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## Incorporating Value and Risk Management Principles in Developing Low-income Housing Projects

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# INCORPORATING VALUE AND RISK MANAGEMENT CONCEPTS IN DEVELOPING LOW COST HOUSING PROJECTS

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تهتم صناعة التشييد والبناء بتلبية حاجات عملائها من خلال تنفيذ مشروعات تحقق اهدافهم وتلآقي توقعاتهم وتتميز تلك المشروعات بانها تتجز في الوقت المحدد و في حدود الميزانيات المرصودة لها وحسب معايير الجودة المطلوبة. علي الرغم من برامج الاسكان العديدة التي تنفذها الجهات الحكومية المختصة الا انه هناك مشكلة حقيقية لاسكان الفقراء، وترجع هذه المشكلة لعدد من الاسباب من بينها عدم قدرة ذوي الدخل المنخفض علي تغطية تكلفة هذه المساكن بالاضافة الي عدم قدرة تلك المساكن على ارضاء حاجة مستخدميها. من هنا تبرز الحاجة الي تطوير حلول ابداعية ومبتكرة تستطيع إنجاز مشروعات سكنية تنال رضا مستخدميها وبتكلفة اكثر فاعلية في أن واحد وذلك من خلال دمج مفاهيم ادارة القيمة والازمات في عملية تطوير مشروعات الإسكان المنخفض التكاليف. ويحاول هذا البحث إنجاز ثلاثة اهداف رئيسية: أولا: مراجعة الأدبيات فما يتعلق بالتطور التاريخي لمشروعات الإسكان ومفاهيم رضا العميل وإدارة القيمة والازمات في صناعة البناء، ثانيا: تحديد إمكانية ادارة القيمة والازمات ومزاياها في تطوير مشاريع الإسكان المنخفض التكاليف. ثالثا: تقديم بعض الدروس المستفادة من مجموعة من الحالات الدراسية لمشاريع ذوي الدخل المنخفض أنشأتها حكومة دولة الإمارات العربية المتحدة بمدينة المصفح التجارية. وأخيرا وضع عدد من التوصيات الهامة للجهات الحكومية والمؤسسات التصميمية والمهتمين بقضايا الإسكان المنخفض التكاليف.

The construction industry is concerned with satisfying its customers' needs through delivering projects that achieve their objectives and meet their expectations on time, within budget and as specified. Despite the several housing programmes constructed by government authorities, there is a real housing problem for the poor. This problem is attributed to a number of reasons. Amongst them, the inability of the low-incomers to cover the cost of supplied houses and the lack of the constructed projects to achieve users' satisfaction. This highlighted the need to develop innovative and creative solutions that can deliver housing projects that achieve the satisfaction of their users and at the most-cost effective manner simultaneously. This aim will be achieved through incorporating the concepts of Value Management (VM) and Risk Management (RM) in developing housing projects for the poor. Towards this aim, this paper attempts to accomplish three main objectives. Firstly, reviewing the historical development of housing projects, the concepts of customer satisfaction, VM and RM in construction. Secondly, identifying the capability of VM and RM and their benefits for developing housing projects for the poor. Thirdly, presenting learned lessons extracted from case studies of low-income housing projects constructed by the government of the United Arab Emirates (UAE) in Musaffah commercial city. Finally, outlining the research recommendations for government authorities, design firms and construction professionals concerned with housing projects for the poor.

*Keywords:* Customer satisfaction, Value management, Risk management, Low cost housing.

## 1. INTRODUCTION AND RESEARCH METHODOLOGY

The urban infrastructure does not develop at the same pace as poverty increases. Today over 900 million people live in the cities' slum areas, lacking water, transportation and electricity<sup>[1]</sup>. The poor, worldwide, resort to all sorts of means to house themselves in the face of a housing industry and policies that fail to provide them with affordable options<sup>[2]</sup>. The considerable importance of housing for the poor contrasts sharply with housing conditions and official policies exist in many developing countries. For all,

but the middle and upper income groups, housing is usually costly in relation to income and the quality of dwellings available. Cramped, crowded and unsanitary settlements are the lot of low-income families, conditions that debilitate their energy and reduce national productivity. Families in such dwellings constantly face the threat of eviction as well as scarcities of water, electricity, sewerage and transport<sup>[3]</sup>. Housing is far more than living space and shelter. Its nature and value are determined by the service it offers. These services are varied, including neighbourhood amenities, access to education and health facilities, and security, in addition to shelter.

Their worth depends upon quality consideration such as design, density, building materials and floor space, access to employment and other income-earning opportunities, public facilities, community services, and markets. Statistics of the World Bank shows that public expenditure on housing projects for the poor usually constitutes a small fraction of total public expenditure at the national level. It is argued that the main reason for this problem has always been economic. This is because the economic resources are inevitably limited; hence, it is necessary to reduce the projects costs. This resulted in scarifying the function and quality of the project for the benefit of cost<sup>[4]</sup>. In addition, the social and psychological factors of the users were not considered. For example, the users' habits, traditions and requirements are not captured or reflected in the briefing and design process. This produced facilities that do not meet users' needs or achieve their objectives as well as mismatch with their expectations<sup>[5,6]</sup>. As a result, users either rejected the facilities or forced to adapt them to accommodate their activities and meet their needs. This has negative impact on the building, users and the environment. This paper aims to incorporate the concepts of VM and RM in the development of low cost housing projects as an innovative approach to construct sustainable, cost-effective facilities that achieve their users' satisfaction. In order to achieve this aim, a research methodology was designed to accomplish three objectives. Firstly, reviewing the historical development of housing projects, the concepts of customer satisfaction, VM and RM in construction. Secondly, investigating the capability of VM and RM and their benefits for developing low cost housing projects. These objectives were achieved through literature review. Thirdly, presenting learned lessons from case studies of low-income housing projects constructed by the government of the UAE in the Musaffah commercial city. Finally, outlining the research recommendations for government authorities, design firms and construction professionals concerned with low cost housing projects.

## **2. AN OVERVIEW OF THE HISTORICAL DEVELOPMENT OF HOUSING PROJECTS**

Housing can be described as a programme of organisation of physical space - which implies a relevant use of land and the investment of considerable resources, usually public- with the principal aim of providing lodging to social groups that are unable to obtain it on the open market. Housing programmes have probably been proposed and realised in every age. In ancient Egypt the Pharaohs were concerned with housing when they had to provide lodging to multitudes of workers who were occupied for their lifetimes with the construction of the pyramids. The Roman did the same with their

soldiers who remained to colonize the conquered lands, and with their ex-servicemen who settled in the suburbs of the capital at the end of their military campaigns. Taking of housing in a modern way as the term is used today, starting with the programmes that have been developed in Europe since the beginning of the nineteenth century. The first housing programmes were primarily urban, because they were applied to the underdeveloped areas on existing towns. Overcrowded by immigrants from the country who came to find harder but better-paid work in industries. The programmes were formulated for the working class, whose economic level was low that prevent them from finding decent lodging in town. Towards the middle of nineteenth century, the housing programmes changed to the modern concept which is construction of new sets of living units on free areas usually located in the suburbs or in proximity of towns. From this point the role of the architect's service were requested, not only for the design, but also for the development of new model of urban growth. The first urban models were a contraction of those middle class houses which were built in town. The developed housing units were far more restricted, the level of comfort much lower and the facilities and equipment much poorer. It shows that the ruling class consider the working class as disabled and have insignificant values to be account of. Towards the end of the nineteenth century, the housing problem began to be considered in the U.S.A. and other countries under colonial power. The pattern in the U.S.A was similar to the ones in Western Europe, merely the name was changed from "working class" to "ethnic minorities". In countries under the colonial power, the problem was completely different from the Western Europe. In these countries, the inferior status of the users were not just implied but openly declared (the colour of their skin was often used a legitimate reason to support this declaration). They were considered underdeveloped human beings (in most cases they were called "savages"). The models adopted to accommodate them were no longer a contraction from the middle class in Europe, but a horrible hybrid of pomposity and misery. In the twentieth century the idea of housing was developed considerably. In Europe and many countries the problem of building housing projects for the working class which was increasing emigrating towards the cities, became so important as to involve the whole urban context. In fact, the allotment of housing sites became a fundamental task in making the master plans of cities<sup>[4]</sup>.

## **3. CUSTOMER SATISFACTION**

Customer is defined as someone who makes use of or receives the products or services of an individual or organization<sup>[7]</sup>. In construction, the customer is the entity that uses the final product of the construction industry. Hence, the client and the end-user are the

customers of the construction industry. Traditionally, customer satisfaction was studied within market research. In the past, no much effort was made to find out which specific factors are important to customer satisfaction and then take action for product improvement. One important reason for this was the view that considered gaining a new customer is more important than retaining old ones. It is, however, much more expensive and difficult to gain a new customer than to keep a satisfied and delighted one<sup>[8]</sup>. The organisation, which excluded its customers from the product development process encountered the risk of getting their customer lost<sup>[9]</sup>. Today, the increasing recognition that customers are the most important asset of any organisation and that they must be treated as the organisation's top priority as they are the ones who pay the bills and the survival of any organisation depends on them<sup>[9,10]</sup>, has actuated many industries to focus on their customers and involve them in the product development process. Understanding the customer's needs and expectations is essential for winning new projects and keeping existing ones. Every organisation must give its customers a quality product or service that meets or exceeds their needs, on time and at a reasonable price<sup>[11]</sup>. The historical development of housing projects showed that end users were excluded from being part of the development of their housing units. In addition, the social and psychological needs of the users, their requirements, habits and traditions are not captured or reflected in design. This produced units that do not achieve the users' objectives or meet their expectations. As a result, either users rejected these units or adapted them to accommodate their activities and meet their needs. This has negative effect of the building, its users and the surrounding environment.

#### **4. VM IN CONSTRUCTION**

VM is the European name given to a service concerned with providing the product or service demanded by a customer at the required quality and at the optimum cost. The philosophy is based on the work of Lawrence Miles who, in 1940s was a purchase engineer with the General Electric Company. Miles, found that using substitute solutions and alternative materials succeeded in providing equal or better performance at a lower cost. Based on these observations he proposed a system called Value Analysis which was defined as an organised approach to the identification and elimination of unnecessary cost that provides neither use, nor life, nor quality, nor appearance, nor customer features. Since that time, VM witnessed obvious development steps in the construction industry worldwide. This took the form of setting out the rules, drawing the boundaries of the discipline, stating its objectives, defining the relevant terminology, adoption and implementation by government authorities, modifying contracts to include

value engineering service clause, initiating professional societies, benchmarking, academic research and publications<sup>[12-20]</sup>.

#### **4.1 Value**

<sup>[21]</sup> stated that value is a very subjective concept; it has different meanings for different people. A customer will regard it as the "best buy", a manufacturer will consider it as "the lowest cost", and the designer will view it as the "highest functionality". The Institute of Civil Engineers (ICE) referred that value is the ration of function achieved to its life cycle cost.

$$\text{Value} = \text{Function} / \text{Cost (LCC)} \quad [22].$$

<sup>[23]</sup> Stated that three basic elements that provide a measure of value to the user: function, quality, and cost. These elements can be interpreted by adding quality to the numerator of the above equation to form the following relationship:

$$\text{Value} = (\text{Function} + \text{Quality}) / \text{Cost (LCC)}$$

where:

Function = The specific purpose or work that a design / item must perform.

Quality = The Client's or user's needs, desires, and expectations.

Cost = The total life cycle cost of the product.

Maximising the relationship of these three elements is necessary to satisfying the customer. From this relationship it is easy to see that value could be enhanced by improving either function or quality or both or reducing cost. A decision that improves quality but increases cost to a point where the product is no longer marketable is as unacceptable as one reduces cost at the expense of required quality or performance. In addition, if added cost does not improve quality or enhance the ability to perform the necessary functions, then value is decreased. A balance between value elements is required to achieve best value for money. From this relationship, Value is defined as the most cost-effective way to accomplish a function that meets the user's needs, desires, and expectations<sup>[24]</sup>.

#### **4.2 The Value Process**

The value process relates to the overall sequence of actions that lead to the achievement of value. The value terms used in VM studies are:

##### **Value Planning (VP) and Value Reviewing (VR)**

VP is applied during the concept and brief development stages to ensure that value is planned into the whole project from its inception. This is achieved by addressing the functions and ranking the customer's requirements in order of performance as a guide to the designer. VR is applied at planned stages to check and record the effectiveness of the value process and its management. It analyses and compares a completed design or project against pre-determined expectations.

## VM and Value Engineering (VE)

VM is defined as a systematic, multi-disciplinary effort directed toward analysing the functions of projects for the purpose of achieving the best value at the lowest overall life cycle project cost<sup>[25]</sup>.<sup>[17]</sup> defined VM as a proactive, creative, problem solving or problem seeking service which maximises the functional value of a project by managing its development from conception to use through structured, team-oriented exercises which make explicit and appraise subsequent decisions, by reference to the value requirements of the client. VE is defined as a strategic, innovative approach to obtain optimum value for money spent. VE reduces overall project and life cycle costs without sacrificing quality, aesthetic, or operation and maintenance capabilities. VE investigates, analyses, compares, and selects amongst the various options to produce the required function and meets or exceeds the customer expectations. VE produces a range of design options for the whole project or for defined parts of it, which are tested against the client's value objectives and criteria to remove unnecessary cost without sacrificing functions or quality<sup>[26]</sup>.

### 4.3 The VM Procedures

The systematic procedures applied during a VM study encompass three phases of: pre-study, workshop or study, and post-study activities.

#### 4.3.1 Pre-Study Phase

The objective of the pre-study phase is to ensure that all parties are well co-ordinated, the study is properly targeted and there is sufficient information available for the actual study. The activities that occur during this phase include:

orientation meeting, finalising the team structure, selecting the team members, deciding on study duration, determining study location and conditions, gathering information, site visit, cost estimate verification, preparation of models and efficiency data.

#### 4.3.2 Study or Workshop Phase

During this phase the Multi-disciplinary team is mobilised to conduct the VM study following the procedure set down in the five-step job plan subsequently described. The team structure is tailored to suit the particular project type, but generally includes a VM Team Co-ordinator (VMTC) (qualified value specialist or equivalent), relevant design engineer, operation experts, quantity surveyor/cost engineer and customer representative. Where constructability issues are of concern a construction manager may participate. The optimal size is generally recognised to be between six to twelve members, overlay large teams should be avoided. The duration of the study depends on the nature and size of the project and the stages at which the study is conducted. The five-step job plan consists of: Information Phase,

Creativity Phase, Evaluation Phase, Development Phase and Presentation Phase.

#### - *Information Phase*

This phase aims to establish a good understanding of the project in terms of: its function, constituent elements, design, operation plan and areas with the greatest potential for saving and needed improvements. To that end, the workshop generally starts with an overview of the activities, which will occur within during the VM process by the value specialist. This will be followed by design presentation from the design team. These activities are followed by the function analysis part of the information phase. Function analysis is intended to assure that every VM team member fully understands all of the project's functional requirements, not just his or her own area of speciality: first by examining the total project and then each of its component elements, to identify their basic and secondary functions.

#### - *Creativity Phase*

This phase aims to generate innovative alternative ideas to achieve the same basic functions at lower costs or to achieve necessary improvements. The most often used method is the brainstorming technique, which consists of VM team generating and recording a large number of ideas without evaluation, (idea evaluation is performed in the evaluation phase). The entire VM team participates in this session, so that ideas covering all disciplines are generated, even by participants in areas other than their discipline. This helps obtaining quantity and association of ideas, eliminate blocks that thwart creativity thinking.

#### - *Evaluation Phase*

Various evaluation methods may be used during this phase to analyse and highlight the best ideas generated during the creativity phase. Since there are usually time constraints on the number of ideas that can properly be developed, it is important that only the best ideas are selected. These ideas are evaluated, both on economic and non-economic criteria such as aesthetics, environmental impact, etc.

#### - *Development Phase*

The ideas for alternatives selected during the evaluation phase are now developed into fully detailed proposals, which generally comprise:

- Description of both the original and the proposed design.
- A narrative on the advantages and disadvantages of each proposal.
- Initial and life cycle cost consequences of the proposals.
- Detailed technical calculations, sketches, etc., which are necessary to fully describe the VM proposal.
- Proposals must be clearly detailed to help making prudent decisions.

#### **- Presentation Phase**

Generally on the last day of the study, a presentation of the refined and developed proposals will be made to decision makers and other interested parties. The developed proposals will be summarised and the life cycle cost saving presented. The VM team members will explain the rationale behind each recommended proposal. Draft copies of summaries of the proposals may be handed over so that decision makers can immediately commence evaluation of the recommendations.

#### **4.3.3 Post-study phase**

Within five to ten working days a preliminary VM report may be submitted which will contain all the detailed proposals and summaries, narratives on the process and so on. Concurrently with the report preparation, and for a period after its issues, decision-makers will consider the recommendations from the VM team. Following an appropriate period for review, an implementation meeting should be held to determine whether proposals are to be accepted or rejected, and to establish subsequent actions<sup>[25]</sup>.

### **5. RM IN CONSTRUCTION**

The construction industry is considered to be subject to more risk than other industries. This is because of the complex and time-consuming process of design and construction as well as the great effort required to co-ordinate a multitude of people, from different organisations, with different skills and interests. A variety of unexpected events may occur during the process of building procurement, and many of them can cause losses to the client or other interested parties. Such events are called risks<sup>[27]</sup>. At the macro level the event may be for example, constructing a building for a forecasted cost, time, and quality. The risk at this level will be that the actual outcome will deviate from those forecasted. At lower level the event, constructing a building comprise thousands of interrelated events with variety of risk degree that they will not turn out as planned. For example prolonged bad weather delaying concrete pour, failure of supplier to deliver materials on time will delay the activities, which will use these materials or the injury of workmen when they undertake risky activities. All construction projects involve different kinds of risk. The initial purpose of risk management process is to help the client decide if the potential benefits associated with investment in construction are sufficient to warrant accepting the identified risks. The second purpose is to safeguard the client's interest when a course of action is selected. It is therefore important to identify the risks, establish when they might occur, what their effect might be and what the appropriate response should be<sup>[28]</sup>. The principles of RM are widely used in the construction industry, applied at various stages during the procurement process. It has been shown that proper application of

RM techniques can significantly improve the investment performance of construction projects<sup>[29]</sup>.

#### **5.1 Types of Risks in Construction Projects**

Risks in construction projects could be classified under many categories.

- According to the events outcome, risk either (a) upside risk when the outcome is better than the original forecast or (b) downside risk when the outcome is worse than the original forecast.
- According to the possibility of occurrence, risk either (a) pure risk, normally arises from the possibility of accident or technical failure or (b) speculative risk, possibility of loss and gain, which may be financial, or physical.
- According to the possibility of reduction, risk either: (a) diversifiable risk, if it is possible to reduce risk through pooling or risk-sharing agreement or (b) non-diversifiable risk, if pooling agreement is ineffective in reducing risk for the participants in the pool<sup>[30]</sup>.
- <sup>[29]</sup> classified construction risks to: political, economic, technical, external relations, management, design, environmental, legal and operational.
- <sup>[27]</sup> classified risks in construction projects as: physical, construction, design, political, financial, legal-contractual, and environmental.

#### **5.2 The RM Process**

The RM process comprises identification, analysis and response strategy to all significant project risks with the aim of reducing the opportunity for and consequence of loss. The process of RM can be broken down into three essential components, they are risk identification, risk analysis, and risk responses.

##### **5.2.1 Risk Identification**

Risk identification is a diagnostic process in which all the potential risks that could affect a construction project are identified and investigated, thus enabling the client understands the potential risk sources at an early stage in the project. Such understanding at the project proposal stage will help clients concentrate on strategies for the control and allocation of risk<sup>[27]</sup>. Different methods are used in risk identification. They are brainstorming, historical data, checklist, tree diagram, and influence diagrams<sup>[31,32]</sup>.

##### **5.2.2 Risk Analysis**

Risk analysis is used to evaluate risks, and to ascertain the importance of each risk to the project, based on an assessment of the probability of occurrence (Likelihood) and the possible consequence of its occurrence (Severity).

$$\text{Risk} = \text{Likelihood} \times \text{Severity Loss/Gain}^{[33]}$$

Risk analysis assesses both the effects of individual risks, and the combined consequences of all risks on the project objectives. The major purpose of risk

analysis is to provide a project risk profile that the client can use to look ahead to possible future events and see the probability of those events occurring. The client can then decide whether or not to invest in the project, or adopt specific strategies for dealing with the major risks. Two techniques are used for risk analysis:

**Quantitative Risk Analysis:** It is a risk analysis technique, which requires input of numerical data and carrying out of some calculations work. The quantitative risk analysis study provides some numerical results, which will allow more informed decision-making by the team.

**Qualitative Risk Analysis:** It is a risk analysis technique, which involves subjective assessment based on experiences of the team, which may be used to determine risk impact. Lack of information, lack of demand for more detailed approach and absence of numerical data related to identifying the risk are two main reasons that force the risk analyst to use the qualitative technique. This does not mean that the quantitative risk techniques are not used. Both techniques are used according to the importance of the project and the availability of information<sup>[27,34]</sup>.

### 5.2.3 Risk Responses

Since all projects are unique and risks are dynamic throughout the project life cycle, it is necessary to formulate a risk response strategy. The information gained from the identification and analysis of the risks gives an understanding of their likely impact on the project. This in turn, enables an appropriate response to be chosen. Typically there are three main types of responses to risks: to avoid or reduce the risks, to transfer the risks or to retain the risks.

**Risk Avoidance or Reduction:** Once the risks have been identified and analysed, it may be possible to formulate methods of avoiding certain risks. During the earlier stages of a project the client may take a preventive action to reduce, avoid or transfer risks. Rejecting a proposal is an obvious way of avoiding risks. However, if the client decided to proceed with a project, then risks should be reduced wherever possible. This will be normally achieved through a variety of actions including detailed design review, further geographical and / or geotechnical investigation, more detailed study of the project environment, the use of alternative contractual agreement, closer co-ordination with the project team or the application of different technology or construction method.

**Risk Transfer:** Risk transfer involves transferring the risk from one part to another, without changing the total amount of risk in the project. Risk transfer can occur between the parties involved in the project or between one party and an insurer. The decision to transfer or allocate risk to another party is

implemented through an insurance policy or the conditions of contract. It is usually up to the client to initiate the transfer of risk, although there are several factors that need to be considered before any risk transfer. First, the capability of the party whom the risk is being transferred to manage or control the risk and accepting the consequences of risk transfer. The second consideration is whether or not the risk premium that would have to be paid for the transfer of a risk is greater than the cost of the consequences.

**Risk Retention:** In some situation the only option available is to retain a risk. The party that is holding a risk might be the only one that can manage the risk or accept the consequences. It is normal for the client to be left with some risks and these are termed residual risks (Shen, 1999; Smith, 1999).

## 6. VM AND RM FOR DEVELOPING LOW COST HOUSING PROJECTS

The use of VM and RM for developing housing project for the poor is promising and expected to deliver housing units that meet the customer satisfaction at the most cost-effective manner. The benefits of incorporating VM and RM in developing housing project for the poor could be summarised as:

### 1. Better Understanding of the Customer Needs and Requirements

VM and RM are total customers driven techniques directed towards understanding the customer objectives, establishing their value system, identifying, analysing and responding to the different risks that affect and hinder the achievement of customer objectives. In addition, the project brief could be improved through refining requirements, analysing functions and feeding back for future projects.

### 2. Removing Unnecessary Cost

Application of VM and RM helps (a) achieving optimum value for money in satisfying a range of customer's requirements, (b) preventing unnecessary expenditure, (c) achieving balance between cost and function, (d) using substitute materials, (e) reviewing design at key points, (f) improving Life Cost Cycling, (g) avoiding over specification and (h) conserving energy.

### 3. Reducing Project Time

This could be achieved through (a) simplifying project design and construction method, (b) managing risks that may delay the project completion and (c) using standard elements.

### 4. Improving Communication and Team Working

The diversity of workshop team members represents a cornerstone for successful results. Representing all project stakeholders ensures that their views, objectives and requirements are well perceived and

adequately reflected in design and construction. In addition, their participation in the decision making process emphasises their commitment to implement the selected decision. In addition, application of VM and RM principles helps escalating employees' enthusiasm and enhancing skills through team participation and improving communication between stakeholders.

#### **5. Created, Challenged and Innovative Ideas**

VM and RM are based on systematic steps which ensure that the problem in hand is thoroughly studied, innovative alternatives are generated and evaluated, best alternatives are selected and implemented. This helps getting better confidence in developed solutions, accelerating the incorporation of new materials and construction techniques, carrying out continual improvement of standards and policies and challenging traditional working processes and procedures.

#### **6. Managing Change Orders Effectively**

VM and RM have different opportunities to be applied throughout the project life cycle in order to achieve best value for money and manage associated risks. These opportunities are at: (a) Conception formulation, (b) Design tentative, (c) Working Drawings, (d) Construction, and (e) Operation stages. This helps managing change orders that may take place during the design and construction stages and helps responding effectively to the drivers that may affect the project brief.

### **7. CASE STUDY RESULTS FROM THE UNITED ARAB EMIRATES**

A recent study carried out by Abdellatif and Othman (2006) to improve the sustainability of low income housing projects in the city of Musaffah, Abu Dhabi, United Arab Emirates showed that: 71.43% of the clients, questioned and interviewed, are not satisfied with their finished buildings. They attributed their satisfaction to a number of reasons:

- The design firm overlooked the clients' requirements and behaved unilaterally in taking design decisions on behalf of them.
- The design firm escalated the building specifications to increase its design fees, as it is a percentage of the building cost. This resulted in specifying luxury materials that does not commensurate with low-income housing projects and adding facilities like central gas systems that were not used due to the economic status of the users and the maintenance cost.
- The whole life cycle of the project was not considered such as using upper water tanks made from durable materials, which are exposed to external weather, humidity and sunlight. This resulted in getting them cracked and their connections rusted. The lifetime of the project

was expected to be 25 years, where these tanks became unusable within 3 years of use.

- The poor workmanship of construction companies that resulted in many construction defects that affected the performance of their buildings.

All end users consulted claimed that they were not engaged in the briefing and design process. Hence, their requirements were not captured and their needs were not reflected in design. For example the increasing family size forced some users to use the service rooms as an accommodation and use the public areas such as corridors and roof as a store. Architects mentioned that this could be attributed to the nature of the government and housing projects, where the end user is usually absent or unknown during the briefing and design process.

### **8. CONCLUSIONS AND RECOMMENDATION**

Having reviewed the historical development of housing projects, the concepts of customer satisfaction, VM and RM in construction as well as investigating the capability of VM and RM and their benefits for developing housing projects for the poor and presenting learned lessons and feedback extracted from case studies of low-income housing projects constructed by the government of the United Arab Emirates, the research may reach the following conclusions: Government authorities, design firms and professionals parties responsible for developing housing projects for the poor are advised to focus on building sustainable, affordable housing projects that achieve the user satisfaction through:

- Supporting and adopting the concept of customer satisfaction by involving the clients and users in the briefing and design process.
- Playing an active role as customer advisors through capturing their requirements, understanding their habits and traditions, getting their feedback and comments in order to close the loop and avoid mistakes and deficiencies in future projects.
- Incorporate the concepts of VM and RM in developing housing projects for the poor. This will help building better understanding of the customer needs and requirements, removing unnecessary cost, reducing project time, improving communication and team working, creating and challenging innovative ideas and managing change orders effectively.
- Paying more attention and keeping architects updated of alternative materials and techniques that could enhance performance and reduce cost concurrently. This highlights the importance of investing in research and development as well as training and motivating architects for self improvement and continues education development.

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