Quality Maturity Improvement Reengineering or What Comes Next

Norbert Fuchs, Alcatel and Technical University Wien

Norbert Fuchs is responsible for process improvement within Alcatel Austria. He is also lead auditor for the Austrian Association for Certification of Management Systems and assistant professor at the Technical University of Wien.

IMPACT OF QUALITY APPROACHES TO THE NATURE OF ASSESSMENTS

Norbert Fuchs, Michael Haux, Alcatel Austria AG, Austria

Summary:

For various reasons quality management is one of the main business topics in the last years. Times of uncertainty (European market, difficult economic development, technology revolution, ...) force companies to distinguish themselves from others. Sometimes quality systems became a necessity, sometimes the last hope. In this paper we report on Alcatel Austria's experiences with various quality approaches, including ISO, SEI CMM, and The European Quality Award. The paper will focus on the assessments/audits corresponding to each approach and how these assessments interact and go through an evolution.

Norbert Fuchs, Alcatel Austria AG, Scheydgasse 41, A-1211 Wien, Austria. Tel: +43 1 27722/2654, Fax: +43 1 27722/3980, Email: Norbert.Fuchs@aut.alcatel.at
Michael Haux, same address. Tel: .../2652, Email: Michael.Haux@...

1. Motivation

Alcatel Austria's Quality initiative has a long history. It began in the 1970s with the introduction of the ITT Quality Program *Quality Improvement through Defect Prevention* which was conducted by the famous Group Quality Manager Philip Crosby. Recognition, certificates and Quality awards of these previous days are still present in many departments of our company to remind staff of our long-standing experience in the field of Quality Management. In the early 1990s our board of directors stepped up the pace of Alcatel Austria's drive to Total Quality with the implementation of Time Based management and ISO 9001. In 1991 we received external certification for the whole company and have maintained our certificate through a reaudit in 1994. End of 1995 we also started with the first internal audits according to the TickIT schema (Software development specific interpretation of ISO 9000 based on ISO 9000-3).

Having received ISO 9001 a new challenge was sought to drive continuous improvement. A new process that could clearly discern strengths from opportunities for improvement was necessary. Therefore we set in motion a Total Quality process using the criteria of the European Quality Award (TEQA). Since 1992 self-assessments play a major part in our business review, because we view the model of the European Foundation for Quality Management (EFQM) as a business model. It is a quality model that links all the aspects of the business, enabling our employees to drive continuous business improvement through Total Quality Management. Alcatel Austria was the first and till now the only Austrian company applied for TEQA in 1993, 1994 and 1995. These systematic efforts made Alcatel Austria a finalist in 1995's award competition. It is the first time a "German speaking" company got this recognition.

As software became a strategic element in our company, the board of directors decided 1994 to start a specific activity aimed at the improvement of software development processes within the relevant divisions of our company. Main quality attributes are: cost, time to market and

reliability. To secure competitive advantage the Capability Maturity Model (CMM) has been selected which is already used within approx. 300 companies. In the meantime CMM was applied all our development divisions within Alcatel Austria.

In early 1994 our board of directors felt that continuous improvements were not sufficient to react immediately to the fast changes in customer attitudes, market, technology and competition. Therefore the board commissioned an experienced consulting company to initiate a Business Process Reengineering project within one of our most critical business areas.

In the function of a central quality department the authors of this paper have been involved in all these activities. This experience will be used to discuss the different approaches and their nature of assessments.

2. Assessment / Improvement / Reengineering

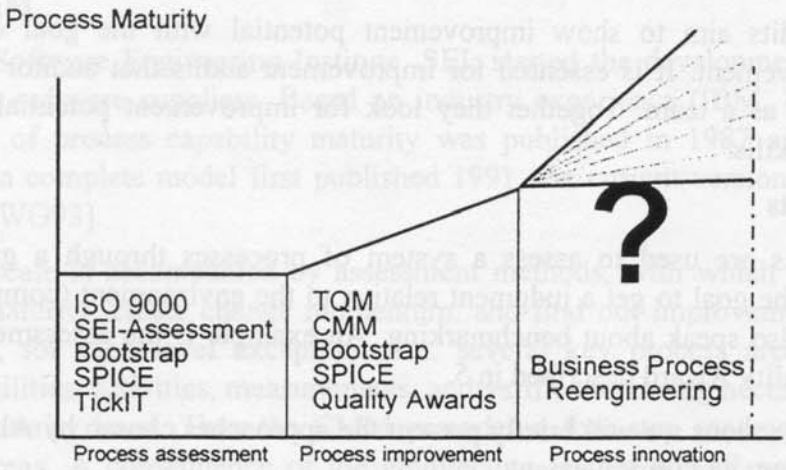

Figure 1. Process assessment, improvement and innovation

In the last years we have a wave of quality awareness within Europe. For various reasons approaches like ISO 9000, TickIT, CMM or TEQA have been taken up by industry very rapidly. As a consequence today industry is confronted with a lot of "new" quality approaches, slogans and abbreviations. To put all these in context the following classification can be done:

The nature of Process assessment is that the maturity of the processes stays unchanged. The assessment itself does not effect the processes, may be the preparation does. Process improvement aims in the continuous improvement, the ongoing optimization. Process reengineering aims in the radical change of the processes, hopefully an improvement but not by nature. Still about 70% of all process reengineering projects fail.

Both - improvement and reengineering - require an assessment first. We always have to know where we are before starting to change. Therefore the methods of process assessment are used and some approaches like CMM for improvement have even their own assessment method (SEI-Assessments).

Together with this development and the increasing process maturity also the audit (assessment) methods have improved. In every company we should be able to see this

improvement. E.g. a company staying with ISO 9000 for five years. After five years the nature of internal audits should have changed. Questions like "Do you have a quality policy?" seem to be childish after five years. With improving process maturity and understanding the audits should developed in the following order:

Awareness audits

Awareness audits are used to prove the applicability of a process description, the awareness of the employees and to check the communication and information flow. The goal is to react as early as possible (changing of process description, training of employee), but also to improve the culture for quality.

Compliance audits

Compliance audits aim in the proof that standards are followed with the goal of a Certificate or an internal approval. ISO 9000 certification audits are a typical example here.

Improvement audits

Improvement audits aim to show improvement potential with the goal of ongoing and preventive improvement. It is essential for improvement audits that auditor and auditee are working together as a team. Together they look for improvement potential based on their experiences and skills.

Assessment audits

Assessment audits are used to assess a system of processes through a group of experts (assessors) with the goal to get a judgment relative to the environment (competition, state of the art, ...). We also speak about benchmarking. An example is the assessment procedure of the European Quality Award described in 5.

In the following sections we will briefly present the approaches chosen by Alcatel Austria for process management and improvement.

3. ISO9001, TickIT, ISO9000-3

The ISO 9000 series of international standards for quality management was first published 1987. The contents is not that new, of course, but has its roots several decades back in military standards. With the enormous international diffusion of ISO 9000 an introduction of the model seems unnecessary here. In September 1995, 80 ISO member countries have adopted the series, more are on the way (ISO, 1995a). According to the Mobil survey over 95.000 certificates of conformance have been issued worldwide up to March 1995 (ISO, 1995b)!

In spite of ISO trying to push ISO 9004 as the standard for building sound quality management systems, the major role is played by ISO 9001. ISO 9001 is the most comprehensive of the three "conformity" standards in the series and contains minimum requirements for a quality management system (QMS). The requirements bring a heavy focus on documentation, i.e. written process descriptions, procedures, etc. The 20 elements in ISO 9001 contain a mixture of life-cycle dependent elements -- like contract review, design control and process control -- and life-cycle independent, supporting elements -- like purchasing, document and data control, training -- as well as management activities (ISO, 1994).

To ease the use of ISO 9001 in software developing organizations, ISO 9000-3 was first published 1991 (ISO, 1991). This guideline instead of the 20 elements uses a more logical structure with the chapters framework, life-cycle activities, and supporting activities. ISO

9000-3 should not add anything in the scope of ISO 9001, since it is a guideline, but just clarify interpretation details specific for software business.

ISO 9000-3 is "just" a guideline. A software organization may very well use it to get ideas for building its quality system in accordance with ISO 9001. An auditor may also use it as a guide. But auditing and certification is at the end nevertheless according to ISO 9001. For software development there is also the TickIT IT sector certification scheme (TickIT, 1995). This scheme is based on the assumption that the existing accreditation system is too weak to enable effective auditing and certification in the IT sector. The main difference for audits are the special requirements on TickIT auditors' IT competence and qualification.

No matter if an organization is using ISO 9001 for two-party agreement, or 2nd/3rd party registration, internal QMS audits are required. These audits should be performed on a regular basis covering all of the organization. We assume that most readers are familiar with the process of both external (certification and surveillance) and internal audits.

4. SEI CMM

Late 1986 the Software Engineering Institute, SEI, started the development of a model for evaluating DoD software suppliers. Based on industry experience (IBM, Mitre Corp., ...) a five-level scale of process capability maturity was published in 1987 and this scale was elaborated into a complete model first published 1991, the current version being from 1993 (Paulk, 1993)[PWG93].

The five-level scale is accompanied by assessment methods, with which organizations can find out their maturity, create change momentum, and find out improvement potential. The model contains, for each level except level 1, several key process areas, indicating the commitment, abilities, activities, measurements, and verification being necessary to satisfy the goals of the maturity level. Thus the CMM provides a four-step roadmap for prioritizing improvement areas. A consequence of the architecture is that not all process areas of an organization are covered, just the key ones. This is a difference compared to the SPICE standard in development under the auspices of ISO with participation of, among others, SEI (Dorling, 1993)(Paulk, 1995b).

There are different motivations for doing assessments according to the CMM:

- Software capability evaluation (SCE) mainly for evaluating DoD subcontractors.
- Software process assessment (SPA) for initiating software process improvement.
- Internal process improvement (IPI) for initiating software process improvement.

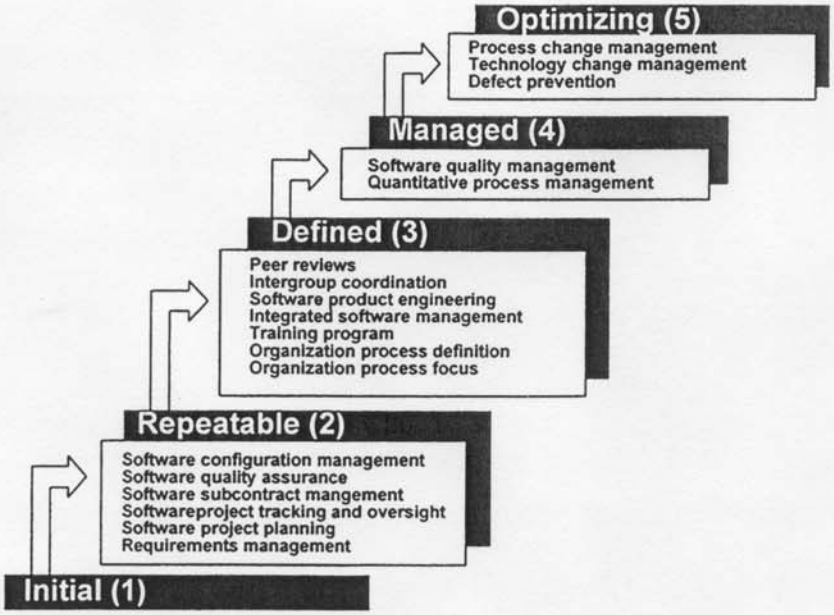

Figure 2. SEI Capability Maturity Model ver 1.1.

A SPA starts from selected project leaders' answers to an SEI questionnaire that provides spot-checking of the situation in the organization. During the following assessment week a systematic methodology including many group techniques is utilized to reach a consensus on the real problem areas and, not the least, to reach a change momentum. Due to the high involvement from the assessed organization with assessment team members, project leaders and many (normally 20-30) practitioners from the projects, the credibility of the SPA method is high. The IPI method is more thorough when it comes to assessing CMM key practices compliance. Figure 3 indicates the whole process of an SPA.

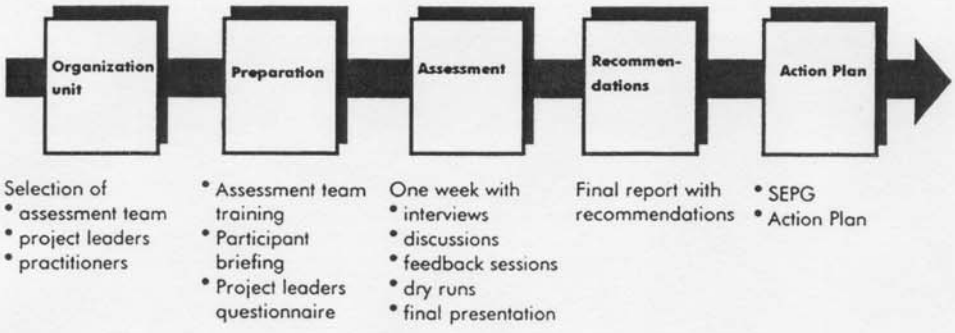

Figure 3. SEI Software Process Assessment (SPA)

In the European Bootstrap methodology (Kuvaja, 1994), the CMM model has been merged with the ISO 9001 requirements and the European Space Agency standards for software engineering. Another characteristic of the Bootstrap approach is a more detailed quantitative process maturity level.

Just like ISO 9000-3, the CMM is under revision. The issues discussed for CMM version 2 include new key process areas (testing, reuse, ...), tailoring of the CMM, and "vertical" key process areas stretching across levels (like SPICE has). The concept of maturity levels has in any case found a nutritious ground in software and system engineering with several maturity models published or underway (system engineering, people, subcontracting, personal software process...) (Paulk, 1995a).

5. TEQA

The European Foundation for Quality Management (EFQM) each year since 1992 presents The European Quality Award. The assessment of the participants in this competition is done against the EFQM model for total quality management. The award and the model are counterparts to the US Malcolm Baldrige National Quality Award (MBNQA) and its criteria. The models are similar, though the European model was from the beginning pushing a total management view, while MBNQA was more narrowly focused. For example business results were part of TEQA from the beginning while MBNQA only lately has broadened the scope. The EFQM model is much wider than the process-oriented ISO 9001 or SEI CMM. We estimate that ISO 9001 covers less than 25% of the model, dealing only with enablers. The CMM in some way deals with all enablers but people management, while going rather into details of the key software development processes.

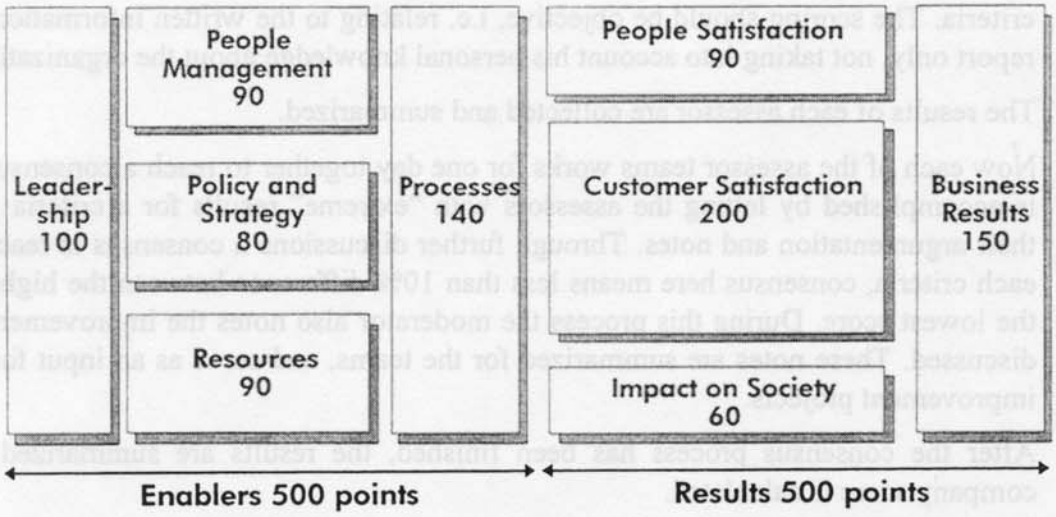

Figure 4. The EFQM model for TQM

The process of participating in TEQA includes the following main steps:

1. Collect information and data on the nine EFQM model elements (Figure 4) from the organization and write a report not exceeding 75 pages.
2. Perform a self-assessment in the company (see below)
3. Provide the company report to EFQM. EFQM assessors assess the company on the basis of this report.
4. If the company has more than app. 550 points, an international assessment team is composed and will perform a site visit to validate the contents of the report, clarify issues and check the real deployment.

5. EFQM summarizes the results of the site visits, adjusts the scores from step 3 and presents the best companies with recognition (award, prizes).

Participating in TEQA is of course not the only goal with using the EFQM model. The model itself provides an excellent mean for management to get a balanced company overview, and in combination with self-assessment, to initiate internal improvement projects. Self-assessment includes the following steps:

1) Select and train internal assessors from senior management, middle management and other staff. At Alcatel Austria other staff includes centralized functions as well as young managers and trainees. In all we use four assessor teams, with a total of about 30 participants.

2) Each self-assessor individually assesses the report using TEQA scoring system, summarized in the following table:

Enablers:	approach - systematic? prevention-based? state-of-the-art?, integrated? PDCA cycle?	deployment - is the approach used for all relevant areas and activities?
Results:	results as such - including benchmarking, trends, and causality	scope - which areas and activities are covered?

In addition each assessor notes strengths and improvement areas for each award criteria. The scoring should be objective, i.e. relating to the written information in the report only, not taking into account his personal knowledge about the organization.

3) The results of each assessor are collected and summarized.

4) Now each of the assessor teams works for one day together to reach a consensus. This is accomplished by letting the assessors with "extreme" results for a criteria present their argumentation and notes. Through further discussions a consensus is reached on each criteria, consensus here means less than 10% difference between the highest and the lowest score. During this process the moderator also notes the improvement areas discussed. These notes are summarized for the teams, and serve as an input for TQM improvement projects.

5) After the consensus process has been finished, the results are summarized and a company score is calculated.

6. Lessons learned

We have discussed a classification of various approaches, the development of assessments (or audits) through the stages awareness, compliance, improvement and assessment/benchmarking. We further presented three major approaches, ISO, CMM, and TEQA, their usage and especially the related assessment techniques. In this chapter we will share our experience about the approaches' influence on the assessment style.

After some time living an ISO 9000 QMS we noticed that the nature of audits has changed. This change was not caused by a conscious shift in the focus, like that we used for the first steps of QMS introduction using awareness audits as described in chapter 2. We noticed several auditors behaving more and more like change agents and improvement moderators. Why - because they noticed the absurd situation to check ISO 9000 requirements and concentrating on status-quo after having had the QMS in place for some years. What

happened was that they changed the way of asking questions. Instead of asking "Please show me ..." they asked "Could you do it in another way?", "Who else could do it?", etc. It was during this transformation period also made explicit by the company's CEO that the ISO audits should not be narrowly focused. Thus we found ourselves doing audits with stronger improvement focus than before.

The assessments performed within the scope of a certain improvement approach go through an evolution, as indicated for ISO 9000 audits above. However, the main evolution takes place at the organizational level -- not limiting the four-stage evolution to one approach but going through the four stages with different approaches. The nature, or style, of the assessments has to reflect the approach. By using complimentary approaches and assessment/audit techniques to manage the evolution of the whole organization through the four stages, we can support the improvements in an orderly way. Table 1 shows how the approaches and evolution stages match each other:

Audit stage	ISO	SEI SPA (CMM)	TEQA
Awareness audits	checked during implementation of QMS	checked in SPA	checked during site visit
Compliance audits	high	low (no accreditation system, no registration system, etc.)	low (as CMM but even less guidance on what to have to get certain points)
Improvement audits	medium	high	medium to high
Assessment audits	no-little (to some extent approach benchmarking)	no-little (to some extent approach benchmarking)	high, both approach and results benchmarking

Table 1. Audit nature versus selected approach.

We can summarize the table above in recommending the use of ISO 9001 to define a basic QMS. Use awareness audits to stimulate communication and to spread the quality management ideas and policies. Use compliance audits to maintain the system, but don't forget to use these audits also to stimulate improvement. In order to continuously improve the software development process use CMM (software or system or SPICE) for best-practices hints and use assessments like SPAs to motivate people and build change momentum. Then use EFQM/TEQA to validate the total management system and to benchmark yourself against others.

The evolutionary stages relate to the following strategic objectives with regard to process improvement and assessment:

- create quality consciousness and support deployment of policies (awareness)
- conform to a basic, internationally recognized, model for competitive or market reasons as well as for defining a first baseline for improvements (compliance)
- drive improvements of software development in order to increase productivity, quality, decrease risks, etc. (improvement)
- benchmark results and approaches with best in class, etc. (assessment)

The objectives of the approaches are reflected in the sources of inputs of the assessment, in the people involvement during assessments and in the outcome. Table 2 summarizes these aspects.

Approach	Main Inputs	Highly involved people	Results
ISO	QMS documentation Quality records	line management project leaders	conformance y/n corrective actions remarks
SEI SPA (CMM)	The voice of the developer Structured interviews with project leaders	middle management project leaders practitioners	CMM level findings&consequences action plan strengths
TEQA	Report describing organization approaches and data/results (mapped to EFQM model)	line and centralized management	score improvement areas strengths benchmarking

Table 2. Inputs, participants and results of audits.

During ISO audits main emphasis is on objective proof of living the QMS, mainly focusing on the "responsible" people in the organization. In the SEI SPA not quite as much proof is requested, and the practitioners are heavily involved, bringing lots of input enabling the assessment team to validate the project leader interviews and to address issues lying outside the scope of the CMM, for instance communication problems. TEQA self-assessments require strategic and business knowledge as well as organizational overview, thus here the participation is focused on management. During the site visits performed by external assessors at the most successful TEQA applicants, deployment and understanding of the TQM principles and approaches are spot-checked at all levels of the company.

Finally, we would like to illustrate the differences in the assessment nature for these three approaches by showing some example wordings used in problem findings, see Table 3.

Approach	Typical findings
ISO	...not documented ...documented procedure not adhered to ...missing requirement ...responsibilities not clear ...not provable
SEI SPA (CMM)	...not understood ...lacking knowledge in... ...not adequate ...should be considered no perceived commitment to... lack of mechanism to... lack of widespread use of procedures... lack of procedures, standards, ...

Approach	Typical findings
TEQA	PDCA cycle missing for... ...no systematic improvement ...show weak trends ...lacks in continuity ...effectiveness evaluation missing No competitor figures available ...lacks in strategy-forming process deployment not ...

Table 3. Example wordings in findings

7. References

Dorling, A.: Software Process Improvement and Capability dEtermination, *Software Quality Journal*, vol. 2, no 4, 1993, 209-224.

ISO 9000-3. *Quality management and quality assurance standards -- Part 3: Guidelines for the application of ISO 9001 to the development, supply and maintenance of software*, ISO, 1991.

ISO 9001. *Quality systems -- Model for quality assurance in design/development, production, installation and servicing*, ISO, 1994.

ISO 9000 Forum: Information letter, Sep 1, 1995a.

ISO Press Release, Ref.: 729, Oct 5, 1995b.

Kuvaja, P. and Bicego, A.: BOOTSTRAP: a European assessment methodology, *Software Quality Journal*, vol. 3, no 3, 1994, 117-127.

Paulk, M. C.: The Evolution of the SEIs Capability Maturity Model for Software. *Software Process - Improvement and Practice*, pilot issue, Aug 1995a, p. 3-15.

Paulk, M. C., Curtis, B., Chrissis, M. B., and Weber, C. V.: *Capability Maturity Model for Software*, Version 1.1, Software Engineering Institute, CMU/SEI-93-TR-24, Feb 1993.

Paulk, M. C., Konrad, M. D., and Garcia, S. M.: CMM versus SPICE architectures. *Software Process Newsletter*, IEEE Technical Committee on Software Engineering, 1995b.

The TickIT Guide: A Guide to Software Quality Management System Construction and Certification to ISO 9001, Issue 3.0. British Standards Institution, Oct 1995.