Investigating the Role of Knowledge gap in enhancing Software Quality

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Software quality has always been described as a poorly developed construct. Several reports and much evidence show clear problems related to software quality outputs. Therefore, software quality problems constitute the phenomenon investigated in this research question: Why does quality management not achieve its anticipated outcomes in the software industry?

This research empirically tests if a possible existence of knowledge management gaps can be a reason behind a possible existence of quality performance gaps. Therefore, this research identifies if these possible gaps may exist in the Egyptian software industry. In addition, this research aims to test the impact of these possible knowledge gaps (if found) on the quality performance gaps (if found).

The main findings include that significant knowledge gaps and quality performance gaps exist in the Egyptian software industry. Additionally, Statistical correlation is statistically significant between these two gaps. Therefore, it came to fore the importance of knowledge management activities and their impact on achieving desired quality outcomes.

Keywords: Knowledge management activities; knowledge gap; Software; quality performance

Introduction

The growing publicity about the failure of many software quality management programs to reduce the level of defective products, for example, the recent Toyota ‘quality crisis’ due to a software glitch has prompted interest in this research (Automotive News, 2010, Canning 2010; Kanter, Maynard & Tabuchi 2010; Willacy, 2010). Furthermore, the growing awareness of links between knowledge and quality in the business literature over the last decade
has deepened interest in the topic of this study (Lyons, Acsente & Waesberghe 2008; Rangachari 2008a; Rangachari 2008b; Wang & Wang 2009, Yang J., 2008). On one hand, it is widely accepted that the underlying theories of quality are fundamental and essential for effective management and competitive survival of organizations (Nair 2006). On the other hand, Knowledge Management has been considered a fundamental component for the delivery of quality (Stewart & Waddell 2008).

This research identifies and empirically analyses the impact of Knowledge Gaps on quality management in software firms. While software quality has always been described as a poorly developed construct (Andrews 1988; Schmitt 1991) with significant evidence of disasters resulting from poor software quality (Kaiser 1996; McDonald 2010; Nuseibeh 1997; Schmitt, 1991), the literature evidences a lack of studies to identify possible reasons (gaps) in getting desired quality performance in software firms. Additionally, although the failure or success of quality performance in software product development process may be related to the omission of Knowledge Management, no studies were found that examine links between Knowledge Gaps and Quality Performance in software development firms. This research plans to fill this void in the literature, presenting a deeper analytical research by investigating the question: why doesn’t quality management in software firms achieve its anticipated outcomes? Research will identify whether critical gaps exist while implementing Knowledge Management activities, and if the existence of these possible knowledge gaps affect quality performance in software firms.

Quality and software, the role of knowledge management

It has always been argued that software quality is often seen as an ‘elusive and mysterious subject’ (Kenett and Baker 1999, p.13). Kenett and Baker (1999, p.13) add that ‘it is perhaps the most ignored topic in the world of software development’. Hong and Goh (2003, p. 364) confirm this by stating, ‘Of all the mysteries of producing software, none are more obscure than those relating to quality’. A report prepared for the American National Institute of Standards and Technologies states that the annual cost of software defects in the United States is US$59.9 billion (Hallem, Park & Engler 2003, p. 66). This report coupled with the previous views exposes the fact that defective software can have effects ranging from customer dissatisfaction to jeopardizing public safety (Parzinger & Nath 1998, p. 239).
Many researchers use a range of examples that clearly show the impact of defective software product (Kaiser 1996; Nuseibeh 1997; Schmitt, 1991). This accumulated evidence of software problems has resulted in an increasing need for managing software quality. Different scenarios and approaches through which this required quality might be achieved have been proposed (Antony & Fergusson 2004; Bamford & Deibler 2004; Bellini & Storto 2006; Galin & Avrahami 2006; Jovanovic & Shoemaker 1997; MacMillan 2000).

Some researchers offer a quality system depending on ideas of quality assurance (Rai, Song & Troutt 1998). Others believe in statistical process control (Lewis, 1999). From another point of view, Total Quality Management (TQM) has been adopted by several as a comprehensive way of dealing with quality problems in software firms (Issac, Rajendran & Anantharaman 2004a; Norman 1998; Noushin 1998; Parzinger & Nath 2000; Rahman & Siddiqui 2006).

Since ISO 9000 is widely accepted as a source for reviewing and defining quality management systems, many argue that it is appropriate for use in software projects (Fuller & Ilan 2006; Yang 2001). The Capability Maturity Model (CMM) was developed to be a framework widely used for quality management in the software industry; CMM developed later into Capability Maturity Model Integration (CMMI) (www.sea.cmu.edu, 2007). More recently, many have proposed Six Sigma as an effective methodology for applying quality in the field of software industry (Antony & Fergusson 2004; Biehl 2004; Carroll 2005; Hong & Goh 2003; Mahanti 2005; Mahanti & Antony 2005,).

Despite these multiple quality initiatives and approaches espoused in and for the software industry, Lazarevic (2003, p. 11) states that software organizations are still facing a number of challenges which put increased pressure on these organizations to produce healthier products. Authors also have noticed that many of the prescribed practices are not suitable for software product development processes (Wilkie et al. 2004). Many others report a remarkable difference between theory and practice in managing the quality of software development (Gillies 1993; Pfleeger 2001). Others claim that there is a pressing need for more studies in the field of software product quality management as a whole (Dromey 1996; Parzinger & Nath 1998; Tervonen & Kerola 1998). Issac, Rajendran & Anantharaman (2004a, p. 314), depending on the previous arguments, conclude that empirical studies investigating the management and control of quality of software development are inadequate.
and insufficient.

With increasing interest in knowledge management, other authors have paid attention recently to the importance of knowledge management in achieving software firms’ objectives (Karhu, Taipale & Smolander 2009; Ryan & O’Connor 2009; Wei & Xie 2008). Arguably, the software development process, despite being knowledge-intensive in nature (Anquetil et al. 2007), is in need of a formal approach to manage knowledge in such software development firms (Haddad & Ribière 2007). That is why some authors point to a critical need for more studies investigating the knowledge management role in enhancing project performance in software firms (Long, 2006).

Knowledge management, evolution of a discipline

Knowledge has been considered as of central importance for the functioning and competitiveness of organizations in modern life (Soliman, 2000). In consequence, knowledge management has emerged over the last decade of the twentieth century and the first decade of the twenty-first century as one of the major improvements in managerial theory (Fugate, Stank & Mantzer 2009; Pappa et al. 2009).


*By knowledge management, I mean public policy for production, dissemination, accessibility, and use of information as it applies to public policy formulation. In this sense, knowledge management constitutes what Yehazkel Dror calls ‘met policy’; that is policy for policy-making procedures.*

However, Tiwana (2004) argues that knowledge management developed after the 1950s and improved in many forms. In the 1950s, 1960s and 1970s, the appearance of Management by Objective (MBO), Program Evaluation and Review Technique (PERT), and Strategic Planning formed the first characteristics of knowledge management tools and techniques.

Tiwana (2004) adds that TQM in 1980s and the learning organization in the 1990s founded the first modern knowledge management discipline in the 2000s. Wiig (2002) goes further by stating that knowledge management began with the epistemological considerations of the Greek philosophers Socrates, Plato and Aristotle. Wiig (1999) argues that knowledge management has many origins, one in religion and philosophy, another in physiology and yet others in economics and social sciences. Recent perspectives suggest its
origin lies in business theory derived from the knowledge era.

In general, several authors state that knowledge management has been at the forefront of management theory and organizations since the mid-1990s (Gold, Malhotra & Segars 2001; Gunasekaran & Ngai 2007; Hsieh 2007). Several publications indicate the increasing consequences of knowledge in enhancing organizational performance (Afiouni 2007; Eftekharzadeh 2008; Gloet & Terziovski 2004; Seleim & Khalil 2007). In essence, Maqsood, Walter and Finegan (2007) argue that knowledge is the ‘race for the future’. According to Soliman (2000), knowledge looks like the main core for surviving.

While knowledge management is considered to have a multidisciplinary definition (Bose 2004; Chen & Chen 2006; Lee, Ho & Chiu 2008), there seems to be agreement among researchers that the aim of knowledge management is to build and develop intellectual capital in order to improve productivity and competitiveness (Nevo, Furneaux & Wand 2008; Pappa, Stergioulas & Telonis 2009). Liebowitz and Wilcox (1997, i) define knowledge management as an organization’s ability to ‘manage, store, value and distribute knowledge’. Bassi and Van Buren (1999, p. 424) state that knowledge management is ‘the process of creating, capturing, and using knowledge to enhance organizational performance’. From a strategic point of view, Grayson, Jackson and O’Dell (1998, p. 4) define knowledge management as ‘a conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that strive to improve organizational performance’. In another view, Beckman (1997, pp. 1-6) defines knowledge management as ‘the formalization of, and access to, experience, knowledge, and expertise that create new capabilities, enable superior performance, encourage innovation, and enhance customer value’. Murray and Myers (1997, p. 29) agree that knowledge management is not more than a ‘collection of processes that govern the creation, dissemination and utilization of knowledge to fulfill organizational capabilities’. That is why Wiig (2002) argues that the definition of knowledge management is broad and embraces related approaches and activities throughout the organization. That is why the notion of Knowledge Management activities is introduced to represent more agreed-upon approach to describe practiced Knowledge inside organizations.
Knowledge management activities

There is a growing interest among researchers in knowledge management practices and activities (Haddad & Ribière 2007; Jiang & Li 2009; Kotlarsky et al. 2007). Many authors highlight this interest by proposing different processes and activities that support the notion of knowledge management (Berawi & Woodhead 2005; Clarke, AJ 2006). These studies have been trying to find links between practiced knowledge and consequent performance (Jiang & Li 2009).

King, Chung and Janey (2008) propose a seven-stage model as a knowledge management life cycle. They argue that knowledge activities comprised by this model form all the knowledge management practices proposed by the literature even if different terminologies are used for the same practice (e.g. ‘knowledge storage’ and ‘knowledge documentation’ are the same, but some authors use one term or the other). These knowledge management practices are: knowledge creation, knowledge acquisition, knowledge refinement, knowledge documentation, knowledge share, knowledge transfer, and knowledge utilization.

However, it has been argued that identifying various knowledge management practices and activities is not adequate guidance for organizations in promoting and fostering their knowledge capabilities (Bonfadelli 2002; Bush & Bingham 2005; Nevo, Furneaux & Wand 2008). That is why the notion of Knowledge gaps is suggested.

Knowledge gaps

Researchers have agreed, then, that knowledge management is an important component for organizations to survive in the knowledge era (Eldridge, Balubaid & Barber 2006). Therefore, producing and utilizing knowledge is essential for development (Ajila 2008; Clarke, M 2006; Kunowski 2008). However, it has been argued that gaps in knowledge can occur especially with the huge sum of knowledge available (Burke, Drasgow & Edwards 2004; Bush & Bingham 2005).

The concept of ‘gap’ refers to differences between ‘haves’ and have-nots’ or ‘haves’ and ‘haves-less’ (Petersen, Pedersen & Lyles 2008; Sinclair 2008). The notion of a knowledge gap was firstly presented in the field of communication by Tichenor, Donohue and Olien (1970, pp. 159-60):
As the infusion of mass media information into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease.

The knowledge gap theory and hypotheses are raised in social trends (Tichenor, Olien & Donohue 1987). Communication literature starts to systematically relate aspects of social status (education, income etc.) to communication patterns (exposure, use, preference etc.) to examine the impact of mass media on social inequity (Bonfadelli 2002; Bush & Bingham 2005). Therefore, Olien, Donohue and Tichenor (1983, p. 455) consider knowledge as ‘the principal basis of social power’. Knowledge gap theory built its claim on the premise that certain subsystems within the overall social system have behaviors and values more conducive to change than others (Bush & Bingham 2005).

Societal structural perspectives were then taken into account and connected with people's socioeconomic status to explain knowledge gap phenomena (Tichenor, Olien & Donohue 1987). This approach is extended later to include community structure and media structure (Bonfadelli 2002). That is why the World Bank (W B 1999) calls unequal distribution across nations as 'knowledge gaps'. Knowledge gaps have been studied from a macro perspective, between (1) nations or groups of nations and (2) regions, classes or communities within nations (Evers 2002).

It has taken more years to move with the ‘knowledge gap’ notion to other domains, especially in health care (Nazzaro 1989) and marketing, particularly in foreign markets (Petersen, Pedersen & Lyles 2008). However, shifting the knowledge gap concept from a macro level to a micro level and from the communication domain to managerial domain has not occurred quickly. Soliman and Spooner (2000) indicate that knowledge gaps may have effects on organizational performance through their effects on strategy development and implementation.

This new approach brought to the fore the importance of effectiveness in applying knowledge management. Lin, Yeh & Tseng (2005) state in a case study that there could be knowledge gaps in knowledge management systems. Lin and Tseng (2005) identify these gaps as implementation gaps in applying a knowledge management system. These gaps are: Gap 1: the gap between the knowledge required to enhance the competitiveness of an enterprise as
perceived by the upper management and the knowledge actually required to enhance its competitiveness; Gap 2: the gap between the knowledge required to enhance an enterprise’s competitiveness as perceived by upper management and the plan to implement knowledge management; Gap 3: the gap between the plan to implement knowledge management as proposed by upper management and the implementation progress of the knowledge management plan; Gap 4: the gap between the knowledge obtained after implementing the knowledge management system and the knowledge required to enhance an enterprise’s competitiveness; Gap 5: the gap between the knowledge required to enhance an enterprise’s competitiveness as perceived by upper management and as perceived by other employees.

This latent study sheds light on the importance of the effective implementation of knowledge management. Lin and Tseng (2005) develop a conceptual framework in this area and conclude that more studies are needed to theorize how effective knowledge management system and activities can be.

With a more theoretical perspective, Molcho et al. (2008) study knowledge gaps between designer and manufacturer. They state that if gaps in knowledge are found between planners and designers, failure may be the main result. They conclude that process planning and product design as integrated processes require collaboration among all parties to optimize product cost and quality.

More recently, Lehtimaki, Simula and Salo (2009) study possibilities of knowledge gaps between buyers and sellers as a main reason for marketing failures. They conclude that knowledge management should be considered as an important enabler of appropriate marketing.

These previous studies despite their theoretical perspectives shed light on the importance of the notion of ‘knowledge gaps’ at the micro level and in managerial success. These studies also founded the critical importance of knowledge management in organizational performance in many sectors of economy.

Research design

Quality is one of the most significant research themes in managerial sciences (Capra, Francalanci & Merlo 2008; Soliman & Mehrez 2009; Yusof & Aspinwall 2000). Several authors highlight the increased level of interest in quality in many sectors of the economy (Anderson & Sohal 1999; Beaumont,
Sohal & Terziovski 1997; Hyde 1992; Sims & Sims 1995). Nair (2006) argues that quality management is a widely accepted organizational goal for most companies. However, it is still unclear to date why the quality management approach may succeed or fail.

In the software industry, for example, evidence shows clear problems with respect to quality management (Lewis & Veerapillai 2005; Miller 2004; Tian 2005). Tiwana (2004, p. 900) estimates that of the US$2.5 trillion spent on IT in 2004, nearly US$1 trillion was wagered on unsuccessful projects, that one in four software projects are cancelled annually at a cost of US$67 billion, and that cost overruns account for another US$21 billion in the United States alone. Recently, Toyota has recalled about 2.7 million of its vehicles due to brake problems in which software defects were blamed for this predicament (Automotive News 2010; Cosgrove 2010; McDonald 2010). It is estimated that this problem will have cost Toyota about US$2.3 billion (Freytas-Tamura 2010), which indicates how software quality may become financially harmful to organizations and physically hazardous to customers.

In addition, a pilot survey conducted among software buyers and users in Egypt confirms the previous argument where more than 78% of respondents verified clear dissatisfaction with respect to quality outcomes of software products. However, despite the large numbers of models found in the literature describing different approaches to manage quality in software firms, no research to date has been conducted to investigate possible discrepancies between desired/ideal and current/actual levels of adopting a knowledge management approach in software development firms.

Within this framework, this research investigates whether quality performance gaps exist between what software customers receive and what software developers provide. Moreover, knowledge management can be fundamental in providing the required quality (Stewart & Waddell 2008; Yang, J., 2008). Thus knowledge management gaps may also exist and can cause quality performance problems in the software industry (Karhu, Taipale & Smolander 2009). In other words, this research investigates whether quality-related problems in the software industry could be due to a lack of implementing knowledge management activities; resulting in knowledge gaps, among software developers.

Accordingly, the research objectives can be summarised as follows:
• identifying whether KM gaps exist in the Egyptian software industry between what software developers define as important (ideal) and what these
developers implement (actual) with respect to KM activities.

- identifying whether quality performance gaps exist in the Egyptian software industry between what software customers expect to receive (ideal) and what these customers actually receive (actual).
- identifying the impact of the existence of KM gaps (if found) on the existence of quality performance gaps (if found) in the software industry.

where ‘quality performance gaps’ refer to differences between what software customers expect to receive from software products (ideal) and what these customers actually receive (actual). From another perspective, given that Knowledge Management (KM) activities may directly affect quality success (Stewart & Waddell 2008), it is important to investigate whether possible gaps in knowledge management activities may lead to another set of gaps in quality performance. In this respect, KM gaps can occur due to discrepancies between what is supposed to be implemented (ideal) and what actually is implemented (actual) or, in other words, differences between Knowledge Management defined degrees of importance and knowledge management defined degrees of implementation.

In accordance, the research problems can be summarised as:

1- How can software firms identify and then tolerate any possible ‘knowledge management gaps’ in order to enhance these firms’ performance?
2- How can software firms identify and then tolerate any possible ‘quality performance gaps’ in order to enhance these firms’ performance?
3- Does the existence of knowledge management gaps (if found) affect the existence of quality performance gaps (if found)?

In respect, three research hypotheses can be developed as follows:

- (RH1): It is hypothesised that significant KM gaps are found in the Egyptian software industry.
- (RH2): It is hypothesised that quality performance gaps are found in the Egyptian software industry.
- (RH3): It is hypothesised that there is a positive relationship between the existence of knowledge management gaps and the existence of quality performance gaps.

Research methodology and methods

Methodology can be defined as the plan of actions while methods are the techniques or procedures used to gather and analyse data related to some
research question or hypotheses (Levy 2006). Based on that, two principal methodologies, quantitative methodology and qualitative methodology, have emerged in the social sciences (Creswell 2003).

Both methodologies have their respective strengths and weaknesses. In essence, while quantitative methodology is used when testing already constructed theories, qualitative methodology provides descriptions of people’s understanding of a phenomenon. However, quantitative methodology may lack generalisation as researchers may be too general or abstract in describing any phenomenon of interest. Qualitative methodology also can be criticised as researchers’ personal bias may affect results.

However, it can be argued that there is no ‘right’ methodology, but appropriateness of methods used comes from their suitability to the research question and objectives that affect the research process and strategy adopted. In this respect, Sarantakos (1993, p. 56) states:

**Quantitative and qualitative methods are the tools of trade for social scientists, who use them according to the circumstances, that is, according to the research question, the available resources, the research conditions and most of all the type of information required. The two methods are different; they serve different research needs and produce equally useful but different forms of data.**

In this essence, this research adopts a quantitative study. This research aims to identify if possible critical gaps in the Egyptian software industry with respect to knowledge management and quality performance and possible casual relations among them can be found.

To identify these gaps, two survey questionnaires were developed and distributed to two groups of respondents. The first group of respondents is “software customers’. These software customers assess in the first questionnaire their perceptions with respect to quality performance indicators degrees of importance and these quality performance indicators degrees of actual delivery. The second group of respondents are “software developers’ who assess in the second questionnaire perceptions of knowledge management activities degrees of importance and degrees of actual implementation.

**Software customers’ questionnaire:**

The first questionnaire distributed to software customers aimed to determine: (1) customers’ ideal degrees of importance of software quality performance indicators, (2) Customer’s actual delivery degrees of these quality performance indicators. Therefore, the customers’ questionnaire includes
quality performance indicators, where respondents were asked to assess both degrees of importance and degrees of actual delivery of process and products quality performance.

The questionnaire has been developed based on the quality performance model of Garvin (1986) and improved by Fynes and Burca (2005) where quality performance is divided into: (1) product quality performance; and (2) process quality performance. The customers’ questionnaire consists of nine questions where respondents are asked to assess degrees of importance and degrees of actual delivery of seven software product quality performance indicators and two process quality performance indicators. This section was built upon Prasad’s (2005) feedback form that was used primarily by IBM.

Table 1: Indicates definitions, questions and reference(s) of constructs used in this survey questionnaire including product quality performance indicators and process quality performance indicators.

<table>
<thead>
<tr>
<th>Quality performance indicators</th>
<th>Definitions</th>
<th>Questions</th>
<th>Reference(s)</th>
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<tbody>
<tr>
<td>Product quality indicators</td>
<td>Product performance: Ability of product in executing its functions. Product capabilities: Ability of product to meet its requirements. Product usability: Ease of use Product reliability: Degree of accuracy (frequency of errors) Product installability: Ease of installation Product portability: Ease of transfer from one environment to another. Product documentation: Adequacy of documentation and how easy to understand.</td>
<td>questions 1-1 to 1-7</td>
<td>rasad 2005</td>
</tr>
<tr>
<td>Process quality performance indicators</td>
<td>Timing: Ability of product to be released in time. Cost: Ability of product to be presented within budget</td>
<td>Questions 2-8, 2-9</td>
<td>Prasad 200</td>
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</table>

Each item of this questionnaire was measured using a 5-point rating scale to assess respondents’ perceptions of the level of importance of each quality performance indicator (where 1=very low importance, 2=low importance,
3=moderate importance, 4=high importance, 5=very high importance), and on the level of actual delivery of these quality performance indicators (where 1=not satisfactory, 2=satisfactory, 3=good, 4=very good, 5=excellent).

This questionnaire was empirically tested by Prasad (2005) based on an IBM form seeking users’ perceptions with respect to software quality. A list of the Egyptian companies working in the Egyptian economic sector was used to distribute this questionnaire.

**Software developers’ questionnaire:**

The second group of respondents are software developers who are responsible for advancing a quality management approach in software organisations. A questionnaire was developed to obtain software developers’ assessed degrees of importance and actual implementation of KM activities in terms of their importance to achieve anticipated quality outcomes.

The questionnaire developed as indicated in table 2 covers knowledge acquisition including activities to acquire knowledge from internal and external sources. On the other hand, knowledge documentation involves activities that institutionalise knowledge. Knowledge transfer includes activities that enable the exchange of knowledge between organisational members and groups. Knowledge creation comprises activities that develop and create skills and knowledge through experience. Knowledge utilisation refers to the organisation’s use of the available knowledge in order to improve its processes, products and services.

**Table 2: Knowledge management activities, definition of constructs**

<table>
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<tr>
<th>KM activities</th>
<th>Definition</th>
<th>Targeted question</th>
<th>Author(s)</th>
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<tbody>
<tr>
<td>Knowledge acquisition</td>
<td>Knowledge acquisition refers to the activities to acquire knowledge from internal and external sources</td>
<td>Questions 1-1 to 1-5</td>
<td>Gloet 2002; Tsai &amp; Chen 2007; Clarke A. J. 2006</td>
</tr>
<tr>
<td>Knowledge documentation</td>
<td>Knowledge documentation involves activities that institutionalise knowledge in the form of an organisational memory that can be reused in the future</td>
<td>Questions 2-1 to 2-4</td>
<td>Clarke A. J. 2006; Orzano et al. 2008; Stewart &amp; Waddell 2008</td>
</tr>
<tr>
<td>Knowledge transfer</td>
<td>Knowledge transfer includes activities that enable the exchange of knowledge between organisational members and groups</td>
<td>Questions 3-1 to 3-5</td>
<td>Clarke A. J. 2006; Orzano et al. 2008; Stewart &amp; Waddell 2008</td>
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<tr>
<td>Knowledge creation</td>
<td>Knowledge creation comprises activities that develop and create skills and knowledge through experience</td>
<td>Questions 4-1 to 4-5</td>
<td>Clarke A. J. 2006; Orzano et al. 2008; Stewart &amp; Waddell 2008</td>
</tr>
<tr>
<td>Knowledge utilisation</td>
<td>Knowledge utilisation refers to the organisation’s use of the available knowledge in order to improve its processes, products and services</td>
<td>Questions 5-1 to 5-7</td>
<td>Clarke A. J. 2006; Orzano et al. 2008; Stewart &amp; Waddell 2008</td>
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</table>

The two questionnaires were distributed to the two groups of respondents (customers and developers) on a parallel base. This is important in comparing respondents’ results at the same time as it has been argued that using questionnaire methods suffers from the limitation of a ‘snapshot effect’ (Creswell 2003; Jick 1979). That is why Malhotra (2007) contends that measurement in time makes it difficult to generalise findings beyond the particular sample within a given timeframe.

**Sampling procedures**

This investigation focuses primarily on the Egyptian software companies and more specifically on stand-alone software firms that produce software for selling and not software embodied in another product or industry. For the first questionnaire targeting software customers, a total number of 132 companies from the Egyptian economic sector listed in the Egyptian Information and Decision Making Centre (IDSC) were sent this questionnaire. These companies were selected based on their response confirming that they buy and use software products developed by Egyptian companies. Questionnaires were sent to managers who are responsible for running these...
software products (whether IT manager, Administrative manager, ......).

In the second questionnaire, software developers acted as candidates for collecting data. Sampling procedures consisted of using email invitations to the software firms listed in the IDSC seeking their list of developers. The aim was to use their ‘members list’ to act as the population of the research. A total of 602 software developers served as the theoretical population of this second questionnaire. The whole population were sent invitations to participate. The main reason was that despite the fact they were a relatively large population, their responses have great importance in assessing the ideal degrees of importance and actual degrees of implementation of Knowledge Management Activities.

**Hypotheses testing**

*Research hypothesis 1 (RH1): It is hypothesised that significant KM gaps are found in the Egyptian software industry.*

This hypothesis assumes that significant discrepancies can be found between developers’ assessed degrees of knowledge management activities importance and developers’ assessed degrees of actual implementation of the same KM activities. Therefore, paired sample T-test was used to compare knowledge management activities ideal degrees of importance and actual degrees of implementation.

Results shows that statistical significance can be found between knowledge management activities ideal degrees of importance and actual degrees of implementation. Discrepancies are clear between software developers’ assessment of what is supposed to be done and developers’ assessment of what is actually implemented. This leads to an acceptance of research hypothesis 1.

*Research hypothesis 2 (RH2): It is hypothesised that quality performance gaps are found in the Egyptian software industry.*

This hypothesis assumes that significant discrepancies can be found between customers’ with respect to assessing quality performance degrees of importance and degrees of actual delivery. Therefore, a paired sample T-test was used to compare quality performance ideal degrees of importance and actual degrees of delivery.

Results indicates that statistically, customers thought that there were some gaps between what can be delivered and what actually is delivered
with respect to quality performance. This leads to an acceptance of research hypothesis 2.

Research hypothesis 3 (RH3): It is hypothesised that there is a positive relationship between the existence of knowledge management gaps and the existence of quality performance gaps.

This hypothesis assumes that significant correlation can be found between the existence of knowledge management gaps and the existence of quality performance gaps. In other words, this hypothesis assumes that the existence of discrepancies in knowledge management activities may lead to discrepancies in quality performance. Therefore, linear regression was used to test this hypothesis. However, Pearson correlations were used as a preliminary test of the existence of this relation.

Results obtained after Pearson correlation indicates that significant correlation is found between the two variables knowledge management gaps and quality performance gaps. The relation is likely to be positive. In other words, it can be stated that the more knowledge management gaps, the more quality performance gaps.

For further analysis, Figure 1 indicates linear regression between the two variables, knowledge management gaps and quality performance gaps.

![Linear regression chart, KM gaps and QP gaps, RH1](image)

**Figure 1:** Linear regression chart, KM gaps and QP gaps, RH1
Figure 1 confirms the same conclusion after calculating Pearson correlations. There is a direct positive relationship between the existence of knowledge management gaps and the existence of quality performance gaps. Thus, according to results obtained, research hypothesis 3 is accepted.

Conclusions

The intention behind this research has been driven by the large amount of evidence that shows a clear problem related to software quality. It was assumed that gaps can be found between what software customers expect to receive and what software developers actually present. This issue is reflected by the term ‘quality performance gaps’. However, the aim of this research was deeper than just identifying the existence of these possible quality performance gaps; it was to find reasons and possible interactions behind these defects (if found) as well. That is why knowledge management activities have been considered as a fundamental component in the delivery of quality.

Therefore, the objective of this research was broadened, after identifying whether ‘gaps’ may exist while advancing a quality management approach in the software industry in Egypt, to investigate whether positive links may be identified between these possible critical gaps in quality performance and knowledge management activities. The aim of this research, then, has been to investigate through a gap analysis approach if quality success in software firms relies on an effective approach to knowledge management activities.

In accordance, three research questions were developed. The first research question asked whether knowledge gaps can be found in the software industry with respect to implementing knowledge management activities. This research question then investigated whether differences (gaps) can be found between what is supposed to be designed and/or implemented and what actually is designed and/or implemented from the perspective of knowledge management activities.

The second research question was: Is there any difference (gaps) between what software customers define with respect to quality performance outcomes (a) degree(s) of importance, and (b) degree(s) of actual delivery? In the third research question, it was investigated whether knowledge management activities may affect quality quality performance.

After analysis, it is significant that knowledge management
gaps exist in the software industry in Egypt due to lack of implementing knowledge management activities. There has also been another significance in the existence of quality performance gaps due to a variation between what customers believe to receive and what these customers actually receive. In addition, it was significant that statistical correlation can be found between the existence of knowledge gaps and the existence of quality performance gaps.

These conclusion can be useful as effective implementation of knowledge management activities affect quality performance. As such, these knowledge management gaps can be the reason behind the quality crises in the software industry. There will be a need then to pay more attention to the reasons behind this lack of implementation.

In addition, this conclusion is important as researchers tend to propose different models to advance quality management programs in software firms. However, all of these programs may fail in the end as there has been unacknowledged mistake in identifying the real problem which tends to be in the knowledge of these quality management programs.

References

really unsafe, I would have had (my wife’s car) in here,’ dealer says. *McClatchy - Tribune Business News,*


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