal development of team members in their project management competence and 2) improvement of corporate reputation, image and potential opportunities. The project team attribute indicated the project team members' personal growth and career development gained from the management process of the project. The corporate attribute included the contribution of the project management to improving the corporate's efficiency, image, management process, and strengthening standardisation and best practices.

Through literature review, 11 critical factors for sustainable project management were identified. Each of the factors was interpreted into several questions for a better understanding of the interviewees. There were total 50 questions developed for a structured interview survey with the purpose of evaluating the importance of factors. As most of the factors were qualitative in nature, the importance of the factors was measured by Likert scale of 1 (not important) to 5 (extremely important), as shown in Table1 below.

Table 1. Development of survey questions

Personal Sustainable Development		ID
Leadership		
1	Good understanding of expectations of Client and other stakeholders	S5.1
2	Managers' leadership skills	S5.2

Personal Sustainable Development	ID
Communication	
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	
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' expectation	S11.6
Team management	
1 In selection of new members, identifying and classifying their ability and needs	S9.1
2 Team coordination	S9.2
3 Employee survey and using the survey results	S9.3
4 Planning training program for team members based on client's feedback	S9.4
5 Task delegation based on members' competence	S9.5
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	
1 Establishment of specific, reasonable and easily understood project objective	S6.1
2 Setting sub-objectives for people involved in the project under the overall project objective	S6.2
3 Ensuring each stakeholder understand its sub-objectives	S6.3
4 Letting members know other peoples' sub-objectives and progress	S6.4
Process control	
1 Managers actively checking the project progress	S7.1
	S7.2

Personal Sustainable Development	ID
2 Risk management ability	S7.3
3 Regular checking on process against contract	S7.4 S7.5
4 Critical path analysis used for process control and optimisation	
5 Balancing time, cost and quality	
Corporate Sustainable Development	
Information management	
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 them	S3.3
4 Standardised document and codes	
5 Impact of market price trend	S3.4 S3.5
Evaluation	
1 Under budget	S2.1
2 Establishing motivation mechanism	S2.2
3 Post project evaluation	S2.3
4 Cutting red tap (reducing complex management process)	S2.4
5 Appreciating team image	S2.5 S2.6
6 Measuring client's satisfaction after completion	
7 Regular checking, assessing and testing project progress	S2.7
Resource management	
1 Financial management	S10.1
2 Effective use of capital investment	S10.2
3 Energy and resource saving policy	S10.3
4 Understanding of relative social, legal, environmental background and technical information of the project	S10.4
Project result	
1 Productivity	S8.1
2 Profit and loss achievement	S8.2 S8.3

Personal Sustainable Development	ID
3 Willingness of team members to work in the team again	
Innovation management	
1 Optimising project management according to stakeholders' feedbacks	S4.1
2 Experiencing challenges or innovation in project	S4.2
3 Adopting new technology and software for project management	S4.3

Note: Measurement scale = 1-5, where 1 = Not important and 5 = Extremely important

Participants

The target participants were all professionals and decision makers involved in public projects, including such as project manager, executive, and chief engineer. The selection criteria of participants include 1) over 3 years working experience, 2) has involved in management of public projects. The basic format of the interview was designed as face-to-face interview between researcher and individual interviewee. In some cases, especially those on-going large public projects, the interviews were carried out between the researcher and the project management team of three to four people rather than individual interviewee. On average, the interview lasted around 60 to 90 minutes. Digital recorders were used to record the interview survey, with the permission of the interviewees. There were 80 participants from 63 organisations were invited to the structured interview survey, among which 60 feedbacks were complete and valid answers. The profile of the participants profile is shown in Table 2 to 4 below.

Table 2 Job title of interviewees

Position	Frequency	Percentage
Administrator	23	38%
Engineer	5	13%
Department manager	13	20%
Senior manager	2	3%
Project manager	6	10%
Other	11	16%
Total	60	100%

Table 3 Work experience of interviewees

Years of experience	Frequency	Percentage
3.1 to 5 years	23	41%
5.1 to 10 years	19	34%

Years of experience	Frequency	Percentage
10.1 to 15 years	12	21%
15.1 to 20 years	2	4%
Total	56	100%

Table 4. Organisation type of interviewees

Government-owned firms	Private-owned firms	Foreign invested firms	Others
42%	40%	8%	10%

The largest two groups of respondents are Administrator and Department Manager, representing 38% and 20% respectively. On work experience aspect, the majority of the respondents have worked in their company over 3 years experience in managing public projects.

The interviewees came from both private sector and public sector including construction, manufacture, IT, transport, consultancy, R&D and government institutes. The organisation types were mainly government-owned and private –owned, together representing around 82%, whilst foreign invested firms accounts only 8%. Other institutes such as government organisations and research institutes accounted for 10%.

The majority (90%) of the interviewees were on the management level, whilst only 10% were technical personal. Around 25% of the interviewees worked over 10 years, others had work experience between 3 and 10 years.

Data analysis

For each factor the average score of relative questions was taken as the importance to sustainable project management. The 11 factors were ranked on the basis of their average score. A further correlation analysis was carried out to investigate the relationship between the interviewees work experience, job title and their evaluation on factors.

FINDINGS

Importance analysis

According to the interview survey, the mean of each question's score was calculated. The factors were ranked on the basis of the average importance as shown in Table 5 below.

Table 5 The score of factors related to the success of process

Rank	Factors	Importance
1	Leadership	4.46
2	Process control	4.30
3	Communication	4.27

Rank	Factors	Importance
4	Objective	4.21
5	Information	4.2
6	Resource management	4.19
7	Stakeholder management	4.19
8	Evaluation	4.18
9	Project result	4.16
10	Team management	3.99
11	Innovation	3.83

The result shows Leadership is the most significant factor in the sustainability of project management, which gains 4.46 point. Leadership development is important for project managers to gain experience in managing project. Process control has been evaluated as the second most important factor, as various process control tools and documents left valuable records for organisations. Effective communication is another essential factor to achieve consensus between stakeholders and avoid unnecessary cost in every stage of the projects effectively.

The least important factors are Team management and Innovation, both below 4. Some interviewees suggested that innovation was commonly associated with risks, which might bring negative influence on the project result and consequently affect the career development of the project managers.

Correlation analysis

In order to probe the relation between the respondents and the successful factors of projects precisely, correlation analysis was carried out by using software SPSS (Statistic Package for Social Science). Since there was more than one question to describe each factor in the survey, the total score of each factor was represented by the average score of all questions related to each factor. Then the Pearson correlation analysis was conducted between respondents profile data and the total score of each factor. The Job title and Work experience were selected to calculate the correlation coefficient with 11 factors.

Table 6 Correlation analysis result of Job title and factors

	Job title	TM	SM	RM	PR	PC	Obj	Lea	Inn	Inf	Eva	Com
Pearson Correlation	1	.099	.164	.010	.219	.028	.009	.107	.135	.259*	.047	-.024
Sig. (2-tailed)		.457	.213	.939	.098	.835	.944	.419	.308	.047	.725	.857
N	59	59	59	59	58	59	59	59	59	59	59	59

The significant correlation coefficient between type of respondents' work and information in process of projects is 0.259 and p-value 0.047. The average score given by various positions is all greater than 4, implying that people from different position regard as important the information in the option of projects.

Table 7 Correlation analysis result of Work experience and factors

		Work experience	TM	SM	RM	PR	PC	Obj	Lea	Inn	Inf	Eva	Com
Total work time	Pearson Correlation	1	.140	.291*	.162	.181	.134	.125	.196	.133	.162	.246	.271*
	Sig. (2-tailed)		.303	.030	.232	.187	.325	.359	.148	.327	.234	.067	.043
	N	56	56	56	56	55	56	56	56	56	56	56	56

Notes:

SM is short for stakeholder management, the same with the other factors in result form1.2.3.

The missing values are excluded pairwise so there are not 60 variables left.

The correlation of Work experience of respondents and the factors are not significant except for the Stakeholder management and Communication whose p-values are 0.03 and 0.043 respectively, both less than 0.05. The correlation coefficient value between respondents' total work time and stakeholder management is 0.291, representing a weak positive relationship. Among the 60 effective interviewees, most of those who have worked more than 4 years gave 4 or 5 scores in the questions relating to the Stakeholder management. This result also corresponds to the practical option of projects in which the interest and duty allocation and other management are very important to the sustainability of project management.

CONCLUSIONS

The critical factors for sustainable project management were evaluated by structured interview survey. The result shows that Leadership, Process control and Communication play the most important roles in the suitability of project management, while the team management and innovation is less significant by contrast. Furthermore, the correlation analysis between interviewees profile and importance linked the results to the Work experience and Job title. Significant relationships were found between Job title and Information, between Work experience and Stakeholder management and Communication. It is recommended for future research to investigate the critical factors in the whole process of project to improve project performance.

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