From ISO 9001:2008 to ISO 9001:2015 – Challenges for Software Engineering in Small and Medium Sized Enterprises

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Abstract: A case study of updating a quality management system (QMS) from ISO 9001:2008 to ISO 9001:2015 is presented. The QMS has covered all activity in a software developing, selling, and implementing ERP projects based on Dynamics AX SME. In the case study requirements of the new 2015 version were analysed. Some areas of the initial QMS needed modifications. BPMN has been introduced as process notation and some processes, roles, tools, and artefacts in risk, knowledge, and change management had also to be newly developed or modified.

Keywords: QMS, ISO9001, Risk Management, Knowledge Management, Change Management

1   Introduction

In order to provide consistent product and service quality, which corresponds to customer requirements, management techniques are used that focus on the structuring of work and tasks. This process is normally specified in terms of a quality management system (QMS). To validate the QMS at a company, it is commonplace to seek for certification in accordance with a recognized standard such as SPICE or CMMI, which include software engineering specific practices. This assures the application of best practices. However, many domains and companies are not interested in such specific certification like SPICE or CMMI, especially in the sector of adapting and implementation standard software. If customers are not directly from the IT industry SPICE and CMMI are labels that are often unknown. Instead, often the generic ISO 9001 certification for QMS is the aim.

ISO 9001 defines the minimum criteria needed to fulfil the key principles of the process approach and related structured work. Implementation of this approach requires significant effort, which often becomes a challenge for small and medium enterprises (SME). At the moment, the ISO 9001:2008 standard is still used around the world (2008 defines the version type). The ISO 9001 standard was updated and published in autumn 2015.

Microsoft indirectly sells Dynamics AX via partners, who also provide support services. To ensure consistent quality and success in product implementation, Microsoft provides a methodology called Sure Step – a life cycle comprehensive methodology, which includes guidance, project management alignment and domain-driven best practice. Although most

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Microsoft partners have created their internal processes and strategies already, Sure Step provides the facility to create and customize projects to fit any domain field.

Although CMMI and SPICE provide concepts for the quality of systems in IT, the case study's company is certified by ISO 9001, because this is more flexible and recognized in different business fields, which is an advantage in terms of customer relationships.

ISO 9001:2015, as a key principle, involves a process approach, which is applied during developing, implementing or improving an enterprise QMS. With the growth of an organization, the complexity increases, so the interactions between processes can be difficult to identify. Therefore, the clear definition of these interactions, connections and distribution of roles might simplify the understanding of organizational infrastructure, enhance overall performance and improve customer satisfaction by providing a consistent output.

The principles of ISO 9001:2015 are:

- Customer focus

- Leadership

- Engagement of people

- Process approach

- Improvement

- Evidence-based decision-making

- Relationship management

Although ISO 9001:2015 does not provide a guideline for a QMS, it consists of a set of mandatory/desirable documents and measurements/tasks, which are essential for certification in accordance with ISO 9001:2015. The main elements of the process definition are activities. An activity will be described, as well as inputs and outputs. Inputs and outputs can be both tangible and intangible. The standard enables the definition of quantitative measurements for evaluating the process result because they simplify monitor and review. ISO 9001 encourages companies to apply the PDCA ("plan-do-check-act") cycle.

2   Method

The revision of the ISO 9001 standard had the goal of making the model more applicable to service companies, which were not the focus in the ISO 9001:2008 version, as well as reflecting the necessary aspects of SMEs. The review of the high-level structure of the documents, as well as the standards board unifying 9001 with other ISO standards, such as ISO 14001 (environment) or ISO 50001 (energy management), was done in order to simplify managing them within one company. Key changes in ISO 9001:2015 are:

- Core text and 10-chapter structure for all the management system standards (MSSs) of the ISO

- Better adjustment for non-producers and service providers

- Focus on the context of the organization and interested parties
- More explicit process approach
- Identification of risk and opportunities and how to handle them, instead of a concept for preventive action
- Document and record terms are replaced by the term "documented information"
- Purchasing and outsourcing are replaced by the control of externally provided services and products
- More focus on efforts to find opportunity improvements
- Increased involvement by the leader of the company's management
- Risk-based thinking
- Simplification of terms, language and structure
- Flexibility in documented information

The challenges of applying ISO 9001 for software engineering in small and medium sized enterprises are subject of this report. A case study about switching from the 2008 version to the 2015 version of ISO 9001 was carried out. The following goals were pursued:

- Updating and analysing the company's process descriptions focused on the overall improvement in quality management by more concrete tasks and definitions, as well as better visibility
- Identifying existing techniques for software engineering models and the special role of ISO 9001
- Analysing the new requirements of ISO 9001:2015 in comparison with ISO 9001:2008
- Creating a concept of changes, which are based on the company's documentation and ISO 9001 requirements, and applying these changes to some of the process descriptions and documents

The case study was a part of a project to prepare the company for recertification in relation to the requirements of ISO 9001:2015.

As ISO 9001:2015 uses the process approach, the key challenge relating to quality documentation is to provide a description of the processes within an organization.

Interviews took place with those employees responsible for quality as well as the managing director, along with an analysis of the company's internal documentation.

3   Results

The first stage of the project included the choice of the most suitable notation principle in accordance with the expectations of the senior management and responsible for the quality

management employee. Initially, all the process diagrams were created using the flow chart and the RASCI diagram.

Based on a review of available techniques and tools BPMN was specified as the most suitable notation principle, due to its better expressiveness, broad usage in different business areas as well as available software tools.

On comparing ISO 9001:2008 with the revised requirements in ISO 9001:2015, the updated necessity of entering newly documented information, as well as updating existing documentation, were identified.

Risk Management: Procedures for risk management and a form for the registration of identified risks were created. The collection of risks and opportunities data results in a list with the attributes of an FMEA analysis. This list consolidates information from the risk forms in which a new attribute is the priority calculated with the composite risk index.

Knowledge Management: At the start of the case study, an extended infrastructure for knowledge management already existed. Based on the requirements of ISO 9001:2015 for the existing structure, the information about the organizational context was added.

Change Management: Change management was partly presented in the older version of ISO 9001; therefore, dealing with change management had been already planned and managed. As such, in the annual management review, it is considered whether the QMS is efficient or requires any changes.

4   Discussion

The revision of the ISO 9001 standard in 2015 focused on the challenges faced by SMEs. Many organizations working in consulting and software development belong to this group.

Risk-based thinking in relation to the standard ensures that certified companies are prepared and have a strategic plan to face and overcome certain unexpected conditions. Due to a limited number of employees, unprepared smaller companies might have a higher risk of business interruption, losing important customers or a significant downturn in profits. Therefore, regular review of risks and opportunities secures the business and demonstrates its reliability to its customers and partners. The ISO 9001:2015 certificate is proof for that.

Another new issue, knowledge management, ensures that certified companies do not lose their know-how and experiences due to employee turnover. A smaller amount of staff increases the impact resulting from the loss of team members, especially in knowledge-intense areas such as IT.

Change management is an essential part of a software project due to the complex nature of defining the requirements and the fluctuations in customer demand. As such, the current focus is also on this area, meaning that the interests of consulting and software companies are secured.

In comparison with other software engineering models, ISO 9001 has a general and flexible approach, which provides an opportunity to construct system in the most effective

way for the business. The implementation of the requirements of ISO 9001:2015 affect the system and the organization of business in terms of strategic and operational planning, evaluation and adjustment. The quantitative estimation of the impact can be determined by comparing customer satisfaction, which is provided annually in report form from Microsoft, with work productivity (e.g., the amount of time taken to handle customer requests or the amount of change requests from customers).

5   Conclusion

ISO 9001:2015 enables companies to focus on key competence processes and apply the relevant principles in the most advantageous ways, which is important for SMEs due to the generally smaller number of the available employees to handle the routines of a software engineering model.

Flexibility, which is offered by the requirements of ISO 9001:2015, is a key factor behind the success of the standard in many business areas and countries. Conversely, without strictly defined rules, there are many decisions that the company should take on its own, which can be also a difficult task. In comparison with other software engineering models, such as CMMI, ISO 9001:2015 provides a set of tools, which are sufficiently universal for its application in different domains.

The main challenge of the project was the absence of a published guideline for the implementation of ISO 9001:2015 (Status 2016). For applying former versions of this standard to software engineering there exists such guidelines [Ir07, An10], even as an official guideline IEEE 90003:2015. The 2015 version of ISO 9001 is still comparatively new. Some general recommendations for its implementation have been already published in scientific and specialist journals, conference papers and reports. But guidelines for application in software engineering industry are still missing, especially in the form of an official guideline.

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