Diyala Journal
of Engineering
Sciences

ISSN 1999-8716
Printed in Iraq

Second Engineering Scientific Conference
College of Engineering –University of Diyala
16-17 December. 2015, pp. 172-182

THE CONSEQUENCES OF POOR QUALITY ON PROJECT MANAGEMENT SUCCESS OF BUILDING PROJECTS

Samiaah M. Hassen Al-Tmeemy, Wadhah amer Hatem
Ministry of Higher Education -Technical Institute-Baquba-Iraq
sam_saf61@yahoo.com

ABSTRACT: - The occurrence of building failure and collapse has become a major issue of concern in construction building projects as the magnitudes of this incident are becoming very alarming. This paper therefore aims to investigate the contractors' viewpoint on the consequences of poor quality in building projects in terms of non-conformance to requirement, cost overruns, and delays. Quantitative method is adopted to collect data from G6 and G7 building contractors within Kuala Lumpur using questionnaire surveys. The study indicated that the cost overrun is the most frequent consequence of quality failure. The findings of this study provide financial justification for all quality improvement efforts.
Keywords: Poor quality, quality failure, building construction project, cost overrun, delay, non-conformance.

1- INTRODUCTION

An evaluating and reporting quality failures incidents is perceived as a useful indicator of project performance and provides opportunities for quality improvements and cost reduction. These failures can cause frequent delay in project, cost overruns and loss of confidence in contractors.

Researches have shown that the cost of poor quality is substantial, and often much larger than is shown in accounting reports. For most companies the quality-related cost range from 25 to 40 % of operating expenses (Juran and Godfrey, 2000). However, few managers are aware of the extent of the impact of failure. This research aims to highlight the consequences of failure in terms of non-conformance to requirement, cost overruns, and delays. Quantitative method was adopted to collect data from G6 and G7 building contractors within Kuala Lumpur using questionnaire survey.

The findings of this study are expected to contribute to construction management knowledge in several ways. First, provide financial justification for all quality improvement efforts. Second, this research is an attempt to alert mangers about any potential improvements in the building projects.

In pursuing this research, the focus of attention is mainly on building companies registered with the CIDB. The target population of this research was limited to building contractors within Kuala Lumpur, who registered under G6 and G7.

2- RESEARCH BACKGROUND

Failure can be classified as internal and external. Internal failure pertains to those found before delivery to the customer, such as scrap, rework, retesting, defects, and so on. External failure costs, on the other hand, are discovered after delivery to the customer. These include repair and litigation, which may lead to loss of reputation. Indeed, these failures (internal and external) have consequences such as cost overrun, schedule slippage, and customer dissatisfaction when non-conformance is observed in the building. While cost overrun and delay are well known within the building construction business, non-conformance to requirement has been interpreted by various terms such as quality deviations (Burati *et al.*, 1992), defects (Josephson and Hammarlund, 1999), non-conformance (Abdul-Rahman, 1995), rework (Love, 2002), and quality failure (Barber *et al.*, 2000).

3. THE RELATIONSHIP BETWEEN COST, TIME AND QUALITY

Juran (1951)) proposed the traditional model of optimum quality costs, which is presented in Figure 1. This model represents the ideas and philosophies on COQ that describe the relationship between cost of control and cost of failure. Juran argued that failure cost decreased as cost of control (COC) increased. A major aspect of this model is that optimum quality level exists and the attempts to improve quality further above this level will increase total cost and decrease financial performance.

In this sense, several authors have claimed that an optimal COQ point does not exist (Crosby, 1979; Schneiderman, 1986). Schneiderman (1986) presented a new model asserting that a program of continuous improvement with modest increase in COC will decrease the cost of failure steadily as the point of zero defects is approached (Figure 2).

Weheba and Elshennawy (2004) pointed out that both models indicate levels of conformance at which COC expenditures exceed failure costs. Therefore, this sends the wrong message to top management, that failures can cost less than COC, which offers no help in justifying process improvement projects (ibid). To overcome the limitations of the above models, Weheba and Elshennawy (2004) proposed a revised model of the cost of quality that accounts for the value of process improvement in achieving economic operations (Figure 3).

The proposed model includes two major cost elements. The first refers to reactive costs, which account for quality-related costs incurred at a given stable level of operation; these include process monitoring cost, product inspection cost, and loss due to deviation from the part design target and delivery schedule. The second pertains to proactive costs, which cover the cost of attaining an improved level of conformance and account for the cost of introducing planned changes to the process as part of continuing efforts to improve conformance.

Chauvel and Andre (1985) tested various hypotheses related to relationships between quality cost components. They found that prevention activities have a direct and positive influence on the profit margin.

Banks (1992) explained the dynamic relationship among quality cost components. He pointed out that costs will rise as more time is spent on prevention. When processes are improved, appraisal costs are reduced as inspection is no longer necessary. Accordingly, internal failure cost is reduced and the greatest savings can be derived.

Reducing failure costs by eliminating causes of non-conformance can lead to substantial reductions in appraisal costs as well. Omachonu *et al.* (2004) demonstrated that in certain service organizations, up to 60% of employee time is estimated to be spent on checking and rectifying errors as well as apologizing for errors.

Based on the above review of quality cost discussions, the interrelationships among the cost categories provide useful comparisons for deciding whether the money being spent is put to good use.

4. RESEARCH METHODOLOGY

Postal and e-mails surveys were employed. The postal approach is used for the self-completion questionnaire, which provided the respondents with time to consider their answers (Brace, 2008). In addition, this approach is often considered the least expensive of other approaches (Brace, 2008, Czaja and Blair, 2005, Vaus, 2002). Moreover, the postal survey approach has been successfully applied in many previous research projects associated with quality management (Arvaiova *et al.*, 2009, Sower and Quarles, 2003, Sousa *et al.*, 2005). Thus, it was considered to be the most appropriate method for this research.

On the other hand, the e-mail survey can be quicker and more effective than postal surveys in terms of reaching wider participants (Adams and Brace, 2006). E-mail was used to persuade the companies who ignored mail questionnaires or who did not answer all the questions.

The selection process of companies for the full survey began with choosing the most reliable and up-to-date database. The online version of Construction Industry Development Board of Malaysia (CIDB) was sought to satisfy these criteria. Therefore, the research sample was drawn from the CIDB's list of construction companies.

There are seven grades ranging from G1–G7 for each category, depending on a tendering capacity that defines the value of projects that can be undertaken. According to Ader *et al.* (2008) the population of respondents must possess adequate information on the survey topic to provide reliable answers to the survey questions. Therefore, the target population of this research was limited to contractors in Kuala Lumpur who are involved in building construction and registered as G6 or G7.

According to CIDB statistics, 1,329 active contractors are currently classified as grades G6 and G7 in Kuala Lumpur. Of the total, 1,196 contractors are involved in building construction, which represented the population of this study. The sample size for this research is 594 contractors for the questionnaire survey

The questionnaire was divided into three parts. The first part was designed to gather general demographic characteristics of the respondents (e.g., educational level, age, experience, and occupation) of the participating companies. The second part was to investigate the contractors' viewpoint on the consequences of quality failure, and cost and time rectification.

Together with a cover letter, the questionnaires were sent out to 594 building companies. Follow-up letters were sent three weeks after the initial distribution in an attempt to improve the response rate. In addition, personal delivery was performed to increase the rate of response and thus the representation of the sample.

The responses gathered from the surveys were analyzed using the Statistical Packaging for Social Science (SPSS), Version 12.0 Software. Prior to data analysis, preliminary processing was undertaken, including handling blank responses, and checking and correcting errors.

First, descriptive statistics were analyzed to describe the basic features of sample data in a quantitative manner. The descriptive statistics included frequency distributions, measures of central tendency (means, medians, and modes), and measures of dispersion (standard deviation and variance). These were employed to develop a thorough understanding of the nature of the data and provide summary descriptions of the projects in the sample.

It is necessary to ensure that the developed instrument for measuring the relationship between COC and PMS has accurately and actually measured the proposed variables. To examine the goodness of the research instrument, validity and reliability of the measures were established (Cavana *et al.*, 2001, Fraenkel and Wallen, 2006).

Where appropriate, the chi-square ($\chi 2$) test was performed on the significance of findings. Chi-squared test is used to examine the difference between observed and expected frequency's distribution according to randomness outcome assumption. The chi-squared test (x2) was conducted using the following formula:

$$x^2 = \frac{\sum_{i=1}^{n}(O_i - E_i)^2}{E_i^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where O_i is an observed frequency, Ei is an expected (theoretical) frequency asserted by the null hypothesis, *i* is the response category index, and n is the number of response category index.

Relative importance index (RII) is used to determine the relative importance of factors, using the following equation:

$$RII = \sum a_i x_i / A*N \quad \ldots\ldots 2$$

where ai is a constant expressing the weight of the ith response, xi is the level of the response given as a percentage of the total responses for each factor, A is the highest weight, and N is the total number of respondents.

5. DATA ANALYSIS AND FINDINGS

5.1 General Respondent Demographics (GRD)

Of the 594 questionnaires dispatched to the selected sample, 153 were satisfactorily completed, pegging the total response rate at 25.7%. This percentage is acceptable according to Akintoye (2000) and Dulaimi *et al.* (2003), who stated that the normal response rate in the construction industry for postal questionnaires is 20%–30%.

General Respondent's Demographics characteristics (GRD) of the respondents are presented in Table 1. GRD helps the researcher to develop a pre-concept on the sample that will be dealt with for the entire study. Frequency distribution was conducted to show four main profiles, namely, educational level, age, occupation, and experience periods.

The educational level of respondents is presented in Table 1. Majority of the sample (90.2%) held a Bachelor's degree, while the rest belonged to high educated levels. Meanwhile, 8.5% of respondents held a Master's degree and 1.3% held a Ph.D. degree.

The highest frequency (40.5%) of respondents was aged between 40–49 years. A lower percentage (38.6%) was aged between 30–39 years. The rest of respondents were distributed among other intervals, as shown in Table 1.

Regarding the occupation of respondents, manager occupation accounted for the largest percentage (55.6%), followed by resident/site engineer (26.8%). The rest of respondents held the positions of director (6.5%), quality assurance/quality control (4.6%), quantity survey (3.3%), and project (construction) engineer (3.3%), as shown in Table 1.

Experience or work tenure was classified into five groups to capture the significance of the variable. Based on Table 1, majority of respondents (96.1%) clearly drew on more than 10 years of experience. Majority of respondents (39.2%) had 20–24 years of experience, followed by period of 10–14 years (24.2%). Approximately one-sixth of respondents (16.3%) drew on work experience ranging from 15–19 years and an equal percentage (16.3%) had experience of more than 25 years. The percentage of respondents with 5–10 years of experience was the lowest (3.9%).

5.2 Quality Failure Consequences

The third question was directed toward capturing the frequency of occurring problems as consequences of quality failures. A five-point Likert scale (1=never, 2=rarely, 3=sometimes, 4=often, 5=always) was provided for the respondents to record their answers. The displayed results in Table 2 show that cost overrun is the most frequent consequence of quality failure (RII= 0.76), where 38.6% of respondents admitted that their organization often faced this problem. A slightly lower percentage (37.3%) indicated that cost overrun occasionally occurred. The rest of the respondents revealed different situations, where 21.6% always faced cost overrun and only 2.6% rarely experienced it. A very significant difference in the statistical hypothesis was recorded at $<P$ 0.01 between the observed and expected distribution of frequencies, which proved the random assumption. The second consequence, "delay on time," was ranked second with RII of 0.73. Over half of participants (54.9%) often experienced this problem and a lower percentage (39.9%) denoted that they occasionally experienced delay. Meanwhile, seven respondents (4.6%) stated that they always experienced delay; with only one respondent (0.7%) claiming that delay rarely occurred. The statistical hypothesis result indicated a highly significant difference at $P<0.01$ between observed and expected frequency distribution according to the randomness status of outcome assumption.

"Non-conformance to requirements" obtained third ranking with RII of 0.64, as shown in Table 2. More than half of respondents (54.9%) indicated that they occasionally faced this problem, while almost a quarter (24.8%) confessed that they often dealt with it. Among the remaining respondents, several (13.1%) acknowledged that they always suffered the problem while others (7.2%) rarely faced it. Table 2 shows a highly significant difference at $P<0.01$ between observed and expected frequency distribution according to the randomness status of outcome assumption.

6. DISCUSSION OF FINDINGS

The implication of COC cannot be realized without reporting and establishing all the true quality costs. To track and report quality costs effectively, establishing a quality cost system is necessary. Such a system highlights the outputs of the improvement process and channels the attention of management to areas where quality costs are incurred so that remedial actions may be taken. However, it is well known that better management of quality ultimately leads to successful project. Companies tend to be more confident in areas where it is best to spend money. For this reason, management needs a valid cost base to compare the expected benefits from improving the process and provides reliable assessment of how COC contributes to overall management success.

The respondents all admitted facing consequences such as cost overrun, time delay, and non-conformance to requirements. These results are not surprising, since local companies are prone to ignore the importance of testing and inspection, or other relevant processes in achieving the quality standard requirement (Abdul-Rahman, 1993). Quality failure results in excessive testing, rework, and maintenance (Lai, 1997). Consequently, this will delay the completion date, decrease productivity, and thus increase cost.

The results are supported by Love and Li (2000a), who stated that quality failure has become an inevitable feature of the procurement process in construction. Similarly, Alwi *et al.* (2001) stated that quality management principles are not strongly embedded in conventional construction management practices. For this reason, rework in many cases is accepted as an inevitable feature of the construction process, increasing the likelihood of project time and cost overruns, and ultimately leading to client dissatisfaction.

It has been noted that construction companies' records show a limited amount of rework (failure) and less than the failure actually incurred (Barber *et al.*, 2000). Therefore, the potential of quality failure costs may be – and probably are – considerably higher than indicated (Abdul-Rahman *et al.*, 1996). In this sense, Willis and Willis (Willis and Willis, 1996) noticed many incalculable costs of construction where costs are incurred by failure other than the actual rework. These include waiting time for decisions on remedial engineering, negative attitudes imparted to craft workers such as the feeling that they cannot produce quality work, and a general dread that problems are bound to occur.

The results of this study resonated with the findings of the study of Love (2002), who found that the mean schedule and cost growth for 161 Australian building construction projects sampled were 20.7% and 12.6%, respectively. However, in the construction phase, the consequences occasionally appear unrelated to poor quality due to the time lag before the reasons are ultimately identified (Rounce, 1998). This is due to fact that certain defects are evident, while others appear after years after the building completion. However, not all time and cost overruns are due to quality failure.

7. CONCLUSIONS OF MAIN FINDINGS

The implication of COQ cannot be realized without reporting and establishing all the true quality costs. Therefore, establishing quality cost is very important; however, it faces many barriers. Barriers to the implementation of a quality cost system are divided into three categories, namely, culture and knowledge, system, and company. The most significant barrier was related to culture and knowledge.

Most building companies cope with the consequences of quality failure, such as cost overrun, time delay, and non-conformance to requirement. These consequences require extra time and cost to be rectified. Typically, quality failure is caused by inadequate cost of control activities.

The finding of this research should help managers to allocate scarce resources better to improve quality. However, the current study has several limitations that offer an agenda for future research. One of these limitations is that the research context was limited to building construction projects in Kuala Lumpur; generalizations beyond this population cannot be made. It is plausible that there may be significant differences in the findings if data were collected from different geographical regions.

For further studies, it would have been interesting to take into account the effect of tracking and recording the failure cost on the performance of the construction projects. An evaluating and reporting quality failure cost is perceived as a useful indicator of project performance and provides opportunities for quality improvements and cost reduction.

8. REFERENCES

1. ABDUL-RAHMAN, H. (1993) the management and cost of quality for Civil Engineering projects. Manchester, UK, University of Manchester Institute of Science and Technology (UMIST).
2. ABDUL-RAHMAN, H. (1995) the cost of non-conformance during a highway project: A case study. *Construction Management and Economics* 13**,** 23-32.
3. ABDUL-RAHMAN, H., THOMPSON, P. A. & WHYTE, I. L. (1996) Capturing the cost of non-conformance on construction sites: An application of the quality cost matrix. *International Journal of Quality & Reliability Management,* 13**,** 48-60.
4. ADAMS, K. & BRACE, I. (2006) *An introduction to market & social research: planning & using research tools & techniques* London, United Kingdom Kogan Page Ltd.
5. ADER, H. J., MELLENBERGH, G. J. & HAND, D. J. (2008) *Advising on research methods: A consultant's companion,* Huizen, The Netherlands, Johannes van Kessel Publishing.
6. AKINTOYE, A. (2000) Analysis of factors influencing project cost estimating practice. *Construction Management and Economics,* 18**,** 77-89.
7. AKKOYUN, O. & ANKARA, H. (2009) Cost of quality management: An empirical study from Turkish marble industry. *Scientific Research and Essay* 4**,** 1275-1285.
8. ALWI, S. & HAMPSON, K. (2003) Identifying the important causes of delays in building construction projects. *The 9th East Asia-Pacific Conference on Structural Engineering and Construction* Bali, Indonesia.
9. ALWI, S., KEITH, H. & SHERIF, M. (2001) Effect of qualith supervision on rework in the Indonesian context. *Asia Pacific Building and Construction Management Journal,* 6**,** 2-6.
10. ARVAIOVA, M., ASPINWALL, E. M. & WALKER, D. S. (2009) An initial survey on the use of costs of quality programmes in telecommunications. *Total Quality Management* 21**,** 59-71.
11. ASSAF, S. A. & AL-HEJJI, S. (2006) Causes of delay in large construction projects. *International Journal of Project Management,* 24**,** 349-357.
12. BANKS, J. (1992) *The Essence of Total Quality Management,* New York, Prentice Hall.
13. BARBER, P., GRAVES, A., HALL, M., SHEATH, D. & TOMKINS, C. (2000) Quality failure costs in civil engineering projects. *International Journal of Quality and Reliability Management,* 17**,** 479-492.
14. BRACE, I. (2008) *Questionnaire design: how to plan, structure and write survey material for effective market research,* London, Kogan Page.

15. BURATI, J. L., FARRINGTON, J. J. & LEDBETTER, W. B. (1992) Causes of quality deviations in design and construction. *Journal of. Construction Engineering and Management* 118**,** 34-49.
16. CAVANA, R. Y., DELAHAYE, B. L. & SEKARAN, U. (2001) *Applied business research: qualitative and quantitative methods,* Australia, John Wiley & Sons Australia, Ltd.
17. CHAN, D. W. & KUMARASWAMY, M. M. (1997) A comparative study of causes of time overruns in Hong Kong construction projects. *International Journal of Project Management,* 15**,** 55-63.
18. CHAUVEL, A. M. & ANDRE, Y. A. (1985) Quality Costs: Better Prevent than Cure. Quality Costs: Ideals and Applications. *ASQC, American Society for Quality Control,,* 2**,** 292-298.
19. CZAJA, R. & BLAIR, J. (2005) *Designing surveys: a guide to decisions and procedures,* United States of America, Sage Publications, Inc. .
20. DIALLO, A. & THUILLIER, D. (2004) The success dimensions of international development projects: the perceptions of African project coordinators. *International Journal of Project Management,* 22**,** 19-31.
21. DULAIMI, M. F., LING., F. Y. Y. & BAJRACHARYA, A. (2003) Organisational motivation and inter-organisational interaction in construction innovation in Singapore. *Construction Management and Economics,* 21**,** 307-318.
22. FRAENKEL, J. R. & WALLEN, N. E. (2006) *How to design and evaluate research in education. ,* New York. McGraw-Hill.
23. JOSEPHSON, P.-E. & HAMMARLUND, Y. (1999) The causes and costs of defects in construction: a study of seven building projects. *Automation in Construction,* 8**,** 681-687.
24. JURAN, J. M. (1951) *Quality Control Handbook,* New York, McGraw-Hill.
25. JURAN, J. O. M. & GODFREY, A. B. (2000) *Juran's Quality Handbook,* International editions, McGraw-Hill.
26. KAZAZA, A. & BIRGONUL, M. T. (2005) The evidence of poor qualityin high rise and medium rise housing units: a case studyof mass housing projects in Turkey. *Building and Environment* 40**,** 1548-1556.
27. KOMETA, S. T., OLOMOLAIYE, P. O. & HARRIS, F. C. (1994) Attributes of UK construction clients influencing project consultants' performance. *Construction Management and Economics,* 12**,** 433-443.
28. LAI, L. S. L. (1997) A synergistic approach to project management in information systems development. *International Journal of Project Management,* 15**,** 173-179.
29. LOVE, E. D. P. & LI, H. (2000a) Overcoming the problems associated with quality certification. *Construction Management and Economics,* 18**,** 139-149.
30. LOVE, P. E. D. (2002) Influence of project type and procurement method on rework costs in building construction projects. *ASCE Journal of Construction Engineering and Management,* 128**,** 18-29.
31. LOVE, P. E. D. & SOHAL, A. S. (2003) Capturing rework costs in projects. *Managerial Auditing Journal,* 18**,** 329-339.
32. OMACHONU, V. K., SUTHUMMANON, S. & EINSPRUCH, N. G. (2004) The relationship between quality and quality cost for a manufacturing company. *International Journal of Quality & Reliability Management,* 21**,** 277-290.
33. ROUNCE, G. (1998) Quality, waste and cost considerations in architectural building design management. *International Journal of Project Management,* 16**,** 123-127.
34. SELLES, M. E. S., RUBIO, J. A. C. & MULLOR, J. R. (2008) Development of a quantification proposal for hidden quality costs: applied to the construction sector. *Journal of Construction Engineering & Management,* 134**,** 749-757.
35. SOUSA, S. D., ASPINWALL, E. M., SAMPAIO, P. A. & RODRIGUES, A. G. (2005) Performance measures and quality tools in Portuguese small and medium enterprises: survey results. *Total Quality Management,* 16**,** 277-307.

36. SOWER, V. E. & QUARLES, R. (2003) Cost of quality: why more organizations do not use it effectively. *Quality Congress. ASQ's Annual Proceedings.*
37. UYAR, A. (2008) An exploratory study on quality costs in Turkish manufacturing companies. *International Journal of Quality & Reliability Management,* 25**,** 604-620.
38. VARILA, M., SUOMALA, P. & JOKIOINEN, I. (2007) New boost to quality costing: from ex post failure appraisal to proactive product and process improvement. *8th Manufacturing Accounting Research Conference.* Trento, Italy.
39. VAUS, D. A. D. (2002) *Surveys in Social Research* Australia, Allen & Unwim.
40. VAXEVANIDIS, N. M., PETROPOULOS, G., AVAKUMOVIC, J. & MOURLAS, A. (2009) Cost of quality models and their iImplementation in manufacturing firms. *International Journal for Quality research,* 3**,** 27-36.
41. WEHEBA, G. S. & ELSHENNAWY, A. K. (2004) A revised model for the cost of quality. *International Journal of Quality & Reliability Management,* 21**,** 291-308.
42. WILLIS, T. H. & WILLIS, W. D. (1996) A quality performance management system for industrial construction engineering projects. *International Journal of Quality and Reliability Management,* 13**,** 38-48.

Table 1: Descriptive Statistics of Some General Respondent Demographic (GRD)

GRD	Groups	Frequency	Percent	Cumulative Percent
Educational	Diploma	0	0	0
	Bachelor	138	90.2	90.2
	Master	13	8.5	98.7
	PhD	2	1.3	100
Age	20-29 yrs	12	7.8	7.8
	30-39 yrs	59	38.6	46.4
	40-49 yrs	62	40.5	86.9
	50-59 yrs	10	6.5	93.5
	60 + yrs	10	6.5	100
Occupation	Quantity Survey	5	3.3	3.3
	Project(construction) Engineer	5	3.3	6.5
	Quality Assurance/Quality Control	7	4.6	11.1
	Resident/ site Engineer	41	26.8	37.9
	Manager	85	55.6	93.5
	Director	10	6.5	100
Experience	5 - 9 yrs	6	3.9	3.9
	10 - 14 yrs	37	24.2	28.1
	15 - 19 yrs	25	16.3	44.4
	20 - 24 yrs	60	39.2	83.7
	25 + yrs	25	16.3	100

Table 2: Quality Failure Consequences

Questions	choices	Frequency	Percent	Cumulative Percent	RII	Ranking	C.S. P-value
Cost overrun	never	0	0	0	0.76	1	χ^2 =51.8 P=0.000
	rarely	4	2.6	2.6			
	sometimes	57	37.3	39.9			
	Often	59	38.6	78.4			
	always	33	21.6	100			
Delay on time	Never	0	0	0	0.73	2	χ^2 =130.1 P=0.000
	Rarely	1	0.7	0.7			
	sometimes	61	39.9	40.5			
	Often	84	54.9	95.4			
	always	7	4.6	100			
Non-Conformance to requirements	Never	0	0	0	0.69	3	χ^2 =82.8 P=0.000
	Rarely	11	7.2	7.2			
	sometimes	84	54.9	62.1			
	Often	38	24.8	86.9			
	always	20	13.1	100			

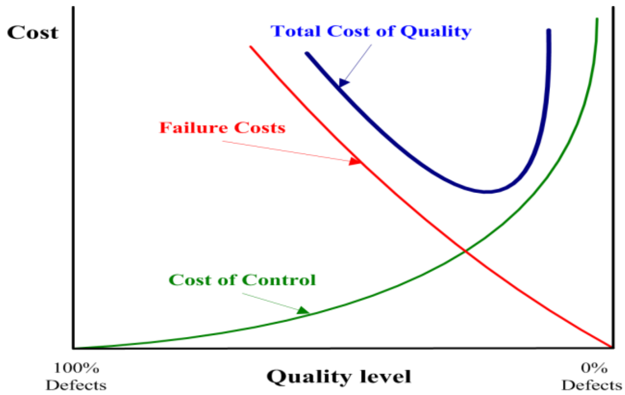

Figure 1: Juran’s Model for Optimun Quality Costs (Juran, 1951)

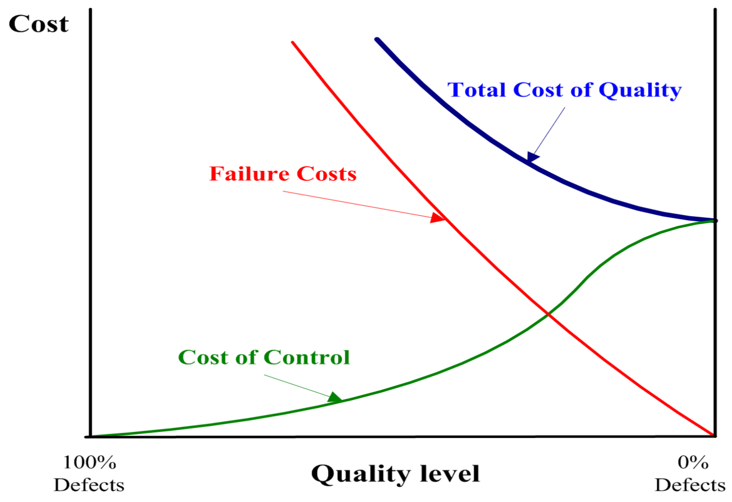

Figure 2: Schneiderman's Model for Zero Defects (Schneiderman, 1986)

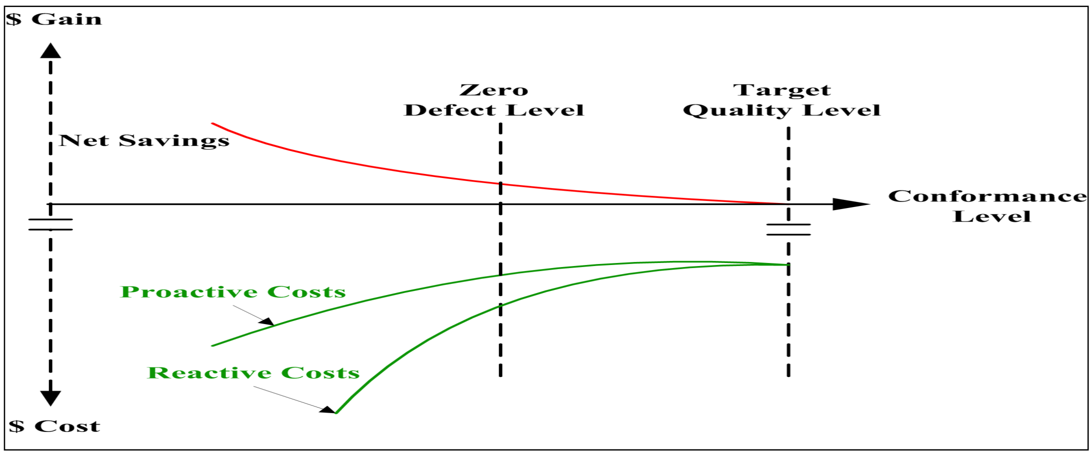

Figure 3: Conceptual Model of Quality Costs (Weheba & Elshennawy, 2004)

الخلاصة:

أصبحت مسألة فشل وانهيار البناء مصدر اهتمام في مشاريع الابنية حيث ان عدد هذه الحوادث أصبح مقلق جدا. لذا تهدف هذه الدراسة إلى التحقق من وجهة نظر المقاولون حول تبعات فقر الجودة في مشاريع الابنية من حيث عدم المطابقة للمتطلبات، تجاوز التكاليف، والتأخير. تم اعتماد أسلوب كمي لجمع البيانات من مقاولي البناء داخل كوالالمبور باستخدام الاستبانة. وأشارت الدراسة إلى أن زيادة التكلفة هي من أكثر التبعات تكرارا نتيجة فشل جودة. ان نتائج هذه الدراسة توفر تبريرا ماليا لجميع جهود تحسين الجودة.