Rationale for an Open Source Application to Support
Process Improvement Initiatives in SMEs

Aamer Hanif
Air University, Islamabad, Pakistan
ahanif@mail.au.edu.pk

Abstract

Process improvement initiatives in small and medium enterprises are essential as these companies contribute a substantial amount to the national economy. Implementation of statistical process control methods are likely to improve business processes, products and services offered by SMEs also as depicted by their proven success in large companies. However, there is a need of a suitable open source quality information system (IS-QIS) in SMEs to implement these initiatives as these companies do not have enough financial and technical resources to employ expensive software. A survey of local small companies was undertaken to ascertain and establish a case for implementing quality and productivity management systems in SMEs. It is proposed to develop an open source application for SPC implementation in SMEs for pursuing process improvement projects.

1. Introduction and Motivation

Since small and medium enterprises (SMEs) constitute over 80 percent of all the business organizations in Pakistan and employ very large labor force, their importance cannot be ignored. Due to financial and human resource constraints, continuous process improvement efforts in these organizations become imperative as these must encompass quality in not just the products and services but in their business processes to allow sustained competitive advantage. Use of relevant and applicable software for this purpose will enable them to excel in their business functions including product and service development, sales, marketing, technical advancement, financial aspects and human resource training and development.

The knowledge based economy requires a process improvement driven approach to stay competitive in future. The present overall financial situation forces small companies to adopt improved processes by which they can design goods and services that will provide them with this competitive advantage. Appropriate information and communication technologies (ICT) are mandatory to help small companies reduce costs and eliminate waste by improving core business processes. This paper focuses on the aspect of implementation of statistical process control (SPC) mechanisms on an appropriate open source software platform in small companies in Pakistan. This important aspect has not been thoroughly researched before and hence lacks practice due to certain shortcomings identified in this paper. Moreover, a framework for putting this into practice is proposed and recommendations are made to enable SMEs to create better products and services.

2. Importance of ICT in SMEs

The current trend of transitioning from manufacturing economy to knowledge economy with heavily reliance on application of ICTs in companies has been explored in several researches [1-5]. These papers provide confirmation of recognition of ICTs as a major source of competitiveness in the small industry in various countries. Pakistani small companies add to over 30% in GDP, over 25% in export earnings and engage 78% of the non-agricultural workforce making the economy of Pakistan an economy of SMEs [6].

As a result of not being fully ICT-capable, SMEs in Pakistan are unable to keep up with the pace of globalization and increased complexity of business processes and practices. Thus they are deprived of ways by which ICTs can help them cut cost by improving the processes. Enhancing quality, reducing cost and lead time have been identified as the major challenges faced by Pakistani industries [7]. ICTs have the potential to make core business processes better and visible to managers since in a pure manual setup, managers become so used to the environment that they cannot notice signs of distress in equipment and services since they don't have access to data giving them better insight into running processes. However, there are barriers to adoption of ICTs in SMEs and there are hurdles across two dimensions. The first barrier is due to lack of proper knowledge, education and skilled owner-managers. Second obstacle concerns non availability of suitable software application for implementing process improvement initiatives in small companies.

Multiple advantages under categories of operational, tactical and strategic benefits have been identified after using ICTs in SMEs [8]. An analysis of these benefits reveals better management of business processes. However,

optimized and continuously improving processes require consistent application of tools and techniques to minimize waste and reduce cost and variation.

2.1 Use of Statistical Process Control in SMEs

Use of statistical tools and techniques principally for the management and improvement of a process is called statistical process control [9]. Use of statistical process control (SPC) as a means for obtaining higher quality has been widely adopted in many organizations in the production sector. However, SPC has received little consideration with SMEs and there is dearth of literature that highlights its effective use in the integrated setup of product/service delivery and quality management activities. SPC tools have mainly been employed in manufacturing concerns all over the world. Some researchers have identified critical success factors for total quality management (TQM) implementation in SMEs [10][11]. Various factors identified include the following:

- Quality in process
- Quality data and reporting
- Internal quality information usage
- SPC usage
- Quality improvement measurement systems
- Measurement and feedback
- Improvement tools and techniques

The above critical success factors necessitate an open source software system to launch an integrated program encompassing these factors in the SMEs. This software system should counter lack of human, financial and technical resources to implement these otherwise in a totally manual setting. Moreover, any tool or initiative selected for adoption will not succeed unless it becomes normal practice in the company and contributes toward a culture of continuous improvement [12]. ICT based SPC implementation will succeed only if top management support is available in terms providing infrastructural assistance, and playing roles of a mentor, critic and financer [13]. In a small company, the SME owner-manager may have to play all these roles. SPC tools were successfully used in small companies in Malaysia and seen as a way for performance improvement. However, these were ICT assisted and supported by top management who realized their potential for process improvement [14].

2.2 The Seven Quality Tools

The fundamental seven quality control (QC) tools were mainly highlighted by Kaoru Ishikawa, professor of engineering at Tokyo University [15], who stated that as much as 95 percent of all quality related problems in the factory could be solved with seven fundamental quantitative tools. However, it is extremely important to know when and how to use a particular tool. Due importance was given to

these seven tools in this research for this reason. These tools are listed below:

a) Cause-and-effect diagram (also called fishbone diagram): Identifies many possible causes for an effect or a problem.
b) Check sheet: A structured form for collecting and analyzing data.
c) Control charts: Graphs which are used to represent how a process changes over time.
d) Histogram: Commonly used graph for showing frequency distributions of gathered data.
e) Pareto chart: Shows the most significant factors on a bar graph.
f) Scatter diagram: Pairs of numerical data are graphed to observe and discover a relationship.
g) Flowcharts: A schematic representation or a visual diagram of a process showing the different activities.

The main purpose for mentioning these tools in this paper is to highlight the need of an open source application which implements these tools and enables SMEs to incorporate such implementations in their business processes so that managers can gain a meaningful and deep insight into process improvement efforts and make them more directed and objective.

3. ICT infrastructure in SMEs

To evaluate ICT implementation in local SMEs, a questionnaire was distributed to 100 small and medium enterprises in the Islamabad and Rawalpindi area. Responses were received from 38 companies (18 from manufacturing and 20 from services sector) after conducting personal interviews of SME managers. The business category of these companies included construction services, food and catering, education, engineering manufacturers, electronics and telecom services and general product suppliers. Table 1 shows level of ICT adoption in these companies.

Table 1. ICT adoption in local SMEs

ICT Adoption Level	Hardware/software resources	% age
Basic Communications	Fixed line/mobile phone, Fax	40
Basic Information Technology	PC with basic software and hardware	32
Advanced Communications	Email, Internet browsing, intranet, file sharing, e-commerce, websites	19
Advanced Information Technology	Databases, ERP, Inventory management CRM software	9

The analysis of data does not reveal a very good picture regarding use of ICTs in these companies for various business processes. Table 1 indicates that 40% of the companies do not possess capabilities beyond basic communication facilities. However, to make full use of an open source software and process improvement applications, the bare minimum requirement is a personal computer with appropriate software and peripherals installed and operated by a trained person. Table 1 shows that 60% of the companies have this capability, hence these are strong candidates for implementation of such initiatives for process improvement.

Similar findings have been reported in a recent research regarding IT implementation in local SMEs [16], which establish the following points:

a) Use of process improvement software was nonexistent in the companies.
b) Word processing and spreadsheet packages were commonly used while networking and communication applications were infrequently used.
c) Employees could not use hardware and software proficiently due to lack of training.

3.1 Use of seven quality tools in SMEs

An objective in current research was to determine whether SMEs were using these tools for quality improvement initiatives and were they using any software application to do so. As a minimum requirement, basic IT facilities are essential to implement the seven basic tools of quality. 60% of the companies had at least one personal computer with office and internet software installed. That meets the minimum technical infrastructure requirement for implementing these tools. SME managers were asked about the use of above quality tools in their companies on a scale of 1 (very low use) to 5 (very high use). The results for use of each individual tool are given in Figure 1.
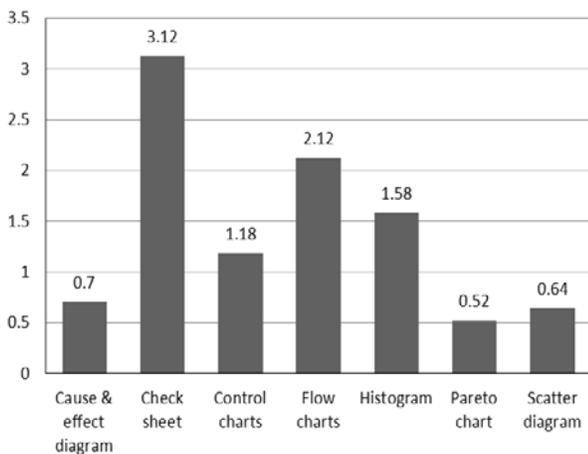

Figure 1. Use of Seven Basic Quality Tools

It is evident that apart from the check sheet, use of these tools is very low which corroborates the findings reported in [16].

3.2 Is Open Source software the solution

During the course of interviews with SME managers, two important aspects related to organizational performance enhancement were discussed. The first was the ability of SMEs to get their hands on suitable software to implement quality improvement initiatives. Since local SMEs are already severely constrained in terms of financial resources, this should not be an excuse for not initiating process improvement projects due to lack of a suitable software application which is freely available. This is an area where the open source community should come to the rescue of these small in size but very large number of enterprises all over the country and enable them to improve their products and services.

The second aspect related to training of managers and workers in areas of quality and productivity management. In these programs, the participants learn some excellent ideas about improving quality and productivity. However, when they have to apply these ideas in the practical world inside their company, they find that the biggest missing link is the information technology as an enabler for process improvement. Since on the contrary, IT is supposed to be an enabler for such initiatives; lack of suitable ICT infrastructure and software applications in these companies does not let business managers harvest the full benefits of managerial trainings and the return on investment on such initiatives is lost.

4. Proposed Solution

An initial proposal for an open course quality information system OS-QIS is being proposed. A snapshot of components to be implemented in this system is proposed in Table 2.

Table 2. Snapshot of proposed OS-QIS

Application Module	Suggested components for implementation
Basic	The seven basic tools of quality
Intermediate	Process capability, Gage study, six sigma statistics
Advanced	Reliability analysis, Design of Experiments
Extra Services	Reporting and feedback services for management

Presently available open source applications target statisticians, scientists and engineers by implementing specific areas like simulation, machine learning, time series analysis and regression etc. To the best of the author's knowledge, no open source application currently

implements all the components listed in Table 2 and many managers interested in practicing process improvement initiatives are resorting to using manual ways of data analysis or use spreadsheet software available as part of typical office applications. Both of these methods result in partial or incomplete data analysis as managers do not have access to a proper application with full capabilities as available in expensive closed source applications. At a later stage, the OS-QIS can be enhanced to provide more features in addition to statistical process control. These features will correspond to other quality management systems like 5S, lean production, total productive management, Kaizen and Six Sigma.

5. Conclusions and Future Work

There is a need of an open source quality information system OS-QIS under the umbrella of an ICT oriented SME policy that addresses its importance in creating value within the business. While many small companies have required infrastructure to apply quality initiatives, results show that these measures are not being implemented to the fullest because of non availability of a suitable software platform. As a consequence, business managers are unable to monitor the quality of products and services produced by small companies and there is less possibility of continuous improvement. An awareness of ICT assisted benefits alone would not be sufficient unless barriers to its adoption are overcome. There needs to be affordable and accessible ICT infrastructure that is available to those SMEs which are at the level of basic communication only. Building human capacity to effectively employ these initiatives would be the next step. With practical steps in the right direction, SMEs will be able to enjoy the same competitive advantage that large companies enjoy. Further research needs to be undertaken in this area to define exact requirements for the OS-QIS, identify required infrastructure and build human capacity to unleash the powers of ICT focused at quality improvement initiatives in SMEs.

Although the presented results are in agreement with other published research on ICT implementation in small companies, some limitations are being mentioned here. Firstly, the sample size of 38 is considered less and larger number of companies needs to be targeted. Secondly, data and facts provided by SME managers were based upon their personal perceptions which may be biased. Thirdly, the companies were located in a specific geographic region only in Pakistan. Hence, the results may not be generalized without considering the mentioned limitations.

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