A practical quality management system implementation framework for small-sized companies

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Abstract: An effective quality management system is critical for having a smooth and efficient supply chain system. Establishing and maintaining quality systems is more challenging for smaller companies compared to larger organisations. This paper presents a cost effective and do-it-yourself approach to design and implement a quality management system for smaller organisations. It proposes a quality system implementation framework for small-medium sized companies to enable their transition from a no-quality system to having a more effective quality system. The study also proposes an effective continuous improvement and system maintenance plan after implementing the quality system. The proposed framework is validated using a case study of a small door manufacturing company. The findings of this study reveal several setbacks during quality management implementation and suggest means to overcome them. Benefits and results achieved by implementation of proposed framework will be useful for quality practitioners, quality managers, consultants, and engineers, especially in small companies.

Keywords: quality management system; QMS; implementation framework; small-sized; ISO 9001; continuous improvement; maintenance.


Biographical notes: Manish Avinash Sawant is a Process Engineer from California with an expertise in Lean and quality management systems and currently working at the Masonite International. In December 2016, he graduated with a Master’s and thesis in Industrial Engineering and Management from the North Dakota State University, Fargo and holds a Bachelor’s in Mechanical Engineering from the University of Pune, India. He is an active member of ASQ and Lean Enterprise Institute since 2014. He is passionate about music, art and sports and a big supporter of Indian Cricket Team and Real Madrid FC.
1 Introduction

The biggest challenge faced by many organisations today is to maximise customer satisfaction by ensuring timely delivery of quality products and services. It becomes even more challenging to retain current customers amidst increasing number of product and service options available to them in the competitive global market. Therefore, numerous organisations adopt different quality management practices to maximise customer satisfaction by implementing a quality management system (QMS) and to facilitate effective interface among all organisational processes. Literature clearly shows that effective QMS is critical to ensure smooth and efficient supply-chain system and maximise customer satisfaction (Foster, 2013). Further, the continuous improvements of QMS ensure supply-chain quality and sustainability in long run and provides stable business performance.

Several QMS frameworks have been proposed in literature either in the form of conceptual frameworks or based on case study experiences (Aldowaisan and Youssef, 2006; Bhuiyan and Alam, 2005; Lee and Lam, 1997; Sarkar, 1998). Many surveys have also been conducted to study the impact and success of QMS implementation (Al-Najjar and Jawad, 2011; Chin et al., 2000). However, very few studies have reported quality management from inception of QMS planning to its implementation. This is especially limited in case of small and medium sized companies. On the other hand, most of the literature available on quality management is based on the implementation experiences in larger size organisations. Nevertheless, the key findings, conclusions, and lessons learned from several QMS implementation experiences are equally applicable to smaller companies (Boon and Ram, 1998).

This paper proposes a detailed QMS implementation framework for smaller size organisations highlighting various stages from QMS planning to its maintenance. The paper begins with a comparison of different QMS approaches along with the discussion on other important findings from the comprehensive literature review. The paper provides a detailed approach on proposed ‘do-it-yourself’ approach to facilitate an organisation’s evolution from a no-quality system to an ISO 9001 based system utilising limited resources on hand. The initial implementation of the proposed framework is presented as
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a case study experience at a small door manufacturing company highlighting the success factors and lessons learned.

The rest of the paper is organised as follows: Section 2 provides a literature review, and a proposed QMS framework is discussed in Section 3. Section 4 presents an implementation case study and section five discusses key lessons learned during implementation. Finally Section 6 concludes with discussion and finding of QMS implementation.

2 Literature review

2.1 Quality management frameworks

Several studies related to QMS implementation have been reported through frameworks, survey analysis, and case studies largely focused on larger organisations. However, most of these studies have limited applicability in small-medium sized companies (Yusof and Aspinwall, 2000). O’Connor (1991) developed a TQM implementation framework focusing on continuous improvement. However, this framework failed to address the extent of organisational needs essential for successful implementation (Yusof and Aspinwall, 2000). Applicability of the framework proposed by Dale (1995) required a quality oriented culture and quality system already in place. A quality circle approach specific to larger companies proposed by Berry (1991) failed to educate the company management and employees on the necessity of changing the system in the inner most circle.

On the contrary, there have been very few studies that focused on QMS implementation in especially small-sized companies. Ghobadian and Gallear (1997) argued that QMS models like European Quality Award and Malcom Baldridge National Quality Award Models have ambiguous expectations to fulfil QMS requirements. Hewitt (1997) also discussed the limitations on the applicability of these models in smaller companies that might not have any sort of quality system in place. A modified pyramid model proposed by Kanji (1996) relies heavily on data and hence companies implementing the modified pyramid model should have an effective acquisition system to collect relevant data. However, the lack of quality oriented environment in smaller companies makes it almost impossible to have a data driven system in place required to implement QMS (Yusof and Aspinwall, 2000). Further, the authors also concluded that smaller companies require easy to understand frameworks with a simple structure explaining the implementation processes unlike frameworks proposed by Hakes (1991), Berry (1991), Dale (1995) and Kanji (1996). Interestingly, to the best of our knowledge, our literature review does not provide any implementation example or case studies using any of these proposed frameworks.

Lee and Lam (1997) presented a framework based on ISO 9000 standards that can be implemented in six different phases. However, it failed to explain the needs of QMS development and documentation even though TQM and quality control circle (QCC) programs have already been established at the company. The framework also failed to highlight the importance of internal customers and need of training programs for new documentation necessary to support organisational change. Aniyan (2002) proposed a 24 step QMS development program for achieving internal benefits through ISO certification. However, the certification was achieved in mere 16 months by hiring outside experts,
which not many small organisations would be able to afford. Moreover, hiring outside expert does not help create quality culture and bring organisational changes necessary for implementing quality management. Both the frameworks failed to address requirements of continuous improvement that are necessary to sustain the quality culture. Similarly, Sarkar (1998) implemented QMS in a large textile company using a step by step approach, but failed to discuss and explain properly the assessment methods required to maintain QMS after certification was achieved. Therefore, we strongly believe that a self-assessment tool is essential for smaller size companies to determine quality levels of their processes on a regular basis and identify missing QMS requirements.

Recently, Garza-Reyes et al. (2015) proposed a five-stage conceptual framework for implementing new quality system. However, we believe that their framework is very complex for smaller organisations and requires prior understanding of audits, quality models, and quality methods. Yet, the approach might be suitable for improving QMS in larger organisations with an established quality system and resource availability. Aggelogiannopoulos et al. (2007) presented a nine-step implementation and certification process using external consultants for a small wine company. However, most of the smaller companies do not have financial capabilities to hire outside experts, and therefore, need a framework that can help and guide them to implement the QMS on their own and build in-house capabilities with time. Also, there are no existing studies that can explain the impact of QMS implementation on the performance of smaller organisations.

In a recent study, Kim et al. (2011) suggested that QMS implementation can be evaluated based on its impact on organisations performance. The authors used classification such as ‘zero impact’, impact with ‘QMS assets’ or ‘improved QMS outputs’ for assessing the impact. They defined QMS assets as a derivative of an effective QMS implementation in the form of improved quality systems (Magd, 2008; Poksinska et al., 2006; Williams, 2004; Yahya and Goh, 2001), standardised organisational processes (Jones et al., 1997; Williams, 2004; Yahya and Goh, 2001; Zeng et al., 2007) and sustainable working environment (Yahya and Goh, 2001; Zeng et al., 2007; Zhang, 2000). Similarly, the QMS outputs achieved by efficient management of QMS assets facilitate improved operational performance like cost reductions related to waste and non-conformance’s, timely deliveries of products and services, enhanced customer satisfaction levels of both internal and external customers, increased productivity through-out product realisation processes, reliable and controlled organisational processes, and shorter cycle times (Han et al., 2007; Jang and Lin, 2008; Mezher et al., 2005). It is also important to highlight that ineffective QMS implementation might have some negative impact on organisations like low employee morale, unconvincing top management, increase in non-value added wastes, and unsatisfied internal customers contradicting to zero impact proposed by Kim et al. (2011). Moving forward, we refer to it as ‘negative impact’ rather than ‘zero impact’ in our comparison of QMS frameworks summarised in Appendix A1. It is important to note that studies summarised in Appendix A1 are representative samples extracted from exhaustive literature review. Based on our review, we conclude that existing conceptual frameworks are too complex for smaller organisations to follow and implement. Moreover, not many of these existing conceptual frameworks have been implemented so far and are still in the development stages. Further, very few frameworks have been proposed and utilised for QMS implementation in smaller organisations.
2.2 Critical success factors for QMS implementation

Very few studies have focused on understanding the reasons of unsuccessful and ineffective QMS implementation. An organisation with a desire to implement QMS must adopt all the necessary requirements specified in the quality standards (Psomas et al., 2010). However, many research studies have found implementation of QMS to be challenging (Chow-Chua et al., 2003). These studies have revealed several barriers and critical success factors that organisations seeking QMS implementation should consider seriously. Oakland (1993) defined critical success factors as elements that need to be examined and categorized to ensure successful implementation of a system. Based on QMS implementation experiences from the literature, all critical success factors and barriers are classified in two separate categories: critical success factors and barriers during QMS planning phase, and critical success factors and barriers during QMS implementation phase.

2.2.1 Critical success factors and barriers during QMS planning

Many organisations do not have well established quality systems and hence lack knowledge and experience on requirements for planning and initiating QMS implementation (Aggelogiannopoulos et al., 2007; Bhuiyan and Alam, 2005; Magd, 2008; Stevenson and Barnes, 2002). This might lead organisations to develop and implement an ineffective QMS without addressing the actual organisational needs (Psomas et al., 2010). Moreover, in that situation the top management and employees might also question the purpose of QMS documentation requirements and their applications (Park et al., 2007). Similarly, there are several other factors that need to be considered before planning and initiating implementation of QMS. These include employee resistance to change (Al-Najjar and Jawad, 2011; Psomas et al., 2010), resource requirement, lack of awareness, and lack of interest in QMS or any other initiatives (Stevenson and Barnes, 2002; Bhuiyan and Alam, 2005; Park et al., 2007; Rokke and Yadav, 2012). Some of these issues exist due to the differences in management and employee perspectives towards quality or lack of awareness. Thus, smaller organisations need help from experienced personnel to create conducive environment for QMS implementation by creating awareness, explaining to both top management and employees the need of QMS implementation and its benefits, and showing some benefits by undertaking smaller initiatives as a pilot study (Watson and Gryna, 2001).

Lack of top management support and commitment to implementation and maintenance, provision of training, and other resource needs are other major barriers faced by small-sized organisations (Bhuiyan and Alam, 2005; Stevenson and Barnes, 2002; Zeng et al., 2007; Rokke et al., 2015). To achieve maximum benefits, organisations must consider QMS for right reasons by assessing the needs for improvement (Psomas et al., 2010). Houston and Rees (1999) concluded that lack of understanding of company’s currently established processes before attempting QMS implementation is a major critical barrier. Organisations should analyse the impacts of process changes before proceeding towards QMS implementation to boost their chances of implementing QMS successfully (Park et al., 2007). Therefore, for any organisation to successfully implement QMS, it is important to have a better understanding of issues with existing processes and functional areas (Park et al., 2007).
Lee and Lam (1997) highlighted that customer focused approach and total employee involvement was major contributors to successful QMS implementation and certification. Czuchry et al. (1997) concluded that QMS implementation was successful because top management successfully educated employees on the purpose and effects of QMS on organisational change. Watson and Gryna (2001) suggested building a positive quality culture through training on quality management practices and sharing the purpose before initiating QMS. The experience and learning from literature makes it abundantly clear that for successful QMS implementation it is very important to delve on these success factors and barriers at the planning stage.

2.2.2 Critical success factors and barriers during QMS implementation

Augustyn and Pheby (2000) highlighted the need for strong commitment for providing effective training on reliable data collection methods like strong complaint monitoring system and error prevention system. The authors consider these as critical success factors to ensure that implementation of QMS is successful in providing desired results. Another study related to small and medium sized enterprises (SME’s) revealed that successful implementation of QMS can be achieved by assigning implementation responsibilities to some expert personnel having necessary qualification and knowledge of QMS processes to carry out continuous improvement activities. (Psomos et al., 2010).

Zeng et al. (2007) found that main barriers to effective implementation of QMS are lack of commitment to maintaining QMS and keeping high expectations from QMS results while attempting to satisfy only minimum requirements to achieve certification. Another study revealed failure to assign proper responsibilities and authorities for QMS maintenance as critical factors that hindered the success of QMS implementation (Park et al., 2007). The authors also highlighted deceitful and dishonest audit reports and other quality records as other barrier. Similarly, Al-Najjar and Jawad (2011) revealed barriers like difficulty in conducting internal quality audits.

Furthermore, organisations have often reported several problems during QMS implementation process like limited financial and human resources, lack of time allotted to QMS planning and implementation (Stevenson and Barnes, 2002; Rokke and Yadav, 2012). These common barriers exist in small-sized companies too (Aldowaisan and Youssef, 2006). A QMS implementation experience in a small-sized winery highlighted barriers as lack of time commitment in carrying out QMS processes and training provided to temporary hires (Aggelogiannopoulos et al., 2007). We believe the organisations should consider factors discussed above during QMS implementation phase to avoid problems faced by several organisations evident in the literature.

From our exhaustive literature review, we conclude that QMS implementation studies focused on smaller organisations have been very limited compared to larger sized organisations. Murphy (2016) encouraged small-medium sized companies to engage in quality management practices for accomplishing business improvements despite several barriers discussed above. The most crucial factors repeatedly discussed in literature are strong commitment from leaders of the company, strong employee commitment to QMS, effective training methods, gaining stakeholders’ trust, and ensuring resource availability. These are important factors to effectively perform organisational changes, which can be compensated by working together with business partners, suppliers and vendors through strategic planning and utilisation of partner resources. Due to lack of literature studies and understanding of factors that cause reductions in small-medium
sized organisations commitment to quality management, Murphy (2016) encourages researchers and quality professionals to do more research studies on this subject and present their implementation results and experiences to promote quality management in SME’s.

3 Proposed framework

After carefully reviewing the critical success factors and barriers, and learning from other case studies, we propose a five-step QMS framework with two different phases as shown in Figure 1. This framework facilitates the due consideration of several critical success factors during both QMS planning and implementation phases. The proper planning before actual implementation of quality systems can prepare organisations to overcome the likely barriers and save time and efforts that organisations normally spend on fire fighting to deal with these issues later. We also strongly suggest the need to develop deep understanding of QMS requirements internally to efficiently plan the implementation program without the help of outside consultants. It is important because developing internal capability provides strong foundation and facilitates long-term and sustainable culture as opposed to hiring external consultant. Though, this approach might take longer, it certainly provides stronger and sustainable foundation and hence worth following this route.

3.1 Step 1: determine organisational needs

The objective of this step is to define the scope of QMS implementation by identifying the organisation’s quality system needs by using self-assessment approach. This can be achieved by assessing current state of performance, identifying issues and concerns, and performing gap analysis between the quality system requirements and existing system of the organisation. The quality system requirements can be adopted either from ISO 9000 document or any other quality award requirements such as European Quality Award. The purpose of this exercise is to limit the scope of quality system implementation to organisational needs that forms temporary boundaries for QMS implementation. We strongly recommend that organisations form a ‘quality improvement team’ (QIT) drawn from different functional areas and led by a management representative (MR) with reasonably good understanding of QMSs. The QIT should spend some time to study QMS requirements and perform gap analysis to determine the critical needs for the organisation. It is important to highlight here that these critical needs may vary depending on the size of the organisation and nature of the business. The idea is to bring people from different functional areas together to make sure it is a common goal for the entire organisation rather than driven by quality or the operations department. That helps create an environment of trust, empowerment, and collective responsibility, which effectively reduces resistance to change. Additionally, by involving people from different functional areas to undertake the change process and facilitate their learning can save costs associated with external consultants and provide effective and sustainable quality culture. The QIT will be responsible for planning and implementation of QMS including designing documentation and data collection process, and providing education and training to employees.
3.2 Step 2: develop QMS infrastructure

The objective of this step is to develop mandatory QMS processes termed as QMS infrastructure that are essential for an effective and successful QMS in any organisation irrespective of its size and nature. These processes form the foundation for QMS implementation that every organisation must possess before embarking on quality system implementation. Chin et al. (2000) studied QMS implementation in several manufacturing companies and concluded that some of the QMS requirements are extremely critical for successful QMS implementation and to sustain the quality system. The failure to manage these requirements will eventually lead to the failure of creating quality culture and establishing quality systems within the organisation. These QMS requirements are related to corrective and preventive actions, management commitment, internal audits, control of documents, and records and control of non-conformance events.

Further, the QMS implementation must always be initiated by establishing a quality policy for the organisation. Therefore, we strongly recommend that organisations must develop a quality policy and create QMS infrastructure based on the requirements and gap analysis results. This will also facilitate continuous improvement and maintenance of QMS on a regular basis. Based on the study of Chin et al. (2000), we propose that organisations must develop QMS infrastructure by creating the following documents and processes in compliance with the requirements:

- management responsibilities
- control of QMS documents
• control of QMS records
• control of QMS non-conformance’s
• corrective and preventive actions
• internal quality audits.

3.3 Step 3: develop QMS for critically important processes

A process or functional area that possesses highest number of non-conformance issues or risk to organisation’s ability in fulfilling customer requirements is defined as ‘critically important process’. The non-conformance or any failures or concerns within such processes severely detriment organisation’s capabilities to provide quality products and services to its customers and thus affect business performance. The objective of this step is to identify few of those critically important processes and use them as a pilot study to test initial implementation of QMS. The purpose of using them as pilot study is to initially demonstrate the benefits gained by implementing QMS within that process. The successful implementation and benefits are then used to create more awareness among employees and win over the resistance to change, if it exists. If any initial implementation issues or concerns are observed, the lessons learned during initial experiments and experience gained will help avoid making the same mistake later.

We, therefore, strongly recommend to assess the current operational performance, perform the gap analysis, and start investigating the root causes of prevailing issues and concerns. The systematic follow up of identified issues and concerns will help uncover fundamental causes of the problems. The processes or functional areas that possesses higher percentage of non-conformance issues in satisfying customer requirements will be ranked as the critically important process. Based on data analysis and findings, organisations should develop action plans to meet QMS requirements and satisfy customer requirements. It also requires the establishment of measurable quality objectives and documentation to have effective mechanisms in place for continuous assessment and improvement. Starting QMS implementation at a smaller level but selecting the most critical process or functional area will have significant impact not only on operational performance but changing the mind set of employees who were otherwise not very supportive of QMS implementation to begin with. We strongly believe that a successful example will motivate other employees, enhance top management confidence in change process, and get more resource commitment from top management.

3.4 Step 4: implement and maintain QMS

The objective of this step is to implement the QMS process for the selected operational process based on information and background work developed during steps 2 and 3. The QMS implementation during this step might lead to some organisational changes depending on the current state of the functional process and gap analysis results. At this stage, it is the responsibility of the top management to ensure availability of the resources required prior to initiating the implementation process. Keeping the process interactions in mind, appropriate training and awareness sessions must be planned and organised for employees that will be affected by the changes to be made during quality system implementation process. Every operational process under consideration for QMS
implementation should have a process owner who should be responsible for driving the whole implementation process including training and awareness programs, resource management, data collection and analysis, documentation, and any other requirements. Process owners should document lessons learned and other valuable information during implementation of QMS and share it with top management and other teams involved in implementation or change process. After successful implementation, it is the responsibility of the top management to ensure that QMS is consistently followed and maintained to facilitate continuous improvement within the organisation to reap the benefits of it. It requires regular feedback on customer satisfaction level, measuring operational performance indicators, putting in place the procedures for corrective and preventive actions, documentations, and periodic management reviews to ensure effective management of QMS and continuous improvement plan. Every deficiency identified during initial implementation of QMS and lessons learned must be rectified and corrected before planning for QMS expansion to other company processes.

3.5 Step 5: expand the QMS scope and maintain

After ensuring successful implementation of QMS in previously selected functional processes, it is time to expand this effort to other functional areas as well. However, we strongly recommend incremental expansion to other functional areas rather than undertaking the implementing of QMS in the rest of the organisation at the same time. The reason for incremental expansion is that there are several factors that vary from one functional area to another functional area and their impact of implementation process also varies. It is, therefore, important to be more careful and avoid any negative impact on the change process. Incremental implementation is easier to manage and react to any situation that might have negative impact, and also allows effective utilisation of available resources. Sometimes, resources could be major constraint if management embarks on QMS implementation throughout the organisation simultaneously and ends up hurting the whole process with a very bad experience. It is also important to devise a long-term continuous improvement strategy to ensure quality system is stable and changes are made as and when required to enhance effectiveness of QMS.

4 Case study: QMS implementation in a door manufacturing company

4.1 About the company

The proposed framework is tested and implemented in a small door manufacturing company named X&Y. For the sake of confidentiality, the name of the company has been changed to X&Y company. The company generates revenue of $43 million through 120 hard-working employees. The company has been supplying doors for commercial and residential building projects since 1982. The main products of the company are interior pre-hung doors, millworks, and exterior doors. Majority of the items used for assembling these doors are purchased from its vendors and machined to match customer’s requirements. Some of the raw material required is also machined to the specifications and assembled into doors. Inventory of raw material and other parts required for assembling doors is received from its vendors and stored in a separate warehouse. Based
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on the production plan, the material is moved to the main warehouse for production processes as specified on the production tickets.

Lately, the company had experienced higher rate of product returns and customer complaints. Replacements were provided to the customers without any quality analysis and investigation of root causes of the returns. Moreover, the company did not have any system in place to collect any kind of data to study and analyse the product returns. The operations department at X&Y company realised a need for an effective management system that will not only help identify root causes behind increased number of customer returns, but also control and improve current processes to facilitate increased customer satisfaction. The company also lacked standardised documentation and monitoring activities required to identify, control, and correct problems before reaching to the customer.

4.2 Phase 1: planning for QMS implementation

To start QMS implementation process at X&Y company, the first step was to form a three-member team called QIT consisting of operations manager (OM), production engineering (PE), and quality engineer (QE). The QIT was tasked with developing a complete plan and resource requirement for preparing QMS implementation. The team was also requested to prepare a comprehensive proposal and present to top management for seeking support and commitment, and also to create more awareness throughout the company. The committee spent fair amount of time to understand QMS requirements in general and specific to the company, benefits that can be gained, resources requirements, and possible challenges that the company might face during the implementation process. This information was used to gain support and commitment from both management and employees of the company. The OM was also appointed as the MR to communicate the status of project implementation to the top management of the company. The time constraint was not a factor during this project, although, bi-weekly meetings were conducted between QIT and top management to discuss the progress of QMS implementation projects. After achieving firm commitment from top management, the committee followed the steps suggested in proposed framework to prepare for QMS implementation.

The primary objective of this project was to develop and implement QMS at X&Y company around the actual needs of the company. Thus, the planning for QMS implementation was initiated using assessment of the current organisational processes with respect to the QMS requirements specified in ISO 9001:2008 standards. Gap analysis was performed to determine the needs of the company. Some requirements already established at the company were verified for their correctness and completeness against ISO 9001 QMS requirements. These were also analysed to ensure they are fit for the purpose. The gap analysis findings were categorised as conforming (C), non-conforming (NC) or opportunity for improvement (O). The QMS requirements that were completely established at the company were identified as conforming. Other QMS requirements that were not established at the company or do not exist were identified as non-conforming. Similarly, partially established requirements that needed further consideration to fully comply with ISO 9000 requirements were identified as opportunities for improvement. Furthermore, top management of X&Y was aware of the
critical success factors evident from the past QMS implementation case studies from the literature and considered counter efforts to mitigate those factors and their effects.

4.2.1 Step 1: identification of organisational needs for QMS

In order to identify organisational needs for QMS, the QIT started an in-depth study of existing literature specially focusing on ISO 9000 and Baldrige Quality Award guidelines to understand basic requirements for establishing quality system. The members of the team also spent time reading case studies on QMS implementation in different industries to develop comprehensive understanding of quality system requirements, challenges, and barriers. At the same time, the two members of the QIT, production engineer and quality QE, started looking into historical data of the company to identify issues and concerns the organisation is having for last several years. Based on the outcome of internal assessment, the gap analysis was performed to establish the baseline and the current state of performance. Based on the gap analysis findings, the identified requirements were categorised as conforming (C), nonconforming (NC) or opportunity for improvement (O) as illustrated in Table 1. The QMS requirements that were completely established by the company and are at industry standard level were identified as conforming. Other requirements that are not established or partially established by the company are defined as nonconforming or opportunities for improvement, respectively.

Table 1  Gap analysis report

<table>
<thead>
<tr>
<th>Sr. no</th>
<th>Quality management requirement – ISO 9001: 2008</th>
<th>Gap finding/risk (NC, C, O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X&amp;Y company has identified all the organisational processes and resources required to carry out its management activities, measure performance and realise its suite of products and make improvements.</td>
<td>O</td>
</tr>
<tr>
<td>2</td>
<td>X&amp;Y has established methods, criteria and specific KPIs to ensure that each process is effective?</td>
<td>O</td>
</tr>
<tr>
<td>3</td>
<td>Interaction of organisational processes and their control has been documented.</td>
<td>NC</td>
</tr>
<tr>
<td>4</td>
<td>X&amp;Y processes have the appropriate level of resources needed.</td>
<td>O</td>
</tr>
<tr>
<td>5</td>
<td>X&amp;Y provides appropriate level of information and instructions required for effective operations and their monitoring.</td>
<td>O</td>
</tr>
<tr>
<td>6</td>
<td>X&amp;Y processes are controlled, monitored, measure and analysed to verify process performance.</td>
<td>NC</td>
</tr>
</tbody>
</table>

Through this exercise, several organisational needs were identified like monitoring and measurement of product realisation processes to identify and control non-conforming products, establishment of data collection system to measure and assess process performance, measure of quality of the product, acceptance criteria for both incoming material and within production system, receiving inspection plan, contract review process, supplier evaluation, customer and supplier communication process, production control, and so on. The QIT came up with a big list of requirements and recommendations to establish a mechanism of data collection and also an effective mechanism to communicate data to all stakeholders. These two mechanisms are very critical to QMS implementation and sustainability.
4.2.2 Step 2: QMS infrastructure for X&Y industries

For creating QMS infrastructure, the QIT found that mandatory QMS requirements specified in the ISO standards were consistent with the findings of Chin et al. (2000) for smaller companies. The team members worked hard in collaboration with other functional managers and supervisors to develop quality management procedures (QP) that address company needs and also comply with mandatory QMS requirements as discussed in Chin et al. (2000). The quality management procedures developed to form QMS infrastructure include ‘control of QMS documents’, ‘control of quality records’, ‘control of non-conformance’, ‘corrective and preventive actions’, ‘internal quality audits’, and ‘management review of QMS’.

The associated QMS infrastructure records and work instructions were also developed to make sure employees can follow the procedures. The QIT also decided that all the procedures developed for QMS must be discussed with the top management and other department managers during the review meetings to get input from other stakeholders, refine the documents, and finally get approval from the top management. After several rounds of discussion and revisions, top management was on board to commit itself to QMS implementation by approving quality policy for the company and the QMS infrastructure. However, few members were still concerned with the magnitude of the change required and additional resource requirements especially when the company is in a tight financial situation.

4.2.3 Step 3: QMS for critically important process at X&Y industries

The QIT documented all the processes of the company and their interactions using process flow maps and process interaction matrix. The purpose of this was to develop better understanding of these processes, their significance within the organisation, and the flow of information and material through these processes. The QIT performed risk assessment on the findings of gap analysis to determine the critically important processes of the company. All the non-conformance and opportunities for improvement requirements identified during gap analysis were carefully analysed for their potential negative impact on X&Y’s ability to provide quality products and services to its customers. The potential impact of risk and corresponding priority actions are listed in Table 2. All QMS requirements related to the organisational processes were ranked based on their importance and risk potential. The processes or functional areas that are highly critical and possess more risk ranked top. During the ranking exercise, the QIT identified the ‘purchasing processes’ of the company as a critically important process. Table 3 summarises the results of the risk assessment of the purchasing process.

<table>
<thead>
<tr>
<th>Potential impact of risk</th>
<th>Action priority for the risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal impact</td>
<td>No action required at this moment</td>
</tr>
<tr>
<td>Moderate impact</td>
<td>Low priority</td>
</tr>
<tr>
<td>High impact</td>
<td>Medium priority</td>
</tr>
<tr>
<td>Severe impact</td>
<td>High priority</td>
</tr>
</tbody>
</table>
It is clear from Table 3 that all non-conforming requirements within the purchasing process possess severe risk to the ability of the company to provide quality product and service to its customers. The QIT members and purchasing department employees were aware of the need for inspecting raw material shipments from vendors but lack of resources hindered the plan for implementing a proper inspection plan. The QIT highlighted the need for vendor selection criteria for a purchasing process, a documented process for verification of purchased vendor shipments, and effective vendor evaluation plan. The QIT members worked with the purchasing manager and other employees of purchasing department to develop and establish a documented procedure for purchasing process. This process clearly described the requirements for selection and control of vendors, purchasing process, purchasing information, and verification of purchased products. A ‘vendor quality questionnaire’ and ‘material receiving inspection plan’ was developed to evaluate the quality performance of vendor shipments against company’s ‘vendor selection criteria’ for purchased incoming material. Purchasing manager willingly accepted the responsibility to evaluate vendor performance every month using the data collected through receiving inspection sheets.

<table>
<thead>
<tr>
<th>Sr. no</th>
<th>Clause 7.4. Purchasing process</th>
<th>Gap finding</th>
<th>Potential impact</th>
<th>Action priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X&amp;Y has established criteria to select and evaluate suppliers?</td>
<td>NC</td>
<td>Severe</td>
<td>High priority</td>
</tr>
<tr>
<td>2</td>
<td>X&amp;Y has established procedures to evaluate its suppliers/vendor’s ability to supply products that meet X&amp;Y’s requirements.</td>
<td>NC</td>
<td>Severe</td>
<td>High priority</td>
</tr>
<tr>
<td>3</td>
<td>X&amp;Y ensures that supplier/vendor evaluation records are kept and discussed.</td>
<td>NC</td>
<td>Severe</td>
<td>High priority</td>
</tr>
<tr>
<td>4</td>
<td>X&amp;Y also ensures that all purchased products meet specified purchase requirements?</td>
<td>NC</td>
<td>Severe</td>
<td>High priority</td>
</tr>
<tr>
<td>5</td>
<td>X&amp;Y ensures that purchasing requirements are adequately specified before discussing them with suppliers/vendors.</td>
<td>NC</td>
<td>Severe</td>
<td>High priority</td>
</tr>
<tr>
<td>6</td>
<td>X&amp;Y has established product verification or inspection methods to ensure that purchased products meet purchase requirements.</td>
<td>NC</td>
<td>Severe</td>
<td>High priority</td>
</tr>
</tbody>
</table>

It was decided to rank vendors as ‘approved vendors’, non-approved vendors’ or ‘provisional vendors’ in the ‘approved vendors list’ based on their quality performance and future potential of providing quality material and services. It was decided that raw materials will be purchased only from ‘approved vendors’ post implementation of QMS. The QIT and purchasing manager also developed a ‘vendor quality manual’ for their vendor’s that explains company’s new inspection policy and other expectations like ‘vendor corrective action evidence’. Work instructions were also developed for performing receiving inspections and filling of vendor corrective action requests (CAR).
4.2.4 Step 4: implement and maintain QMS around the critically important process

The QIT members worked hard to ensure that documentation required to meet QMS requirements were accepted and approved by the purchasing department prior to its implementation. The purchasing department’s involvement and willingness to accept recommendations and work on those recommendations was crucial for the success of QMS implementation. The manager of the purchasing department was officially announced as the ‘process owner’ for managing implementation process. Process performers, i.e., purchasing agents and other employees were trained to understand their roles and responsibilities, follow work instructions, and use a documentation process. A measurable ‘quality objective’ was established for the purchasing department. Process owner was responsible for maintenance of their procedures using control of non-conformance, and corrective and preventive actions. The QIT decided to perform an internal audit after three months. The implementation process was rather slower than expected and hence the QMS implementation was initially limited to the purchasing function.

4.2.5 Step 5: expand scope and maintain QMS

At this moment, the QMS implementation process is limited to purchasing department only and so far no other functional areas were considered. However, the QIT members had initial discussions to plan QMS implementation in other functional areas and eventually cover the entire organisation. During early discussion, the QIT members decided to first review the QMS implementation process in the purchasing department thoroughly and analyse lessons learned. It is very important to make changes and adjust the implementation process based on the experience gained and lessons learned from earlier efforts and not to repeat the same mistakes. It was decided to highlight the positive gains of QMS implementation in the purchasing department to solicit involvement of employees from other functional areas and also create positive work environment. To reap maximum internal benefits of this successful implementation, it is important to ensure that the QMS is implemented throughout the company and sustained to create continuous improvement culture throughout the company. Process owners were responsible to ensure that QMS process performers follow documented processes. Similarly, QIT and primarily MR ensured that QMS processes like control of non-conformance, and corrective and preventive action procedures are regularly followed throughout the predefined scope.

Furthermore, to ensure QMS is sustainable and creates a continuous improvement culture within the organisation, the QIT developed an effective continuous improvement and maintenance plan for QMS using a 'process health tracker' (PHT). The PHT will help track the process quality status of organisational processes. Quality status of a process is dependent on the quality performance of the process outputs evident from the measurable quality objectives and key performance indicators. The PHT should be accessible to all the process owners and top management. This will allow top management to keep a close eye on the process performance on a regular basis without waiting for QMS audit results and other management review meetings. Figure 2 shows the process PHT format that can be used to monitor the quality status.
The overall health of a process is determined by the total health score, which is dependent on the internal score and external score. The total internal score is the sum of process performance score and CAR score. The external score is dependent on the customer complaints received by the company in the form of product return requests, replacement requests and warranty claims. Customer complaints are analysed to determine its true cause and corrective actions to eliminate it. The process associated with the cause of a customer complaint is identified to assign a score in the PHT. Thus, the status of process performance can be validated using external scores to avoid any bias of process performance by process owners. Similarly, a stable process must result in zero or relatively minimum customer complaints.

Figure 2 Process health tracker (see online version for colours)

<table>
<thead>
<tr>
<th>Continuous Improvement and QMS Maintenance</th>
<th>Process Performance Score</th>
<th>Corrective Action Requests</th>
<th>External Score</th>
<th>Total Health Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Status</td>
<td>Importance</td>
<td>Score</td>
<td>No. of CARs</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------</td>
<td>------------</td>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td>1. QA01 - Quality Assurance</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. QA02 - Internal Quality Audit</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3. QA03 - Control of Documents</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. QA04 - Control of Non-conformances</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations Processes</th>
<th>Status</th>
<th>Importance</th>
<th>Score</th>
<th>No. of CARs</th>
<th>Score</th>
<th>No. of Complaints</th>
<th>Score</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. OP01 - Customer Communication (Requirements)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. OP02 - Sales Contract Review</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3. OP03 - Purchasing Process</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. OP04 - Vendor Performance Evaluation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5. OP05 - Receiving</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>6. OP06 - Production Control and Product Release</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>7. OP07 - Preventive Maintenance and Calibration</td>
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<td>0</td>
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<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>8. OP08 - Packaging and Delivery</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9. OP09 - Control of Customer Property</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>10. OP10 - Monitoring Measurement and Analysis</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

In addition to that, unstable processes having higher problems must also result in higher number of corrective actions and vice versa. The following criteria were used to determine the process quality status:

a. **Low (1):** process is stable. All performance indicators, metrics, objectives related to the process are consistently achieved as planned.

b. **Medium (2):** minor non-conformance exists in the process. Correction of these non-conformances might need minor process or product changes.

c. **High (3):** unstable process with poor performance. Correction on these non-conformance requirements might need major process or product changes. Such processes may or may not have significant findings during past audits.

d. **Critical (4):** unstable processes with consistent poor performance. Top management must take crucial decisions to correct non-conformance requirements responsible for
poor performance. Hence, it is expected to have a significant audit finding in the last six months and need a major process or product change.

Similarly, the following criteria were used to determine the level of process importance:

a  *Low (1):* there is little to no-risk of adversely affecting the internal and external customer satisfaction, resulting quality of product, service, delivery and profitability of the company even if the process fails.

b  *Medium (2):* there might be an adverse negative effect on the satisfaction of internal and external customers, resulting in poor quality of product or service, poor delivery and lower profitability of the company if the process fails.

c  *High (3):* any kind of process failure will most likely to have a very significant negative effect on internal and external customer satisfaction, product and service quality, delivery, or profitability of the company.

d  *Critical (4):* any kind of process failure will most likely cause safety or regulatory compliance issues for the internal or external customer.

Based on the total health score of the processes, the internal audits can be conducted, if needed, to find the nonconformities in the QMS and initiate corrective actions for improvement. We strongly believe that process and improvement tracker will increase the engagement of top management in QMS and continuous improvement. The audit criteria based on PHT are described in Table 4.

<table>
<thead>
<tr>
<th>Total score</th>
<th>Internal audit criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5</td>
<td>Internal audit should be scheduled at least once per year.</td>
</tr>
<tr>
<td>6 – 12</td>
<td>The audit should be scheduled within six months and review periodically, as necessary.</td>
</tr>
<tr>
<td>&gt; 12</td>
<td>Internal audit should be scheduled every month until process performance is improved and reviewed every quarter, as necessary.</td>
</tr>
</tbody>
</table>

5  **Key lessons learned**

The case study focused on building a quality system for a small company based on its actual needs with very limited resources. The project was intended to achieve maximum internal benefits for the company. We found the validation of our proposed model challenging but successful. Our case study revealed several issues for a small manufacturing company. A company without any quality system lacks a data collection system, which is essential to facilitate evidence based decision making. This was found true at X&Y company as decisions were taken based on experiences rather than facts. Lack of expertise to initiate quality practices was another reason for small companies not to have any quality systems. This was especially true for X&Y that ran on a tight budget and lacked resources to hire for engineering positions. Due to the lack of a documented quality system, quality of processes and products could not be measured prior to QMS implementation. The needs were realised only when the rate of customer complaints exploded and went beyond the bearable limits. Without proper quality system in place,
there was a lack of control over organisational processes, no standardised processes, no measurable performance indicators, and there was no problem detection and correction system in place.

Despite realising the need for QMS, there were many obstacles faced by the QIT members. All the processes in the company needed to be identified, verified and documented. The lack of resources was a major cause of delay in QMS implementation as a tight financial situation hindered several initiatives despite top management commitment. This caused the whole implementation process to slow down. However, we believe the positive outcome of initial implementation and continued top management support will help the company to succeed in achieving its goal of creating a quality culture and improving its business performance through higher customer satisfaction. The QMS designed for the purchasing department facilitated selection of vendors based on vendor evaluations.

6 Conclusions

The paper proposed a QMS implementation framework for small sized companies. The proposed framework was built on assessing the needs of the organisations and integrating QMS requirements with operational processes through organisational needs. The proposed do-it-yourself approach will significantly help decrease the cost associated with outside experts and consultants because it advocates creating internal capabilities to implement QMS. One major limitation of the proposed approach is slower implementation as it requires both creating internal expertise as well as implementing QMS progressively. However, this approach seems to be more successful and stable as it allows learning through implementation and incorporating that learning in the subsequent implementation efforts. The case study provided a cost-effective quality management model that can be adopted by any organisation. This study will be very useful for QEs, quality managers, quality consultants and other quality practitioners looking to develop and implement QMS especially in smaller organisations.

References

A practical quality management system implementation framework


### Appendix

#### Table A1  Comparison of QMS frameworks

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>QMS literature</th>
<th>Quality system</th>
<th>Type of study</th>
<th>Organisation applicability</th>
<th>Motivation</th>
<th>Impact of QMS</th>
<th>Driving force</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Garza-Reyes et al. (2015)</td>
<td>ISO 9001</td>
<td>Conceptual framework</td>
<td>Small-large Internal or external</td>
<td>Insufficient information</td>
<td>Insufficient information</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Kim et al. (2011)</td>
<td>ISO 9001</td>
<td>Conceptual framework</td>
<td>Small-large Internal or external</td>
<td>Insufficient information</td>
<td>Insufficient information</td>
<td></td>
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<tr>
<td>3</td>
<td>Aggelogiannopoulos et al. (2007)</td>
<td>ISO 9001</td>
<td>Case study</td>
<td>Small</td>
<td>Insufficient information</td>
<td>Insufficient information</td>
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<tr>
<td>4</td>
<td>Bhuiyan and Alam (2005)</td>
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<td>Case study</td>
<td>Small</td>
<td>Internal and external</td>
<td>QMS outputs</td>
<td>Outside expert</td>
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<tr>
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<td>Small</td>
<td>Internal or external</td>
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<td>Internal and external</td>
<td>QMS outputs</td>
<td>Outside expert</td>
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<td>Houston and Rees (1999)</td>
<td>ISO 9000</td>
<td>Case study</td>
<td>Large</td>
<td>Internal</td>
<td>Negative Impact</td>
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<td>Large</td>
<td>External</td>
<td>QMS outputs</td>
<td>Outside expert</td>
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<td>ISO 9000</td>
<td>Case study</td>
<td>Large</td>
<td>Internal</td>
<td>QMS outputs</td>
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<td>Large</td>
<td>External</td>
<td>Insufficient information</td>
<td>Inside and Outside expert</td>
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