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INTEGRATING QUALITY MANAGEMENT AND VALUE MANAGEMENT METHODS: CREATING VALUE ADDED FOR BUILDING PROJECTS

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ABSTRACT
The construction industry has a vast impact on the environment and the economy. Construction project performance requires a focus on increasing the resource efficiency and reducing the impact on the environment during the construction lifecycle. This on-going research is addressed towards the need of improving construction project performance by creating added-value for building projects using quality management (QM) and value management (VM) approaches. This research employs a quantitative approach through a questionnaire survey distributed to construction industry stakeholders. The questionnaire consists of three parts of discussion including identification of critical success factors and barriers that exist typically at each construction stage in building projects, plus identification of additional functions in building projects, and total investment cost for building projects. As the significant findings indicate, this research evaluates how the understanding of quality and its perceived processes plus how the identification of additional functions can be applied to deliver efficiency and more added-value in building construction projects e.g. Energy Efficient Buildings.

Keywords: Building Projects; Energy Efficiency; Innovation; Quality Management; Value Management

1. INTRODUCTION

It is argued that the value of improving project quality for many construction companies is to produce a better product and to ensure business survival, i.e. winning contracts and getting continual contracts. In a project scenario, quality can be defined as meeting the legal, aesthetic (Arditi & Gunaydin, 1997), and functional requirements of a project (Berawi, 2006). In terms of quality in the construction industry, Arditi & Gunaydin (1999) argue that 'a high quality building project' should include a design that is easily understandable and applicable, with a conformity of design with specifications, economics of construction, ease of operation, ease of maintenance and energy efficiency. Additionally, Zantanidis & Tsiotras (1998) and Abdul-Rahman & Berawi (2002) argue that the expectations for quality of construction projects would continue to grow rapidly as the number of affluent, educated, and quality-conscious customers are increasing. With the globalization of the economy, construction firms worldwide are actively engaged in achieving internationally acceptable quality levels to ensure their position in the emerging international market, especially those in developing economies. Thus, the need to have a proper system that ensures quality control is critical, coupled with high level of attention paid to quality management in the construction industry (Hiyassat, 2000).

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On the other hand, a proper Value Management (VM) method, as a systematic and multi-disciplinary team approach to analyze the functions, is expected to produce an optimum outcome for a project in terms of quality, efficiency and innovation (Dell'Isola, 1997; ASTM E-1699, 2010; Berawi & Woodhead, 2008). Based on these benefits of QM and VM methods, it is therefore expected that the integration of both methods can improve the current project performance.

2. QUALITY AND VALUE MANAGEMENT IN CONSTRUCTION INDUSTRY

2.1 Quality Management in Construction Industry

Quality not only refers to the product, but also the process. Arditi & Gunaydin (1999) state that product quality in the construction industry is referred to as achieving quality in materials, equipment, and technology that has been used in the building structure. Furthermore, various definitions of quality have been characterized as: Customer/client satisfaction, Cost-effectiveness, Defect-free work, and Products or services free of deficiencies. Also included are Fitness for purpose as well as Meeting legal, aesthetic and performing functional requirements of the project (Sylvester, et al., 2011; Arditi & Gunaydin, 1999; Berawi, 2006).

The concept of Quality Management is to ensure that the efforts to achieve the required level of quality for the product are well planned and organized (Wong and Fung, 1999). Harris & McCaffer (2001) in Tan & Hamzah (2011) describe that quality management has to provide the environment within which related tools, techniques and procedures could be deployed effectively, leading to operational success for a company. The adoption of Total Quality Management (TQM) in the construction industry has been promoted and the ISO 9001 standard is well-developed to ensure the quality of construction projects.

2.2 Value Management in the Construction Industry

Value Management (VM) is a systematic and structured process of team-based decision making. It aims to achieve the best value of a project or process by defining the functions required to achieve the value objectives and delivering those functions at the least cost (whole lifecycle cost or resource use), consistent with the required quality and performance (Hammersley, 2002). The VM method is developed to provide a way of managing value and improving systematic innovation to create a competitive advantage of a product or a project (SAVE - International value standard, 2007). The method focuses on the understanding of function from each component of an engineered product, because products are bought for what they can do (the function of a product), either from what function they can deliver or aesthetic quality they can offer. In various countries like USA, UK, Australia, and Japan, the application of VM has solved many problems in the construction industry and further implementation of the VM application has increased their competitive advantage (Nakagami, 1996; Berawi & Woodhead, 2008; Yeong, 2009). The ability of VM in increasing the competitiveness of construction industry in some countries cannot be separated from the enormous benefits that VM brings to construction projects. VM’s ability in making right decision at the planning stage is one of the benefits that can be cited. Furthermore, the ability to produce the right planning decisions will increase the efficiency in the execution of building construction projects (Robinson, 2008).

2.3 Integrating Quality Management System and Value Management

Quality Management System (QMS) and Value Management (VM) have been widely accepted as methods for effective project management. Based on their benefits to the construction industry, it is expected that the integration of both methods can contribute to a new approach in improving current project performance. There are studies on integrating the Quality Management and Value Management methods such as Zlotin & Zusman (1998) who propose a Hybridization of Value Engineering and Quality Engineering based on the Theory of Inventive

Problem Solving (TRIZ) known as Value Quality Engineering; Ong (2003) introduces the element of VM into QMS, called Value-Managed Quality System (VMQS); Jariri & Zegordi (2008) propose the integration of Quality Function Deployment and VM; and Mandelbaum, et al., (2010) and Ried (2010) support the argument for combining VM and Zero Defect programs for supply chain management.

Since the built environment has a vast impact on the natural environment and the economy, this research is conducted to integrate the VM and QM methods in producing building strategies that can be maximized in terms of both economic and environmental performance. The use of the QM method is to identify the key success factors of high quality building in a building project's lifecycle and to ensure that the added-value in building design, as generated by VM method, can be successfully delivered.

The integration of both methods in this research focuses on exploring the potential to address energy efficiency in buildings. As the building sector represents 40% of the world's energy consumption and a related one-third of the global greenhouse gas (GHG) emissions, this sector has the responsibility and opportunity to take the global lead in reduction strategies at zero cost or net savings using currently available technology and knowledge (UNEP SBCI, 2009). Buildings consume energy directly for heating and cooling and indirectly through electricity for lights, appliances, office equipment, refrigeration, cooking and motors in pumps and ventilating systems. The energy system in a building is required to perform the final conversion from delivered energy to useful energy services (Forsström, et al., 2011).

3. METHODOLOGY

In order to attain the objectives of this study, the research methodology is divided into two main phases. Stage I is employed so as to outline the quality performance indicators and barriers of a building project. Then, the Stage II is conducted to address ways to improve the value of the building through additional functions and cost analysis. This research employs a quantitative approach characterized by the use of control variables and objectivity obtained through statistical methods.

The research instrument is a structured questionnaire used in a survey for data collection. The questionnaire identifies the perception of the construction industry stakeholders (limited to building construction) in discussing quality and value management. The data collected from the questionnaire survey has been analyzed using the Statistical Package for Social Sciences (SPSS) 20. The questionnaire was sent to respondents in both offline and online formats. For the offline survey, 52 copies of questionnaire had been sent to the targeted respondents, which included owners/developers, architectural firms, state owned and publicly owned general contractors, universities, and governmental institutions. While for the online survey, the questionnaire was spread out to the members of Indonesian construction industry mailing list groups. Sampling used in this research was the non-probability sampling design with probability sampling statistical methods.

4. RESULTS AND DISCUSSION

Data processing was performed based on the result of respondents' answers in the survey which had been framed structurally in order that the respondents could comprehensively complete the survey. The structure of the questionnaire consisted of three parts, including total investment cost for a building project, key success factors of quality, and identification of additional functions in a building project.

4.1 Background of The Respondents

In this section, the questions were in the form of employment information, educational level, position in the company, and their experience within their respective company. From the total of 35 respondents completely fulfilling the questionnaire, 31% of them worked in contractor firms, followed by 29% of the respondents working in consultant firms. Information about the respondents' workplace is required as a consideration in analyzing the survey's data. Most of the respondents' position in the company is architect/engineer and middle managerial staff (46%), followed by 9% at director level.

4.2 Key Success Factors and Barriers to Building Projects

The perception of quality in terms of its key success factors and barriers for the success of a building project are described in the following figures. The factors that influenced the process of quality at the lifecycle of the projects were also determined. Figure 1 shows the dominant factors or performance indicators for the success of a building project that consist of: time and schedule of project completion, effectiveness and efficiency of investment/capital cost, effectiveness and efficiency of operation and maintenance costs, security and safety (security & safety), ease in the maintenance implementation (maintainability), and physical and psychological comfort of the occupants.

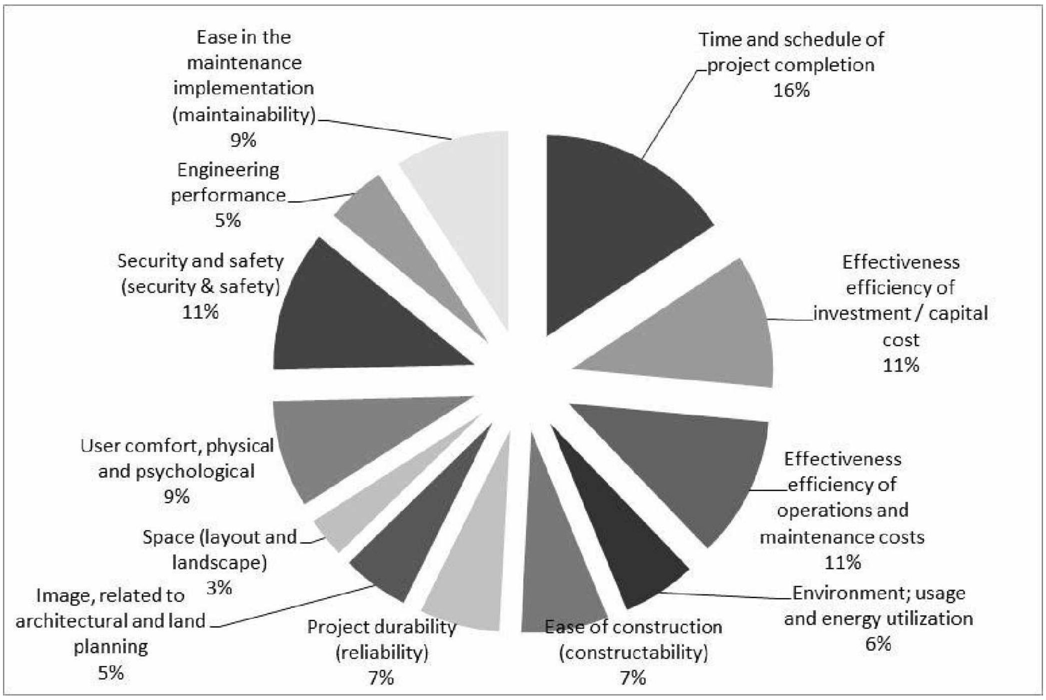

Figure 1 Factors of performance indicators for the success of a building project

On the other hand, the respondents argued that the lack of commitment and support from management, unethical behavior from the professionals, lack of supervision, lack of expertise in the project, and a delayed implementation schedule have all been identified consistently as barriers for the success of a building project (Figure 2).

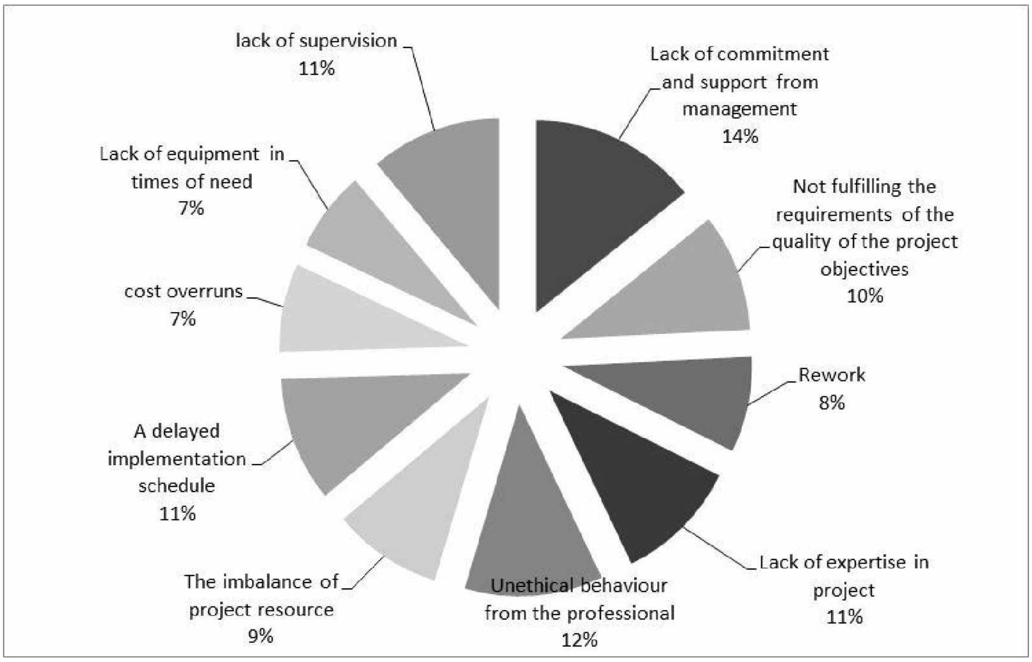

Figure 2 Barriers for the success of a building project

From the survey responses, it also can be seen that the factors in considering the limitations of a building project at the design stage consist of: understanding the client's expectation in relation to function and cost, the collection of project data and information, understanding the project scope and complexity, and understanding the design and project overview (Figure 3).

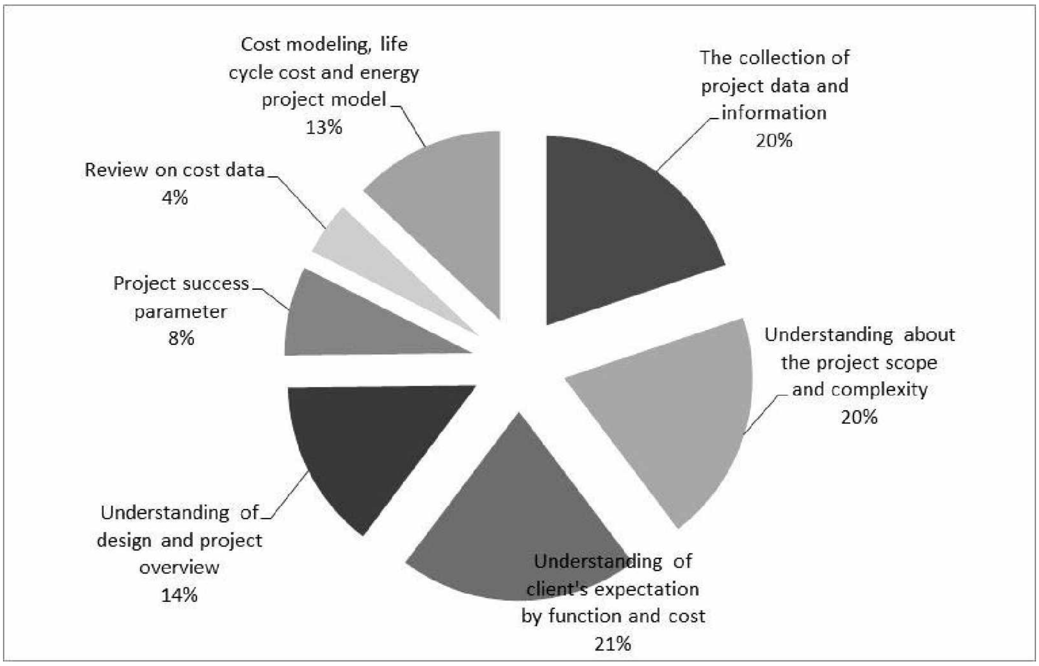

Figure 3 Factors in considering the limitations of a building project at the design stage

4.3 Creating Value in a Building Project: Energy-Efficient Buildings

Added-value should be created to enhance the built environment as a strategy in maximizing the potential contribution to both the economic and natural environmental performance. This value can be generated in the form of additional functions in buildings by applying the VM method. The survey results presented the type of benefits and the applications expected by the respondents from the innovations attached to a building so as to add to its value.

The most expected benefits from the concept of energy efficiency in a building project that have been identified are based on the responses from the survey. These include reducing electricity costs, lowering maintenance costs, resource efficiency, and avoiding global warming. Benefits that are largely expected from the concept of being environmentally friendly include energy efficiency and conservation, protection to the area around the construction site from destruction, and creating a healthy environment for the occupants.

From the standpoint of security and safety functions, the greatest benefits that can be expected to be obtained for the design improvements in the building project include increasing sensitivity to fire protection and in controlling the installation of the entire system's technology equipment. The majority of the respondents expect benefits from design improvement by optimizing the functions concerning the comfort and health of the occupants the building project that have been identified based on the responses from the survey, i.e. a comfortable, controlled environment. In the relation to the functions of accessibility and mobility, the most expected benefits are to control access to the building in a flexible way, followed by ensuring the privacy of the occupants of the building. Benefits mostly expected in optimizing the functions of effectiveness of the operations and maintenance in a building project are cost reduction, which can be led by the use of intelligent systems through energy efficiency, and the ease of centralized controls provided by an integrated system. The summary of the results is presented in Table 1.

Furthermore, Table 2 shows that the concept of energy efficiency can be applied to improve the design of a building project by planning for efficient, artificial, energy-saving lighting, planning for artificial, efficient, and energy-saving cooling, and planning for an appropriate building envelope; whereas the concept of environmentally friendly can be applied as such in these ways so as to include conducting energy efficiency and water efficiency programs.

The function of security and safety can be applied by procuring fire protection systems, the integration of accident prevention through the use of building materials and construction techniques, an occupant emergency evacuation planning system, a building design which reduces the possibility of accidents, and the installation of an integrated security system. In order to obtain the functions for comfort and health, the application should be able to optimize the systems of HVAC (Heating, Ventilation and Air Conditioning), thereby reducing the impact of toxic particles in the air. Applications that can be used in order to optimize the design of a building project are a comfortable access system for handicapped/disabled/mobility impaired people, the provision of easy access to public space and emergency/assembly points, and the control of vertical transportation, especially in an emergency. Easy to operate and low maintenance design, use of easy to maintain and energy-saving equipment, and easy to operate maintenance systems are some of the applications that may be used in the building project in order to obtain an optimum design from the functions of operational effectiveness and maintenance.

Table 1 Expected Benefits of Additional Functions

Additional Functions in a Building Design	Expected Benefits
Energy efficiency	- Reducing electricity cost - Lowering maintenance costs - Resource efficiency - Avoiding global warming - Encouraging the use of renewable energy - Considering the building aesthetics
Environmentally friendly	- Energy efficiency and conservation - Protection to the area around the construction site from destruction - Creating a healthy environment for the occupant - Economic benefits (saving money) - Improving air quality - More durable and long lasting building
Security & safety	- Increasing sensitivity to fire - Controlling the entire system's technology equipment installation - Reducing total life-cycle cost - Protecting occupants from unwanted attacks
Comfort & health	- Comfortable controlled environment - Integrated control for the resource elements through one system - Regular temperature that can be controlled and adjusted to user needs - Quick service for the occupant - Submission of a rapid and precise communication
Accessibility & mobility	- Controlling access to the building in a flexible way - Ensuring the privacy of the occupant - Tracking and tracing the movement of the occupants/visitors for security - Controlling the opening and closing of access to the use of building as wished - Accessing the parts of the building without using any key andaPIN code that is shared among others
The effectiveness of the operations and maintenance (Maintainability)	- Use of intelligent systems to reduce costs through energy efficiency - Integrated system providing ease to centralized control - Extending the lifecycle of a building - Lowering operational cost for human resources (for maintenance activities, service, and security) - Reducing capital expenditures and operating costs over the building's lifecycle - Better data to maintain and operate the building

Innovation in a building project can be seen as a way towards achieving added-value specifically in relation to cost-effectiveness for energy use in a building. It also reflects one of the key success factors in a building's project performance indicators. Furthermore, ensuring additional functions with certain high level of quality is thoroughly required during the building's project lifecycle.

4.4 Total Investment Cost of a Building Project

Additional functions attached to the building project will contribute to the increase in the investment cost. The majority of respondents argue that increasing the investment cost can still be tolerated when the additional functions in the building project increase up to 30% from the total investment cost of the building as shown in Figure 4.

Table 2 Application of Additional Functions

Additional Functions in Building Design	**Applications**
Energy efficiency	- Planning for efficient artificial energy-saving lighting - Planning for artificial efficient and energy-saving cooling - Planning for appropriate building envelope - Use of renewable energy - Selection of efficient vertical transportation
Environmentally friendly	-Energy efficiency -Water efficiency - Improving the quality of the spatial environment - Optimizing operations and maintenance - Structure design efficiency and placement - Material efficiency - Waste reduction
Security & safety	- Procurement of fire protection systems - Integration of accident prevention through the use of building materials and construction techniques - Occupant emergency evacuation planning system - Building design which reduces the possibility of accidents - Installation of integrated security system - The use of controlled access system (authorized entry system) - Control system against the threat of cybercrime and information technology
Comfort & health	- Optimizing the HVAC system (Heating, Ventilation, and Air Conditioning) - Reducing the impact of toxic materials in the air - The use of work systems and automation control - Integrated communications system
	- Development of comprehensive network access in the building - Energy metering, automatic monitoring system integrated to the billing of energy usage - Entertainment
Accessibility & mobility	- Comfortable mobility system for handicapped / disabled people - Provision of easy access to public space / emergency assembly point - Control of vertical transportation systems - Setting-up a vehicle access system into the building - Access gate supervision - Door locking arrangements
The effectiveness of the operations and maintenance (Maintainability)	- Easy to operate and low maintenance design - Easy to maintain and use of energy-saving equipment - Easy to operate maintenance system - Implementation of a centralized operational monitoring system

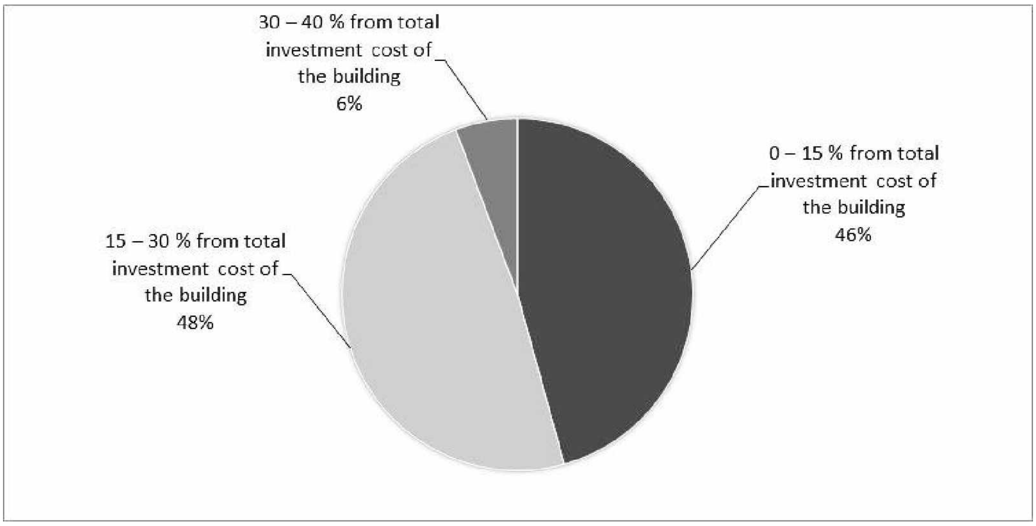

Figure 4 Increase of investment cost of a building project with additional functions

Furthermore, the respondents argue that the cost efficiency with alternative process of maintaining the existing functions to the building can result in a cost savings of 0 - 15% from the total investment cost of the building (Figure 5).

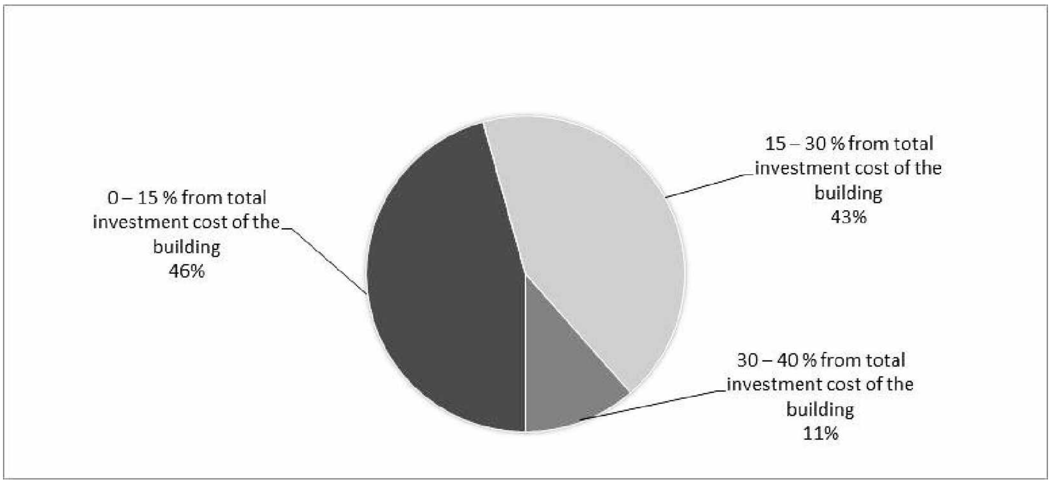

Figure 5 Cost efficiency of a building project without additional functions

5. CONCLUSION

The quality and value issues still arise not only at the end-product stage, but also in the process of construction projects. Value creation for a building project is applied to produce projects with a different approach compared to what has been commonly used. Stimulating innovation using Value Management through the addition of new functions in a building can be seen as a way to optimize the investment cost. Meanwhile the Quality Management method is applied to ensure the performance of a building project with added value that is systematically managed during the lifecycle of a project. This on-going research is expected to produce a conceptual design for a building project that can be more economically and environmentally innovative.

6. ACKNOWLEDGEMENT

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