Theoretical Framework for Reducing Housing Defects (ReHDe Framework) in Newly Built Terrace Housing Malaysia

N. Hamzah, A Ramly*, H. Salleh*, N. M. Tawil and A.I, Che Anie

Abstract—In an era of highly intense global competition, countries apply quality methodologies in the form of strategic quality management, quality systems, quality assurance and quality control in order to gain or sustain a competitive edge. Construction Industry Development Board (CIDB) Malaysia has taken various significant and effective steps as well as initiatives that are geared towards the enhancement of the Malaysian Construction Industry particularly in the aspect of quality by promoting CIDB’s D.I.Y. (Do It Yourself) ISO 9001 Scheme, developing QLASSIC (Quality Assessment System in Construction). However, aspect of quality in newly built housing is remains an issue. From a study of the literature, 21 variables that affect housing quality had been identified. Taken newly built housing defect as quality indicator, a survey had been conducted among three construction professionals comprising: private clients, consultants and contractors. From a factor analysis, ReHDe framework are finally formed with a list of 3 major construct factors and 14 possible variables for managing the quality of house are determined. Results also show a moderate level of construction quality in newly built houses and, still, there is a great potential for quality improvement in the process. Consequently, this paper present possible factors for failure in the quest for quality in housing construction as essential first step towards establishing methods for a real improvement of construction quality in Malaysia. It is expected that this study will provide some empirical insights into the process of project management in the development of housing construction projects in Malaysia.

Keywords—Design, Human capital, Newly built housing defects, Quality framework, Site Management.

I. INTRODUCTION

In recent years, construction industry in Malaysia is moving towards quality. As our ex-Malaysian Minister of Works, YB Dato’ Seri S. Samy Vellu said in his opening speech at Opening Ceremony of the Award Appreciation to Contractors Successfully Obtained The Certification of ISO 9001:2000 Through CIDB DIY ISO 9001 Scheme, “In view of the rapid growth of the industry, quality in the building and construction sector has been a major concern to the Government and public alike. There have been many initiatives to institute reforms in this industry over the years. However, the need has never been felt more acutely than now when quality no longer is just an icing on the cake but an essential ingredient in the cake itself.” [1]

In contrast to what government had promoted, complaints regarding housing sectors in Malaysia have been recorded as the highest percentage received by National Consumer Complaints Centre (NCCC) in 2005 [2]. In addition, several more cases have been identified in a year of 2006 such as, wall crack, dipping porch floor and poor drainage in Bandar Puteri Klang, poor finishing in Taman Sentosa Klang, leakage problem in Bandar Baru Bangi and the worst case were fallen water tank in Bandar Puncak Alam have highlighted this issue. These cases reflect the quality level of Malaysian housing construction industry.

Quality is a very common word but difficult to define and it means different things to different people. Numerous expressions have been adopted to define quality of project in construction industry. Burati et al. (1991) defined quality as customer satisfaction [3] and Crosby (1979) defined as conformance to requirement [4]. Holistically quality is defined in BS 4778 Part 1: Quality Vocabulary [5] and ISO 9001: Quality Sytems- Model for Quality Assurance in Design, Development, Production, Installation and Servicing [6] as the totality of features and characteristics of a product/ service that bears on its ability to satisfy stated/ implied needs.

II. LITERATURE REVIEW

A. Review Stage

Quality in newly built houses is not a domestic issue. A significant numbers of defects have been found at new homes in UK by James Sommerville and Julie McCosh, (2006) and lack of quality in high rise and medium rise housing units in Turkey were found through a case study of mass housing projects, conducted by Aynuz Kazaz and M. Talat Birgonul in a year of 2004.
A building is defective when there is a failure or shortcoming in the function, performance, statutory or user requirements of the structure, fabric, services or other facilities [7]. In a more broader picture, defect is define as a shortcoming or falling short in the performance of a building element [8]. The CIB W86 (1993) also supports the above by defining a defect as a situation where one or more elements do not perform its/their intended function(s) [9] and [10]. Consistence to this, Chan and Tam (2000) states quality within the house-building sector of the construction industry can be defined as fitness for purpose, the achievement of agreed goals and the conformance to requirements [11]. Defects in building indicate the level of quality in construction product. The linear relation shows, higher numbers of complaint and frequency of defect occurs in newly built building indicates a low level of quality. In other words, Quality means not zero defects and right first time, but also means after-sales care [12].


“A failure is a departure from good practice, which may or may not be corrected before the building is handed over. A defect, on the other hand, is a shortfall in performance which manifests itself once the building is operational.”

Simplifying the understanding of defects, National House Buyers Association, Malaysia, (2006) defines defects by classifying defects into 2 categories [16]:

- Physical defects – defects that can be identified through visual inspection and
- Technical defects- latent defect. Defects found during the occupancy stage are commonly known as latent defects, most of which were rarely found during the construction stage and are thus rarely accounted for by the designers and building developers [17].

B. Previously reviewed literatures on housing defects in PM perspective

Starting at least from Building Research Establishment (BRE) (1976) and followed by other individual or group researchers conducted various research to workout the nature and root causes of defects in building. As Low and Wee (2001) found that defects arise due to two main reasons – nature and human errors. However, in some instances, human error alone may be the cause of the defect [14]. Many factors have been identified associated with building quality, the most common factors are an implementation of quality management system [18-19], absorption of quality culture in construction process [20-23], defective design [24-25], site management during execution stage [26], coordination among project team members [27] and training of workers [28]. In a more structured study, factors were grouped into 3 domain of sub-systems ie. sub-system technical, sub-system management and sub-system human resources [9]. Similar to Love, Atkinson (1999) also presented factors in 3 domains called human resource element, management element and global element. Beside from human factors, the processes of delivery project also found contribute to product quality. For example as early as initial stage, clients’ involvement is important in providing information and preparing the scope of works as well as requirements. To the next phase of planning and designing, Andi and Minato (2003) founds the key factor contributing to building quality is the design quality as well as construction process. Most of researchers agreed that construction and site management are the most critical in determining building quality. Some of the key issues have been highlighted are commitment of quality, monitoring and supervising level on site.

Even there have been many research presented by researchers in other country, however due to different circumstances, culture, environment, etc. understanding and dimensions are very specific and vary from one country and another country. Further discussion on the major factors contributing to housing defects in Malaysia will be finalised and discussed later according to Malaysia construction scenario and practices.

### III. DATA COLLECTION

The review of the existing literature revealed factors and variables responsibility for housing quality are as listed in Table I. The questionnaire was structured in way that variables regarded as contributor to each of the factor were separated and well captioned under the appropriate heading.

#### TABLE I

<table>
<thead>
<tr>
<th>No</th>
<th>Variables</th>
<th>Symbol</th>
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<tbody>
<tr>
<td>1</td>
<td>Project team structure</td>
<td>SF1</td>
</tr>
<tr>
<td>2</td>
<td>Variation by clients or standards</td>
<td>SF2</td>
</tr>
<tr>
<td>3</td>
<td>Leadership skill of top management level</td>
<td>SF3</td>
</tr>
<tr>
<td>4</td>
<td>Planning upfront</td>
<td>SF4</td>
</tr>
<tr>
<td>5</td>
<td>Level of knowledge of project team members</td>
<td>SF5</td>
</tr>
<tr>
<td>6</td>
<td>Level of expertise of project team members</td>
<td>SF6</td>
</tr>
<tr>
<td>7</td>
<td>Level of experience of managers</td>
<td>SF7</td>
</tr>
<tr>
<td>8</td>
<td>Constructability of design</td>
<td>SF8</td>
</tr>
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Factor Analysis, SPSS version 17 used to analysis result. Factor analysis is a collection of methods used to examine how underlying constructs influence the responses on a number of measured variables [29]. The main purposes of using factor analysis techniques are to reduce the number of variables and to detect structure in the relationships between variables, which is to classify variables. Therefore, factor analysis is applied as a data reduction or structure detection method in this study. Prior to that Bartlett’s test and Kaiser-Meyer-Olkin were used to test the suitability of factor analysis for the data.

From Table III, KMO value equal 0.541, bigger than 0.500. This indicates correlation between variables can be explained by other variables and factor analysis was suitable for this study. Besides p-value for Bartlett’s test was nearly to zero (0.000), and less than 0.050. This shows that correlations exist among variables and factor analysis can be use for this study.

Data collected from field work were then tested on factor extraction and rotation. Initially all variables were combined without grouping them at first. Then to group the variables, principal axis factoring and extraction method were used.

Result established as in Table IV shows the correlation between variables by having value of factor loadings more than 0.500. Thus, the variables with loading factor more than 0.500 are chosen. This value indicates the variables were acceptable and can be use for this study. From the result, all

<table>
<thead>
<tr>
<th>Likert Scale</th>
<th>Description</th>
<th>SF8</th>
<th>SF9</th>
<th>SF10</th>
<th>SF11</th>
<th>SF12</th>
<th>SF13</th>
<th>SF14</th>
<th>SF15</th>
<th>SF16</th>
<th>SF17</th>
<th>SF18</th>
<th>SF19</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not Contributes</td>
<td></td>
<td></td>
<td></td>
<td>.110</td>
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<tr>
<td>2</td>
<td>Least Contributes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.077</td>
<td>.009</td>
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<tr>
<td>3</td>
<td>Contributes</td>
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<tr>
<td>4</td>
<td>Very Contributes</td>
<td></td>
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<tr>
<td>5</td>
<td>Extremely Contributes</td>
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*Extraction Method: Principal Axis Factoring.*
*Rotation Method: Varimax with Kaiser Normalization.*
variables were chosen except for SF11, SF20 and SF21 were less than 0.500. So the variables were not acceptable and can be eliminate from the study. To simplify the interpretation of factors, Varimax method of rotation with Kaiser Normalization was used to group the variables. All selected variables then been group into 3 factors namely human capital development (F1), design factor (F2) and site management (F3). In detail, variables SF1, SF3, SF4, SF5, SF6, SF7 lies under Factor 1 (F1), variables SF2, SF8, SF9, SF10, SF18, SF19 lies under Factor 2 (F2), and SF12, SF13, SF14, SF15, SF16, SF17 lies under Factor 3.

B. Human Capital Development Factor

From the analysis, it can be observed that competency of project players are crucial in determining building quality. Competence is the ability to acquire and apply project management knowledge and skills in an appropriate context [30]. Level of knowledge, experience and integration of both by possessing effective managerial skills indicate the level of competency of project players in project environment. Level of knowledge can directly be seen by education certification, professional certification on the other hand is a demonstration of competence and not a test of academic achievement or of knowledge, which would be examined at a lower level. It could be gained by various training, skills development programs, involvement as well as vase experience in various type of projects. It also reflects the level of expertise of project players in handling projects. Result shown human capital capabilities for example leadership style, coaching, coordination and strategic planning behavior are elements contributing to human factors.

C. Design Factors

At this point of stage, clients’ involvement is needed to verify and to contribute necessary input to ensure the project is in the right track and to avoid variation. Variations can cause from client, standards or codes and changes in government regulations and laws. Therefore well planning documentation might help progress of work runs smoothly. It also works to optimise project resources and minimise surprises by getting the plan out early and allow corrective feedback.

In 2003, Andi and Takayuki Minato from Japan found the relation of design quality and quality of construction product. The result of study shows that the problems of defective designs are complex and deep rooted, influenced by many factors operating at individual designer, company. construction industry and global and national levels [24]. Poor performances of project were considered as a direct result of design documents deficiencies [27]. Andi found insufficient design time and fee for design work are the two key factors affecting design document quality. He also noted that design constructability also occurred as problem due to lack of construction knowledge on the designer side need to be given an attention. The latter study on the aspect of design quality stated that the better understanding of client’s need may help designer to produce a design to satisfy client as well as standard without neglecting the importance of design constructability [31].

Because of drawings act as communication medium between clients to consultant and between consultant to contractor, lack in clarity, accuracy and detailing of design for example cross sections details of structural elements, joints, plumbing and electrical connections may contribute to drawing’s misinterpretation that lead to defect. Therefore, drawings and other types of communication must be systematically documented and well organized to make sure the process of information transfer works effectively.

D. Site Management Factor

Execution or construction stage is critical in determining building quality. There are 6 variables fall in this factor. Firstly, site condition and environment.

The analysis conducted by Josephson and Hammarlund indicates that on average 32% of defect costs originated in the early stage, i.e., in relation to the client and the design. Approximately 45% of the defect cost originated on the site, i.e., in relation to site condition, site management, the workers and sub-contractors. Approximately 20% of the defect cost originated in materials or machines [10]. Hammarlund and Josephson (1991) suggested that large parts of the failure found in construction projects are attributable to the poor skills of site management. From their study, they found the major causes of quality failure in order of precedence to be; defective workmanship, defects in products, insufficient work separation, inadequate construction planning, disturbance in personnel. Moreover, in a latter studies [32]; Low & Wee, 2001[7, 33][7, 33]; and [9], aspects such as the following are highlighted: poor care in workmanship, lack of site supervision, inadequate information, poor communications and poor documentation.

Stable and long-term close working relationships between contractors and subcontractors may also contribute to their superior quality performance as this becomes the second variable in site management factor. In construction projects, teamwork and good coordination among project players is not a choice but a necessity. Contractors need to embrace their subcontractors and develop closer working relationships of mutual benefit, rather than continue with the present trend towards risk aversion [34]. Such closer working relationships can build up trustworthiness relationship among them and create “win-win” situations to enhance works productivity. Thirdly, with a close supervision, monitoring and controlling will helps to reduce the numbers of workmanship defects from occur and fourthly, clear definition of construction specification may avoid sub-standard material used in project that lead to material defects.

A massive development in construction project leads to high demands of skilful management personnel and labourers. Thus, the next variable in site management factor is resource availability. For example, unavailability of sufficient professionals and managers, unavailability of sufficient amount of skilled labourers and lack of readily available utilities on site, they may affect the result in quality and safety issues in the construction phase [26]. Finally, level of
commitment puts in project may contribute indirectly to quality of project. Commitment may come in varies way for example in the process itself by implementing quality system management like ISO or by just having in house program like quality talks, seminars or rewards system as a motivation factor for workers.

V. CONCLUSION

Defects in housing area are a popular topic among researchers. However, many of them concentrated on the technicality factor that directly caused to the defects. The improvement of these housing quality not only limited to technical factors, but also factors in project management perspective both from the aspect of processes involve and the influence of human attitudes, mentality, skills and behavior. With that spirit, study based on the same issue and problems (defects) but looking from a different angle had been conducted and ReHDe framework has been proposed as in Fig. 1.

Based from the literature finding, 21 variables have been listed to be studied. However, only 19 variables were observed based from Factor Analysis performed on the data which shown correlation between variables. According to rotation technique conducted, selected variables then were group into 3 factors namely human capital development factor, design factor and site management factor. Only 3 variables fall under human capital development are level of knowledge, level of expertise and managerial skill. On the other hand, 5 variables found to be under design factor are design constructability, design accuracy, design clarity, variations and information transfer. Site management factor is having the highest number of variable starting from variables of site condition, working relation, site execution, resource availability and commitment to quality. The ReHDe framework shows that an effective project quality management system today must combine process improvement with the human sciences of people and their relationship. A quality outcome of the project will not succeed in full unless both process and humanistic aspects are addressed.

An in-depth study as to what extent these factors and variables can positively and negatively affect the housing quality are suggested for future study. The reliability and criticality of ReHDe framework are also required to validate the significance of the framework.

REFERENCES


