

Software Quality and The Success of Small and Medium Enterprises: The Management Perspective

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Abstract: The enterprises today including Small and Medium Size Enterprises (SMEs) are critically dependent on software to accomplish their objectives and maintain survivability and sustainability in their businesses. Although, studies on software quality assessments and models have been developed but for SMEs management perspective of quality is still lack and there is no specific attributes associated with management perspective of software quality available in literature. Previous studies have revealed the importance of software quality from management of SMEs view and to know the relationships between software quality and the success of SMEs. The objectives of this study are to determine the quality factors from management's perspective and to determine the relationship between the quality and the impacts of the productivity of SMEs. It is implemented through a survey conducted in Malaysia which involves forty three respondents who are among the managers and management of SME companies. The survey indicates that efficiency, expandability, functionality, reusability, safety and usability are the most influential quality factors for the management of the SMEs. The research hypotheses defined in this study are accepted with strong relationships between the defined variables. It shows that the higher level of SME productivity is linked to the higher level of software quality assessment and factors.

Key words: Software quality, Small and Medium Enterprise (SME), management perspective, empirical study, relationships, sustainability

INTRODUCTION

The world today is progressing at a rapid pace in every aspects of our life and the only factor that is regarded as constant is change. The fundamental reason behind this rapid progress is technological development and advancement. No matter which type of organisation, it is indispensable for them to embrace the latest technology. Small and Medium Enterprises (SMEs) are organisations whose number of employees falls below certain limits. In the US and Europe, the number of employees can be as high as 1500, although, the cap that it has is of 500 employees.

Today, only those organisations either Small and Medium Enterprises (SMEs) or Multinational Corporation (MNCs) can survive that are tech-savvy and adopt strategies to utilize technology. In this trend of technology usage, organisations not rely on software and technological tools but also spend an enormous amount

on the maintenance and quality of these tools and software products. All these strenuous effort are made by the SMEs to maximize the productivity and to achieve efficiency in every operation that they perform with the aid software and technological tools. The focus of this study revolves around the same issues. This research aims to discover the role of software quality assessment on success and failure of SMEs. In particular this research takes into consideration impact of software quality assessment on success and failure of SMEs.

Literature review

Background: In the early 70's, the success or failure of SMEs is a paramount importance for the nation's economies, particularly as the activities of many SMEs, led to failure of these organisations (Stewardson and Coleman, 2003). One of the reasons that associated with the failure of SMEs was found to be coincided with the usage of information technology (Brynjolfsson, 1993).

However, in recent years, success of new SMEs has rebounded to some extent, especially in the field of manufacturing but the overall negative correlation that exists between economic success and the advent of computers is behind most of the arguments. They claim that IT has not aided to gain SMEs success or even some researches recount that investments in the field of IT have been very counterproductive (Brynjolfsson, 1993).

Cron and Sobol (1983) conducted a study to investigate the impact of IT among SMEs and revealed that on an average, the impact of IT success of SMEs was not significant but it appeared to be linked with both the low and high performers (Cron and Sobol, 1983). The findings of their study established the basis to put forwarded the hypothesis that IT (including all aspects of IT such as software, hardware, technological tools and networks) tends to reinforce management approaches which helps the success of those SMEs that are well organised. However, those managers who are confused and are not successful in structuring the production operation in the first place may fail. Hamdan *et al.* explored and discovered several factors that influence the used of IT by the SMEs. The main factors discovered by this study were: increase in sales and productivity, improve internal efficiency, enrich company's image or opportunities and quality and some other less important factors.

A study conducted by Strassman (2009) indicated that there was no relationship between updated software usage, profits and productivity of SMEs. On the other hand, the study by Panko showed that SMEs that employed the latest technology with updated software and maintained the performance and quality were successful. To address the issue of software quality, software quality model is required.

Software quality from technical and user's perspective:

Several software quality models are available in literature but with different approaches and practicality. Examples of these models are McCall, Boehm Model, FURPS, ISO 9126, Dromey (1999) and PQF Model (Yahaya and Deraman, 2010). The mentioned quality models are basically based on technical perspective or sometimes are referred to as behavioural perspectives of the software. It measures how the software behaves in the environment. Figure 1 presents previous quality models from technical perspectives and their associated attributes. The most current model (PQF Model) is the only model that integrates the user's perspective in the quality model but with limited scope and focus (Yahaya and Deraman, 2010).

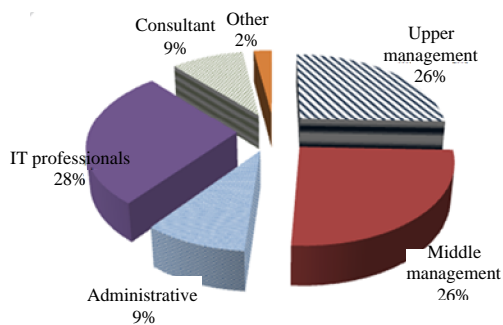


Fig. 1: Distribution of respondent's position

The other views of software quality are through user's perspective approach and process engineering. Yahaya *et al.* (2014) proposed a software quality model based on user's perspective approach (Yahaya *et al.*, 2014). This research classified the users into four main categories: experts, public, management and technical and for each category, the associated and relevant quality attributes were identified. For example, in management category, the relevant attributes are decision efficiency, communication effectiveness and confidence level. This work is still on-going research progress. While Rossi (2014) presented his research related to the aspect of software product quality in association with process engineering.

In this study, factors of software quality that affects productivity in SMEs are identified. The rationale is that managers as the main decision makers can have a great impact on software quality assessment practices and principles. Furthermore, literature shows lack of research on management perspective of software quality.

Small Medium Enterprises (SMEs): In general SMEs contributes to more than 95% of economy progress in many countries such as Hong Kong, Japan, Malaysia, Philippines, Korea, Singapore, Taiwan and others (Mohd, 2011). Definitions of SME differ from one country to another. Some countries define SMEs by certain number of employees within the organisation. On the other hand, there are multinational corporations which are the organisations that conduct their operations in more than one country or registered in more than one country (Prashantham, 2007).

Since, the advent of Information Technology (IT) in the year of 80's and after more than 30 years, IT has sparked a phenomenon that is very impressive. With the advent of information technology, many large organizations and SMEs have realized the importance of IT in the business and various other activities. IT

will not only facilitate the work but also to increase productivity, competitive advantage, improve management performance, thus, saving operating costs and add value to a product or service in the business market either locally or internationally. No wonder, then SMEs are the lifeblood of the economy, representing over 90% of businesses and employ 65% of the total workforce in Malaysia. This market segment contributed 37% to the Gross Domestic Product (GDP) by the end of 2010; this makes it so great to economic growth.

SMEs play the important role in developing the world economy. Nowadays, software industry is recognised as an important economic activity, emerging, growing and getting strong day by day. This industry is considered as a chief economic force throughout many countries globally. The software industry in many countries has an industrial setting, made up largely of SMEs software enterprises (Pino *et al.*, 2008) favouring the development of national economies. Referring to document produced by National Credit Regulator (NCR), it is estimated that SMEs employ 22% of the adult population in developing countries. United Nations Industrial Development Organisation (UNIDO) estimates that SMEs represent over 90% of private business and contribute to more than 50% of employment and of gross domestic products in the most African countries (Mahembe, 2011).

Despite the significant importance and contribution of SME to economic growth, SMEs across the whole world are facing numerous challenges such as lack of adequate training and education, high rates of business failures and poor management skills (Mahembe, 2011).

MATERIALS AND METHODS

This study employs a quantitative approach using 50-items questionnaire. The rationale for the selection of

quantitative approach is that the study aims to test hypothesis with quite large population and accordingly the research results would be generalize. This study adopts a random sampling technique where companies were selected randomly from the list of SMEs in Malaysia. Then the survey questionnaires were sent to those companies members.

The objective of the research study was to determine the current practices of software product acquisition in SMEs while determining the need of software quality assessment in SME based on manager’s perceptions. The questionnaire is composed of five main sections, namely the respondent background, organization background, SME quality control, human resource development and training and SME productivity. Table 1 shows the design and items in the questionnaire.

To address the validity of the instrument, first, the content validity and face validity of the questionnaire were evaluated by two experts. Then a pilot study was conducted to determine the reliability of the questionnaire using Cronbach alpha. The questionnaires were distributed among 10 SME managers with the same characteristics as the real study respondents. Cronbach alpha is a common measure of internal consistency, i.e., reliability. In Cronbach alpha, the internal consistency is measured through α . If $\alpha > 0.9$, it reflects that the internal consistency is excellent; whereas $0.6 \leq \alpha < 0.7$ indicates the consistency to be acceptable. In the case of $\alpha < 0.5$, the internal consistency is considered to be unacceptable. The researcher used this approach to determine the reliability of the questionnaire. This allowed the researcher to understand whether the questionnaire can be used for this study or not. It is shown that, the internal consistency was between ($0.7 = \alpha < 0.9$) which reflected that the reliability was good. The pilot study results showed that the instrument has acceptable level of reliability. The results are shown in Table 2 and 3.

Table 1: Software quality attributes in previous models (Yahaya *et al.*, 2011)

Quality characteristics	McCall in 1976	Boehm in 1978	FURPS in 1987	ISO 9126 in 1991	Dromey in 1996	Systemic in 2003	PQF in 2007
Testability	x	x					
Correctness		x					
Efficiency	x	x	x	x	x	x	x
Understand ability		x			x		
Reliability	x	x	x	x	x	x	x
Flexibility	x						
Functionality			x	x	x	x	x
Human engineering		x					
Integrity	x						x
Interoperability	x						
Process Maturity					x		
Maintainability	x						
Changeability		x					
Portability	x	x		x	x	x	x
Peusability		x				x	
Usability			x	x		x	x
Performance		x		x			
User Conformity							x

Table 2: Research questionnaire design

Main sections	Sub-sections	No. of items
Respondent background		5
Organisation background		3
SME quality control	Software acquisition	5
	Quality factors	1
	Software quality assurance	13
	Software acquisition policy	5
	Importance of quality issues	9
Human resource development		7
Training and SME productivity		2

Table 3: Pilot study results on reliability

Constructs	Cronbach alpha result
SME quality control	0.78
Software quality and SME productivity	0.82
Human resource development	0.85

The empirical study: The empirical study was conducted involving SMEs in Kuala Lumpur, the capital city of Malaysia. The sampling technique used was random sampling technique. In this technique each company and each respondent selected randomly which meant that the selection was entirely by chance. Considering the nature of this research, the researcher selected IT companies for reliable and consistent results. Therefore, the companies selected included government agencies, semi-government agencies and private companies. The questionnaires were distributed to 43 SMEs managers and all of them returned back their forms. The data collected was analysed using both descriptive and inferential analysis using SPSS 20. Descriptive statistic includes frequency, percentage, mean and standard deviation while inferential statistics includes Pearson coefficient and multiple regressions.

RESULTS AND DISCUSSION

Analysis and findings: The respondents were asked questions related to their demographic backgrounds. Among the respondents more than half of them are male (69.8%) and 30.2% are female. Most of the respondents in this study are software engineer and IT professionals (27.9%), upper management (25.6%) and middle management (25.6%), administrative staff (9.3%), support staff and consultant (9.3%) and others (2.3%). This is shown in Fig. 2.

Most of the respondents in this survey involves in software development (39.5%) while 20.9% involve in standardization and quality process, 20.9% involves in strategic direction of the company and 2.3% involves in authorizing purchase of product, services and selecting providers. These are shown in Table 4.

When the respondents were acquired about the importance of price during software selection, it indicated that 51% of the respondents considered price essentially or very important. In addition 28% indicated that price to

Table 4: Respondent's Involvement in Organisation

Involvement in organisations	Frequency (%)
Software development	17 (39.5)
Standardization and quality process	9 (20.9)
Strategic recommendation	9 (20.9)
Setting development budget	4 (9.3)
Authorizing purchase of product or services	1 (2.3)
Selecting providers	1 (2.3)
Others	1 (2.3)
Missing	1 (2.3)
Total	43 (100)

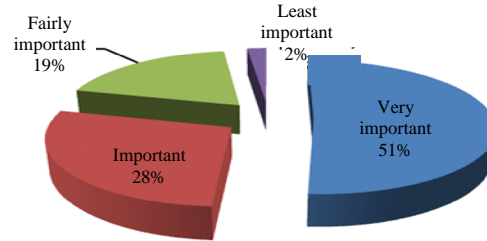


Fig. 2: The significant of price in software selection

be important element during software selection. On the contrary, 19% indicated that was fairly important for their organisations in software selection criteria and only 2% revealed that price were least important criteria during selection. Considering the statistics, it can be concluded that price plays an influential role in software selection process and criteria (Fig. 3). When the respondents were asked about the satisfaction of operational software based on its quality, it indicated that majority of the respondents (68%) were satisfied while the remainders remained neutral.

Descriptive analysis of software quality attributes:

During literature study, sixteen software quality factors or attributes were identified which were efficiency, expandability, flexibility, functionality, integrity, interoperability, intra-operability, maintainability, portability, reusability, reliability, safety, survivability, testability, usability and verifiability (Dromey, 1996; Yahaya and Deraman, 2010). In this study, respondents were requested to examine and assess the importance of these attributes from their perspectives. In this questionnaire instrument, respondents were asked to indicate the importance of these attributes in Likert scales of 1(not important) to 5 (very important). The analysis shown that the following six attributes: efficiency, expandability, functionality, reusability, safety and usability have been seen as important attributes to determine and measure software quality from management's perspective. This finding is shown in Table 5.

It should be mentioned that the attributes with the mean values of 4.25 and above were identified and

Table 5: Software quality attributes: the mean scores

Software quality attributes	Mean of all
Efficiency	4.318
Expandability	4.295
Flexibility	4.136
Functionality	4.295
Integrity	4.000
Interoperability	3.954
Maintainability	4.045
Portability	3.795
Reusability	4.295
Reliability	4.136
Safety	4.295
Survivability	4.090
Testability	4.136
Usability	4.272
Verifiability	3.976

Table 6: Correlation matrix of the research variables

Correlation matrix	1	2	3	4
(1) Software quality	1			
(2) SME quality control	0.795**	1		
(3) Human resource development and training	0.503**	0.589**	1	
(4) SMEs Productivity	0.501**	0.503**	0.589**	1

*Significant values

selected as important and influential attributes in this study. The attributes with mean of 4.25 out of 5 Likert scale obtain at least 85% in percentile rank and measure. It is computed as the following:

$$4.25/5 * 100 = 85\% \tag{1}$$

Therefore, the attributes with scores ≥ 4.25 are included in the model, constructed by our research group.

Inferential statistics and analysis: Appropriate statistical tests are applied to examine the relationships among the variables based on research objectives and hypothesis. Three hypotheses (H_1 - H_3) have been defined and tested:

- H_1 : there is a statistical positive relationship between SME quality control and software quality

The first hypothesis focuses upon the identification of relationship between SME quality control and software quality. The Pearson correlation method is applied to address the relationship between the level of SME quality control and software quality. The results of Pearson correlation test presented in Table 6. There is a statistically positive with strong magnitude significant relationship between the level of SME quality control and software quality, ($r = 0.795, p < 0.01$). The analysis reveals that the higher level of SME quality control is linked to the higher level of software quality and vice versa. It means that with any increase in SME quality control, the

software quality will increase too. Consequently, we can conclude with 99% confidence, the research hypothesis is approved:

- H_2 : there is a statistical positive relationship between human resource development and training and software quality

The Pearson correlation technique is used to test the relationship between the human resource development and training and software quality. Similarly, the results are presented in Table 6 and there is a statistically positive with strong magnitude significant correlation between human resource development and training and software quality, ($r = 0.503, p < 0.01$). The analysis indicates that the higher level of human resource development and training is linked to the higher level of software quality and vice versa. In other words with any increase in human resource development and training in the software quality will increase too. Therefore, we can conclude with 99% confidence, the research hypothesis is approved:

- H_3 : there is a statistical positive relationship between software quality and SME's productivity

The third research hypothesis is regarding the relationship between SME's productivity and software quality. To test the relationship between the level of SME's profitability and software quality, Pearson statistical test is applied and the result is presented in Table 6 which also indicates that there is statistically positive with strong magnitude significant correlation between the SMEs productivity and software quality, ($r = 0.501, p < 0.01$). It shows that the profitability of SMEs is linked to the higher level of software quality and vice versa. In other words, the increase in software quality will result in increased profitability of the SME. Consequently, the research hypothesis is approved with 99% confidence.

One of the important software quality factors selected by the management is efficiency which is associated with the extent to which the software is able to do more with less system resources. This study found that efficiency is an important factor affecting the software from management perspective and it is consistent with past studies by Yahaya *et al.* (2006), Yahaya and Deraman (2010). Expandability is concerned with the ease of adapting software products to the changes of specification. Here, the management has chosen this factor as important to software quality assessment.

Functionality is associated with the extent of possibilities and services provided by software. It is another factor selected as important quality attribute by

the management of SMEs. Reusability, associated to the ability of software element to serve for the construction of many different applications, is another factor selected by the management as important to software quality assessment.

Software safety optimizes system safety in terms of the design, development, application and maintenance of the software system. It is another factor highlighted as important in this study. Usability, related to the ease with which people of various backgrounds and qualifications can learn to use software products and apply them to solve their problems is another factor selected by the management.

To sum up, software quality factors including efficiency, expandability, functionality, reusability, safety and usability have significant impact on the quality assessment as shown by the empirical finding discussed in this study. Some of these attributes are consistent with previous study such as efficiency, functionality, safety (or integrity) and usability (Yahaya *et al.*, 2006).

Based on the results presented in Table 6, there is a statistically positive with strong magnitude significant relationship between the level of SME quality control and human resource training and software quality. The results of the analysis reveals that the higher level of SME quality control and human resource training is linked to the higher level of software quality and vice versa. It means that with any increase in SME quality control and human resource development and training, the software quality will increase too. The result of test also reveals that there is a statistically positive with strong magnitude significant correlation between software quality and SMEs productivity. This shows that, any increase in software quality, the productivity will increase as well. Hence, as there is a direct, positive relationship between software quality and SME productivity, the productivity of the SMEs are increased.

CONCLUSION

This study has presented the descriptive analysis on software quality attributes from management's perspective. Total of forty three respondents participated in this empirical study which included participants from the management level. It is related to the view in regards of relationships between software quality and SMEs productivity. The analysis have revealed that the most important and influential attributes are efficiency, expandability, functionality, reusability, safety and usability. This study also investigates the relationship between research variables and hypotheses. The research hypotheses were accepted because of the stronger

relationship between the delineated variables. The results reveal that the higher level of SME productivity is linked to the higher level of software quality and vice versa. To recap, analysis showed that factors of SME quality control (human resource development, software acquisition and software quality assurance) and software quality factors including efficiency, expandability, functionality, reusability, safety and usability have significant impact on the quality assessment. Since there is a positive and direct relationship between software quality assessment and SME productivity, increase in the value of the above mentioned factors will result in the improvement of SME's productivity.

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