



A Review of the Concept of ISO Standard 9000 Family

Sonali Chawla
MCA 2nd Semester
Ansal University, Gurgaon,
Haryana, India

Kiran Khatter
Department of Computer Science
Ansal University, Gurgaon,
Haryana, India

Abstract---*In order to live in this period of customer oriented business every industry is endeavoring to slake the subsisting customers and additionally magnetize initial customers. One of the policies used is to maintain a quality standard of the products exceeding the client's prospect. The software industry is no exclusion to identically tantamount. It is necessary for organizations to set up, manage and promote their quality control system and quality assurance systems and their integral standard operating functions and other quality documents to provide high-quality products and accommodations to plenarily gratify customer requirements and prospects. Quality control and quality assurance systems together form quality schemes. Quality management consists of both quality control as well as quality assurance. Quality control is engrossed on consummating quality requisites, whereas quality assurance is fixated on providing confidence that quality requisites are consummated.*

Keywords---*Quality, Quality Management Standards, ISO Standard 9000-3, ISO Standard 9001, Capability Maturity Model, ISO 9000 Family, Total Quality Management*

I. INTRODUCTION

In a competitive world everybody is striving for customer gratification and in software industry where developer can't afford the worst outcome of any work done. A lot of interest is paid by software development foundations on quality organization [13] [38]. High levels of quality is essential to achieve company core objectives. As per [30], Quality (a source of competitive advantage) should be represented as a hallmark of Company products and services. High quality is a vital fundamental requisite. Quality does not only relay exclusively to the terminus products and services a Company provides but withal relates to the way the Company workforce do their job and the work processes they follow to engender products or accommodations. The work processes should possibly be efficient and continually improving. Company staff constitutes the most consequential resource for amending quality. Each member of staff in all organizational units is responsible for ascertaining that their work processes are efficient and continually ameliorating. Top management should provide the training and a felicitous motivating environment to foster teamwork both within and across organizational units for employees to ameliorate processes. Ultimately, everyone in a Company is responsible for the quality of its products and accommodations.

All over the world, the ISO 9000 set of quality standards [24] are widely utilized as standards for quality management. ISO 9000-3 was categorically designed for system growth. These standards are conventionally used to accommodate two purposes namely they can be habituated to provide guidance to organization installing quality system to engender goods and accommodations of the desired quality or there is substructure of their certification of quality system. It indicates quality certification gives a positive impact to the buyer with the reference of supplier.

II. THE SCOPE OF QUALITY MANAGEMENT STANDARDS

The scope of certification norms differ from appraisal standards by content as well as by accentuation [11]. The scope of certification standards is resolute by the aims of certification are to:

- Enable a software development organization to demonstrate consistent ability to assure that its software products or maintenance accommodations comply with acceptable quality prerequisites. This is attained by certification granted by an external body.
- Serve as an acceded substratum for customer and supplier evaluation of the supplier's quality management system. This may be accomplished by customer performance of a quality audit of the supplier's quality management system. The audit will be predicated on the certification standard's requisites.
- Support the software development organization's efforts to ameliorate quality management system performance and enhance customer contentment through compliance with the standard's requisites.

The scope of assessment standards is additionally determined by the aims for assessment, which are to:

- Serve software development and maintenance associations as execute for self-measurement of their ability to carry out software development projects.
- Serve as an implement for amelioration of development and preservation processes. The standard indicates directions for method amendments.

- Help obtaining the organizations to determine the capabilities of prospective suppliers.
- Perform training of assessors via outlining qualifications as well as training program curricula.

Therefore, while the certification standards accentuation is external – to fortify the supplier–customer relationships – the accentuation of the assessment standards is internal because it fixates on software process amelioration.

III. THE ISO 9000 STANDARD

The ISO 9000 series addresses sundry features of quality management and holds some of ISO’s finest kened standards. The principles provide guidance and implements for companies and groups who want to ascertain that their products and accommodations consistently meet customer’s requisites and that quality is constantly amended [2]. The International Standards ISO 9000-9004 standards guide companies in implementing quality system. Organization may go for certification by an independent certifying institution when it has put in the sundry clauses of the standard. The certificate can then be utilized by the organization to show the customers that the company adheres to externally verified quality standards.

The philosophy of the quality standard is consistent with the development in the theory of the quality management [29]; the focus is shifting from controlling the quality of the final product to the quality of its stimulated course. The main soul of ISO [32] is that corporation should visibly control all the aspect of the business in order to ensure a minimum level of quality standard for its creation. The standards doesn’t describe that what is most efficacious and efficient way of controlling industry practice, it just needs to adopt sets of quality procedures and guidelines without designating them. This is both the vigor and the impuissance of the standard.

Everything has some cons and pros, so do this. As per [21], the advantages of ISO 9000 are as follows:

- Increased marketability
- Reduced operational expenses
- Better management control
- Increased customer satisfaction
- Improved internal communication
- Reduction of product-liability risks
- Attractiveness to investors

The disadvantages of ISO 9000 are:

- Inadequate understanding of certification process
- Funding to establish the quality system is inadequate
- Heavy emphasis on documentation
- Lengthy process

IV. THE ISO 9000-3 STANDARD

ISO 9000-3 [23] is typically considered as an international standard for quality. It is the crucial standard accepted by virtually all European and North American motherlands. Software development companies are often required to conform to ISO standards in order to be considered for contract awards. ISO 9000-3 offers special guidelines for implementing ISO 9000, and was engendered categorically for the software development industry. It is utilized for system development which is contributed in “guiding principle for the expansion, deliver and maintenance of software”. The process to be proscribed is the life cycle of model. The software development regulation document for ISO 9001 remains as a very general description of the procedures and guidelines for quality management.

The ISO 9000-3 offers a structure with some requisites relegated as follows [3]:

- All-purpose company and management requirements:
 - Management responsibility
 - Quality system
 - Internal quality system audits
 - Corrective action
- Supporting activities requirements
 - Configuration management
 - Document control
 - Quality records
 - Measurements
 - Rules, practices and conventions
 - Tools and techniques
 - Purchasing
 - Included software product
 - Training
- Projects and maintenance period requirements
 - General
 - Contract reviews
 - Purchase’s requirement specification

- Development planning
- Quality planning
- Design and implementation
- Testing and validation
- Acceptance
- Replication, delivery and installation
- maintenance

The main denigration of the utilization of ISO 9000-3 for system development are:

- The fact that is designated for quality system development organization and that designation attention is given to quality measures on the caliber concrete development projects.
- The ISO 9000 agnize only one certifiable level of quality, while in practice different quality level may be advisable for different situation.
- The emphasis' on stringent procedure and their documentation in manual leads to bureaucratic type of comportment instead growing vigilance of the paramountcy of quality for the organization probing for incipient insight methodologies in system development may be hampered. Boehm's spiral [7] is the good example of it which copes with dubiousness in system development but clashes with the rules of ISO 9000-3.
- Though through-put time may be paramount in some cases than superb quality and scarcely expeditious and dirty approach might then be advisable, quality standards leave very little room for the conception of end-user and rapid application development.

V. THE ISO 9001 STANDARD

ISO 9001 standard puts the criteria for a quality management structure and is the only standard in the series that can be certified to (albeit this is not a requisite). It can be utilized by any organization, immensely colossal or minute, despite of its field of activity. In fact ISO 9001 is applied by over one million companies and organizations in more than 170 countries.

This standard is predicated on a number of quality management principles with a vigorous customer focal point, the motivation and implicative insinuation of top management, the procedure approach and repeated amelioration. As per [2], these principles are as follows:

- Principle 1: Customer focus
- Principle 2: Leadership
- Principle 3: Involvement of people
- Principle 4: Process approach
- Principle 5: System approach to management
- Principle 6: Continual improvement
- Principle 7: Factual approach to decision making
- Principle 8: Mutually beneficial supplier relationships

ISO 9001 is a conformance standard [23]. It is utilized for external quality assurance to provide confidence to the company's quality system provides an acceptable product. It consists of twenty elements that must be addressed by an organization in the development and implementation of a quality assurance system. This is the most comprehensive of the conformance standards in that it addresses the design function of an organization, which makes it unique from the other two conformance standards.

For example, construction organizations that would cull ISO 9001 as the standard for their quality assurance system would be architectural and engineering organizations where the design of products is an integral part of their customer offering. In integration, construction companies that provide design accommodations would withal utilize ISO 9001 as their model [35].

VI. DOES ISO 9001 BENEFITS MONETARILY?

In 1987, ISO published the initial ISO 9000 sequence of quality management standards (QMS). Since then, above one million institutes in 178 countries have attained ISO 9001 certification because it provides financial benefits. The Meta-analysis [6] shows that ISO 9001 certification does certainly enhance monetary performance, and that this is achieved primarily through incremented sales. This can be expounded by looking more proximately at the relationship between ISO 9001 mechanisms and the internal, external and signaling benefits that can lead to incremented financial performance (Figure 1)

First, ISO 9001 implementation can bring internal benefits, albeit organizations may not become financially more efficient immediately after being certified. Second, incremented process control, quality, productivity and efficiency may ameliorate customer contentment and, therefore, provide some external benefits. Lastly, the ISO 9001 certificate itself may provide benefits by signaling quality. According to signaling theory, an information asymmetry subsists in markets in the sense that customers often do not have full cognizance of the characteristics of the product and its supplier. Quality management standards can solve this quandary, in parts, by signaling the quality of the organization. The study betokened that ISO 9001 certification incremented sales, but it remains obscure if this is caused by incremented customer gratification, or by the signaling effect.

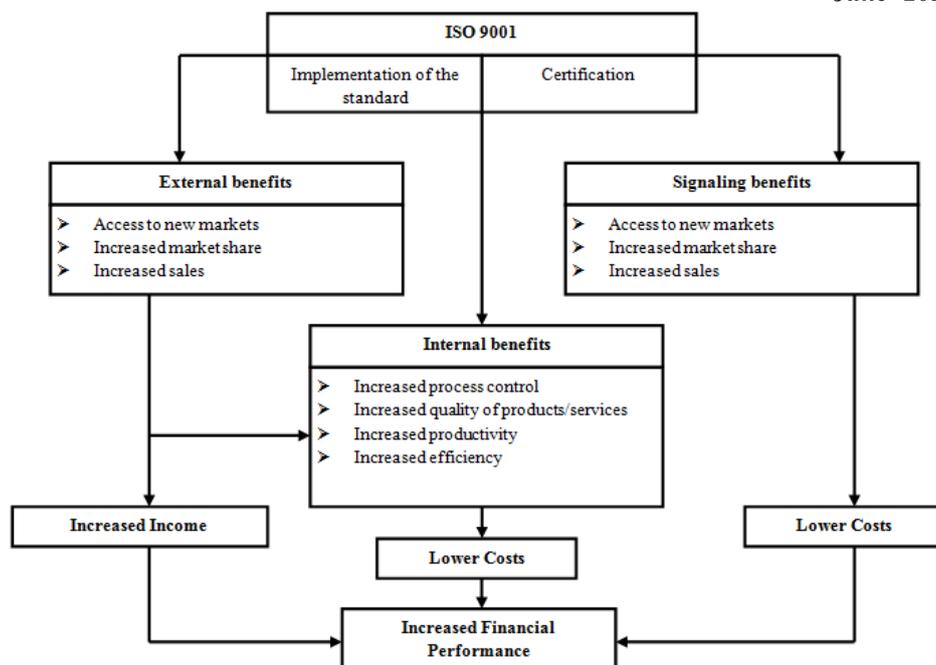


Figure 1: Relationship between ISO 9001 mechanisms and the internal, external and signaling benefits

VII. CAPABILITY MATURITY MODEL

The Capability Maturity Model for Software (CMM), developed by the Software Engineering Institute, the SEI CMM has been the standard set of quality guidelines for companies developing software for the US Government i.e. usually the Department of Defense. The SEI Capability Maturity Model (CMM) was initially developed as an assessment model for software engineering management capabilities of software provider [19-20] [36-37]. Companies wishing to develop software under these standards are evaluated according to five capability levels, ranging from uncontrolled development processes to consistently effective organization-wide implementation. This maturity model presents a growth theory according to which the quality level of a systems development organization can grow theory according to which the quality level of a system development organization can grow along a given growth path. The gist of the model is that several quality levels for the systems development process can be recognized. As a result of this deeper understanding new practices in process-based software engineering have been emerging in the last decade. An organization can go from one stage to another and thus grow from a situation with no quality management to a mature situation with a very high level of quality control (Table 1)

TABLE 1 CMM LEVEL WITH THEIR DESCRIPTION

Level of CMM	Description
1. Initial Processes	<ul style="list-style-type: none"> ➤ Ad hoc, sometimes chaotic processes ➤ Project success not guaranteed
2. Repeatable Processes	<ul style="list-style-type: none"> ➤ Process are characterized ➤ Organization is reactive
3. Defined Processes	<ul style="list-style-type: none"> ➤ Process documented ➤ Process standardized ➤ Tailored standards used for each project
4. Managed Processes	<ul style="list-style-type: none"> ➤ Process understood ➤ Process measured ➤ Process controlled
5. Optimizing Processes	<ul style="list-style-type: none"> ➤ Focus on process improvement ➤ Focus on rapid technology updating

VIII. COMPARISON OF ISO 9000-3 AND CMM

In software industry the ISO 9000 and CMM are widely accepted standards. The CMM using companies are growing rapidly mainly in Europe and Japan where as ISO is being extensively used in major Asian countries. ISO 9000-3 and CMM can be considered stable in the sense that they have widely been used for a number of years and “teething troubles” have been cured. Both of these can be compared as summarized in Table 2 [17].

TABLE 2 COMPARISON BETWEEN THE ISO 9000-3 AND CMM

Basis	ISO 9000-3 Score	CMM Score
Stability	High	High
Scope of the model	Average	Average

Area of application	High	Average
Ease of application	Average	High
Availability of tools	Average	Average
Availability of experience	Average	High
Ease of gradual improvement	High	Low
Ease of presenting results	High	Average
Degree of acceptance	Low	High

IX. SOFTWARE INDUSTRY? ISO 9000-3 OR CMM

As it can be observed from the above discussion that some issues in ISO 9001 are not covered in CMM and vice versa. The levels of detail also differs significantly [32] e.g. Chapter 4 in ISO 9001 is 5 pages long, section 5,6 and 7 in ISO 9000-3 comprise 11 pages where as the CMM standard is over 500 pages length. The ISO 9001 clauses on control of customer-supplied products and handling, packing, preservation and delivery do not have strong relationship to CMM. The clause in ISO 9001 that addresses in CMM in a completely distributed fashion is servicing. There is significant debate about the exact relationships to CMM for corrective and preventive action and statistical techniques. The biggest difference is the emphasis in CMM on continuous process improvement where as ISO only addresses minimum criteria for an acceptable quality system.

So in connection to a software industry it is observed that for certain things both play a genuine role but if the better approach as compared to ISO 9000-3. Figure 2 shows the difference as well as the overlapped portions (similarities).

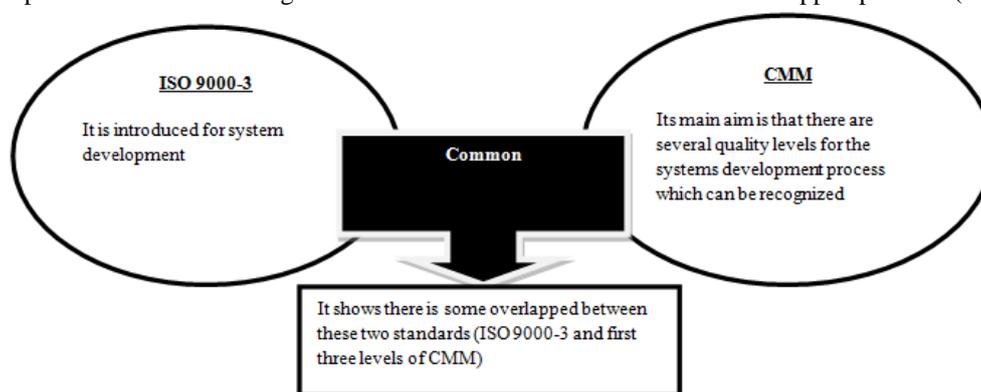


Figure 2: The relationship between ISO 9000-3 and CMM

X. ISO 9000: SOME CRITIC'S ARGUMENTS

Argument 1: It is not necessary that the implementation of an ISO 9000 quality system will always lead to better software products, reduce time-to-market, and improve the return on investment [34].

Pro: Various working group of international experts in quality management meets together to form ISO 9000 suggestions. However, standards are developed by international experts but no empirical proof, no hypothesis, and no explicit [14] model has been given in order to justify or explain the relation between the suggestions of the ISO 9000 family and the achievement of the objectives. Other models for software process improvement, like the Capability Maturity Model (CMM), have similar weaknesses. Following conclusion has been drawn by the experts investigating the position of payoff when they apply CMM: 'We need to achieve an understanding of the critical factors that cause success and failure.' [28]. Therefore, the lack of understanding and of an explicit model explaining causes and effects does not count as a weakness of the ISO 9000 family.

Pro: Very few managers are able to calculate the benefits of an ISO 9000 quality system [9]. Most of them are not sure to what degree the implementation of the ISO 9000 quality system is reducing cycle time, working effort and product failures. There is no collected data, or produced documented records of success. Therefore, there is an unclear impact of ISO 9000 on productivity, cycle time and product quality in most organizations.

Con: Providing guidance to quality management and to quality assurance is the key objective of the ISO 9000 family [22]. Quality Management depends on the objectives an organization practices or on the specific activities it is applied. It may, or may not, lead to increases in output and product quality and in reducing costs and time to market.

Argument 2: 'ISO 9000-3 may be effective for promoting an organization's quality level from third class to second class, but it may not be effective for first-class organizations' [39]. The implementation of an ISO 9001/9000-3 quality system does not benefits mature organizations [15].

Con: ISO 9001 specifies quality system requirements that demonstrate a supplier's capability to provide satisfactory products [22]. ISO 9000-3 specifies guidelines for the application of ISO 9001 to the development, supply and maintenance of software [25]. For 'promoting an organization's quality level' from one class to another class; ISO 9001 and 9000-3 must not be used. ISO 9001 and ISO 9000-3 are not designed to help an organization involved in software development to advance its software process.

- Con: Total Quality Management (TQM) approach, suggested by ISO 9004-1 and 9004-4, emphasizes continuous process improvement, tracking of quality costs, motivation of staff, quality in marketing, leadership, etc. Applying these aspects may also pay off for excellent companies. ISO 9004-1 and 9004-4 mainly supports evolutionary ‘grass-roots improvements’ [14]. However, the standards do not support revolutionary ‘breakthrough improvements’. Unfortunately, as most companies in the software field do not apply ISO 9004-1 and 9004- 4 [9], there is no empirical proof to verify this opinion.
- Pro: A number of software companies have misunderstanding regarding the objectives of ISO 9001 and has used it as a guideline to design and execute a software quality system [1]. ISO 9001 only states minimum requirements. These requirements should be necessary for mature organizations.
- Con: However, most of software-producing organizations are not admirable companies [37]. They have not completed mature software processes. They do not have complete knowledge of software testing strategies, configuration management and other basic software engineering techniques. Although software process improvement is not the objective of ISO 9001 or of ISO 9000-3, the standards might, on the other hand, help second and third-class companies to improve their software development capabilities.
- Argument 3: ISO 9000 application may be sufficient in large software development companies but it may not be sufficient for small companies [34].
- Con: Sizable voluminous software companies had established formalized processes long afore the implementation and certification of an ISO 9000 quality system was orchestrated [14]. When preparing for the certification audits, some sizable voluminous companies only acclimated the quality system to the requisites of ISO 9001 and documented the status quo. These companies did not achieve major amendments. A consequential number of more minuscule software companies had not implemented stable processes, explicit organizational structures, etc. afore they commenced implementing an ISO 9000 quality system. ISO 9000 availed them to accomplish substantial amendments during the implementation of the quality system.
- Con: The precedent counterargument shows that the size of the company is not the most consequential aspect when considering the potential benefits of implementing an ISO 9000 quality system. The subsistence, efficacy and efficiency of organizational structures and procedures are much more consequential. Companies that suffered from a lack of organizational structures and limpidly defined procedures seem to have the most immensely colossal benefits from quality management. Investing in an ISO 9000 quality system customarily pays off in these companies.
- Argument 4: ‘In ISO 9001, support for continuous improvement is almost absent’ [15]. ISO 9001 ‘... is based on conformance rather than effectiveness of an organization’ [8].
- Pro: The sentences are veridical. ISO 9001 does not fortify perpetual amendment. Likewise, ISO 9000-3 does not fortify perpetual software process amendment.
- Pro: Many companies fixate on conformity rather than on efficacy and efficiency. A consequential number of quality systems in the software industry are stakeholder-motivated, which denotes that a company implements a quality system in replication to demands by customers or other stakeholders but not primarily to achieve quality amendments [9].
- Con: The authors of the ISO 9000 standards prefer the management-motivated approach in which the company’s own management initiates the effort to install a quality system. ISO 9000-1 and ISO 9004-1 accentuate the desideratum for perpetual amelioration of processes and products. ISO 9004-1 accentuates that it is ‘a business need to procure and to maintain the desired quality at an optimum cost’ [26]. The arguments quoted above adequately reprove the current practices of some software companies and certification bodies. However, it is not adequate to pick out only one standard of the ISO 9000 family and to ignore other essential standards.
- Argument 5: ‘ISO 9000-3 implicitly requires huge volumes of paperwork, because the only way to show evidence of quality management to third persons ... is by providing documents and keeping records’ [39].
- Pro: It is veridical that ISO 9000 promotes documentation. Documents are highly paramount elements of an ISO 9000 quality system. A quality auditor pointed out that ‘any aspect that has not been documented virtually does not subsist in an ISO 9000 environment’. Many companies engender an inflexible and bureaucratic documentation overhead. A third of all companies regarded the efforts to engender, maintain and update documents required by the ISO 9000 standards as a solemn quandary [16].
- Con: ISO 9004-1 points out that it is ‘a business need to procure and to maintain the desired quality at an optimum cost’ and that it is ‘important that the efficacy of a quality system be quantified in financial terms’ [26]. Of course, these suggestions must withal be applied to documentation. ISO 9000-1 designates the intention of documentation in the context of the ISO 9000 family ‘to be a dynamic high-value-integrating activity’ [22]. Some organizations involved in software development have understood this conception. They have designed and installed IT-systems that support documentation in a very flexible and efficient way [31]. If many companies do not implement cost-efficacious documentation this may be due to a misunderstanding of the standards, or to inadequate advice given by consultants.
- Argument 6: The ISO 9000 standards were designed for quality systems for engendering of tangible manufacturing products. Software is an intangible design-intensive product. The most paramount and fundamental

quandaries with ISO 9001 stem from the fact that its quality systems are designed for tangible products [8, 15, 34, 39].

Pro: It is veridical that the authors of the ISO 9000 standards accentuate some aspects that are typical for engendered. For example, handling, storage, packaging, preservation and distribution are not of great paramountcy in the software field. Additionally, the authors seem to underestimate typical quandaries of software development. ISO 9000 is not subsidiary to surmounting impuissance in software engineering techniques. Quandaries that distinguish software development from a manufacturing environment are conventionally not reduced when implementing an ISO 9000 quality system [9].

Con: However, software development suffers from many quandaries that are prevalent in most industries: inadequate communication, poor documentation, lack of management commitment to quality, insufficient organizational structures, missing process amelioration activities, etc. Software companies have achieved substantial amendments in these aspects during the implementation of ISO 9000 quality systems [9]. ISO 9000 accentuates process management, defect aversion, gratification of customer requisites, maintenance of quality at optimum cost, orchestrating for quality, auditing, perpetual amelioration of the quality system. Most of the rudimentary assumptions of the ISO 9000 family are applicable to tangible as well as to intangible products. They are subsidiary for manufacturing as well as for design-intensive environments.

Argument 7: The software industry should develop standards categorical for software and supersede ISO 9000-3 with them [39].

Con: Software development customarily is an element of sundry accommodations. Similarly, software products are customarily embedded in intricate IT systems consisting of hardware, accommodations, people, organizational structures, and business processes. It might be subsidiary to have mundane standards that are applicable to all elements of an IT system. The ISO 9000 family is such a baseline. The software quality community should not endeavor to erect barriers that might impede co-operation with other disciplines that are essential for developing efficacious and efficient IT systems.

Pro: Of course, the ISO 9000 family has to be complemented by more concrete standards and guidelines. However, this is not typical for the software industry. The chemical, the pharmaceutical, the automotive and the construction industry apply the ISO 9000 standards and they have established standards that transcend the requisites of ISO 9000. These standards are not a component of ISO 9000 and we do not visually perceive any reason why standards designating software quality management should be a component of ISO 9000.

Argument 8: The fixate on certification is the most paramount impotency of the ISO 9000 family [39].

Con: The certification process has been a vigorous impetus for staff members in many software companies [9]. Indubitably the ecumenical trend to certify quality systems has empowered the conception of software quality management. Certification has given the indispensable momentum to the ISO 9000 standards. The ISO 9000 initiative has amended quality cognizance in the software community, at least in Europe.

Pro: Often, customers and official bodies oblige software companies to implement quality systems and obtain a certificate no matter how intransigent this might be. Software suppliers surmise that they will rapidly lose market share if they do not receive an ISO 9001 certificate. They regard an ISO 9001 certificate as a prerequisite for maintaining sales figures. Consequently, they implement a quality system [18] and seek certification albeit they might not be convinced of positive internal effects.

Pro: The current practice of some certification bodies seems to enforce the negative trend. A certificate does not indispensably designate the quality of a quality system [10]. A certificate does not distinguish between organizations that only consummate the letters of ISO 9001 and other organizations that accomplish the spirit of the entire ISO 9000 family.

Pro: ISO 9001 suggests sundry measures, such as contract review, design control, control of quality records, etc. These quantifications can be regarded as abstract solutions to potential quandaries in a concrete organization. However, nobody knows whether the set of solutions suggested by ISO 9001 adequately reflects the quandaries in a concrete organization. An ISO 9001 certificate requires that all measures are implemented, no matter how adequate they might be. Perhaps, in some companies sensible implementation of only one or two elements of ISO 9001 might establish more substantial amendments than cursory implementation of all elements.

Argument 9: ISO 9001 does not provide a framework that can be tailored to meet business needs. Tailorability is relegated to the audit process [39].

Con: ISO 9001 is not a guideline for the implementation of quality systems. ISO 9004-1 and ISO 9004-4 provide guidance for implementing quality management. The suggestions of these standards can be tailored to meet business needs. 'The International Standards in the ISO 9000 family describe what elements quality systems should encompass but not how a categorical organization implements these elements. It is not the purport of these International Standards to enforce uniformity of quality systems' [22].

Pro: ISO 9001 and ISO 9000-3 are open to sundry interpretations. ISO 9001 does not designate the constraints of admissible interpretation and tailorability. The ISO 9001 certificate does neither designate the nature nor the scope of interpretation. A third party has no chance to reproduce interpretation and tailoring in order to analyze whether the quality system is acceptable. Sundry initiatives have been commenced to surmount these quandaries. For example, the TickIT-Guide [12] designates the requisites of ISO 9001 and the

suggestions of ISO 9000-3. ITQS, the acquiescent group for assessment and certification of quality systems in information technology and telecommunication [27], promotes harmonized assessment and certification accommodations in the IT sector. These are subsidiary. However, they still suffer from two impuissant points: first, the initiatives are not apperceived ecumenically. TickIT, for example, does not matter in Germany. Second, the guidelines do not designate the circumscriptions of admissible interpretation and tailorability.

TABLE 3 SUMMARY OF THE ARGUMENTS

Argument 1: ISO 9000 does not obligatorily lead to ameliorated productivity, cycle time and product quality.

Pro: No empirical proof, no hypothesis, and no explicit model justify the relation between ISO 9000 and amended productivity, cycle time and product quality.

Con: Amendments in productivity, cycle time and product quality are not the key objectives of the ISO 9000 family.

Argument 2: Implementing and ISO 9001/9000-3 quality system does not pay off for mature organizations.

Con: ISO 9004-1 and 9004-4 provides guidelines for implementing quality systems. Implementing these guidelines should withal pay off for mature organizations.

Con: Albeit software process amelioration is not the objective of ISO 9001/9003, the standards might nevertheless avail the majority of software companies.

Argument 3: The application of ISO 9000 may be adequate for astronomically immense but not for minuscule companies.

Con: This has been refuted.

Con: Size is not the most consequential aspect; companies suffering from poor organizational structures seem to have the most sizably voluminous benefits from quality management.

Argument 4: ISO 9001 does neither support perpetual amendment nor efficacy of an organization.

Pro: Fortifying perpetual amelioration and ameliorating organizational efficacy is not within the scope of ISO 9001.

Con: ISO 9004-1 and 9004-4 accentuate the desideratum for perpetual amendment and for amending organizational efficacy.

Argument 5: ISO 9000-3 requires sizably voluminous volumes of paperwork.

Pro: ISO 9000 promotes documentation and many companies engender an inflexible and bureaucratic documentation overhead.

Con: The fact that many companies do not implement cost-efficacious documentation is probably due to a misunderstanding of the standards.

Argument 6: The ISO 9000 standards are not adequate for intangible design-intensive products such as software.

Pro: The ISO 9000 standards accentuate some aspects that are typical for the manufacturing industry and underestimate other typical quandaries of software development.

Con: Most of the rudimental assumptions of the ISO 9000 family are applicable to manufacturing as well as to design-intensive environments.

Argument 7: The software industry should develop standards concrete for software and supersede ISO 9000-3 with them.

Con: Software development is conventionally embedded in sundry accommodations. It is an advantage of the ISO 9000 standards that they are applicable to all elements of IT system development.

Pro: The ISO 9000 family has to be complemented by more categorical standards and guidelines. However, this is additionally true of other industries.

Argument 8: The fixate on certification is the most consequential impotency of the ISO 9000 family.

Con: Certification has empowered the conception of software quality management and has given the indispensable momentum to the ISO 9000 standards.

Pro: Many software suppliers fixate on certification. They only consummate the letter of ISO 9001 and do not accomplish the spirit of the entire ISO 9000 family.

Pro: In some companies sensible implementation of only one or two elements of ISO 9001 might establish more sequential ameliorations than cursory implementation of all elements.

Argument 9: ISO 9001 does not provide a framework that can be tailored to meet business needs.

Con: The suggestions of ISO 9004-1 and 9004-4 can be tailored to meet business needs when implementing quality systems.

Pro: ISO 9001 does not designate the inhibitions of admissible interpretation and tailorability.

XI. SYNTHESIS OF THE ARGUMENTS

In the following paragraphs we summarize key aspects of the arguments outlined in the antecedent section. We do this by addressing three questions [14]:

- Does the current discussion adequately reflect the benefits of ISO 9000 for software quality management?
- Most of the critic's arguments do not adequately reflect the benefits of ISO 9000 for software quality management. This is mainly due to two facts: (1) some reprehenders fixate on ISO 9001/9000-3 only in lieu of taking into account the entire ISO 9000 family; (2) some arguments are fair and plausible when reviewing the practice of implementing and certifying quality systems but they are not quite in place when discussing the letter and the spirit of the standards.
- How can software organizations gain maximum benefit of ISO 9000 predicated quality systems?

Most misunderstandings and inadequate implementations of the suggestions of the ISO 9000 family conspicuously result from the fact that software organizations fixate on ISO 9001 when implementing a quality system.

Software suppliers suffering from poor organizational structures conventionally benefit from implementing the requisites of ISO 9001/9000-3 [25]. However, software quality systems could probably be ameliorated more efficaciously if they were predicated on the suggestions of the entire ISO 9000 family, particularly on ISO 9004-1 and 9004-4, rather than on ISO 9001/9000-3 only.

ISO 9004-1/9004-4 predicated quality systems would not fixate on conformity to the standards but on enhancing business prosperity by ameliorating productivity, cycle time, product quality, etc. ISO 9004-1 and 9004-4 suggest a Total Quality Management (TQM) approach [40] that accentuates perpetual amendment, tracking of quality costs, motivation of staff, quality in marketing, leadership, etc.

- How can the ISO 9000 family be amended to fortify software quality management more efficaciously?

The ISO 9000 standards could probably support software quality management more efficaciously

- if the authors of the standards described an explicit model that explicates the postulated cognations between the suggestions of the ISO 9000 family and the accomplishment of the objectives of the standards, and
- if the standardization bodies designated the circumscriptions of admissible interpretation and tailorability of the standards

On this substratum further research work should be conducted to examine under which circumstances which of the suggestions of the ISO 9000 standards are auxiliary to accomplish superior software quality management and to provide confidence that the requisites for software product quality can be met. In particular, empirical research work is needed to assess potential benefits and pitfalls of implementing ISO 9004-1/9004-4 predicated software quality systems

Albeit ISO 9004-1 and 9004-4 accentuate many paramount aspects of TQM the standards could be ameliorated in the following aspects: the responsibility and active participation of all members of an organization in implementing a quality system should be accentuated more limpidly. Furthermore, leadership, change management, and marketing should be fortified more efficaciously.

Most inadequate arguments and inefficient implementations of the suggestions of the standards conspicuously result from misunderstandings of the standards. Standardization bodies should therefore meticulously monitor the current practice of interpreting and implementing the suggestions of the standards. If mundane misunderstandings and paramount pitfalls are detected standardization bodies should probably admonish readers more explicitly of these quandaries.

XII. CONCLUSION

Today we live in an intricate ecumenical economy. Relationships are frequently built on reputations for supplying quality products, accommodations and processes. International values bring technological, monetary and societal benefits. They avail to harmonize technical designations of products and accommodations making business more efficient and breach out barriers to international deal. Orthodoxy to International principles avails support customers that products are secure, efficient and fine for the environment.

As international trade, peregrinate and communications increase, international standards are habituated to enable products to be traded across Europe and ecumenical. Leading experts in the software community accede that we must achieve advances in quality management. According to the survey conducted by Basak Manders and Henk J. de Vries, adopting the quality management standard (ISO 9001) has proven to be very beneficiary for an organization, not only in monetary terms but additionally in non- monetary terms. Certified management standards are quickly diffusing crosswise over numerous commercial ventures. Yet uncertainly still subsists about their role and function. The ISO 9000 provisions frequently followed are (1) examination and test status; (2) investigation and testing; (3) control of non-conformance item; and (4) taking care of, capacity, and conservation. Therefore, the quality management standards are vital for every organization.

REFERENCES

- [1] "European survey reveals construction industry lags behind on ISO 9000", ISO 9000 News, 3 (6), 1994, 4-6.
- [2] "Quality Management Principles", ISO, (2008).
- [3] "The International Guideline: ISO 9000-3", ESSISCOPE.
- [4] Abdulaziz A. Bubshait, Tawfiq H. Al-Atiq, "ISO 9000 Quality Standards in Construction", Journal of Management in Engineering, November 1999.
- [5] Ann Terlaak, Andrew A. King, "The Effect of Certification with the ISO 9000 Quality Management Standard: A Signature Approach", Journal of Economic Behavior and Organization, 2002.
- [6] Basak Manders and Henk J. de Vries, ISO, (2012).
- [7] Boehm, B.W., "A spiral model of software development and enhancement", Computer Vol.21-NO.5, (1998), pp.61-72.
- [8] D. E. Avison, H.U. Shah and D.N. Wilson, Software Quality standards in practice: the limitations of using ISO 9001 to support software development, Software Quality Journal, 3, 105-111, 1994.
- [9] D. Stelzer, W. Mellis and G. Herzwurm. Software process improvement via ISO 9000? Results of two surveys among European software houses, in Proceedings of the Twenty-Ninth Annual Hawaii International Conference on System Sciences, 3-6 January, 1996, Wailea, Hawaii, USA, Volume 1. Software Technology and Architecture, H. El-Rewini and B.D. Shriver, (eds) (IEEE Computer Society Press, Washington, 1996) pp. 703-712.

- [10] D. Stelzer. Interpretation der ISO 9000-Familie bei der Zertifizierung von Qualitätsmanagementsystemen fuer die Softwareentwicklung, in Qualitätsmanagement und Software: ISO 9000-Softwareentwicklung-Ethik-Analysen-Tools, N. Ruppenthal and U. Sigor, (eds) Lit Verlag, Muenster, 1995).
- [11] Daniel Galin, "Software Quality Assurance: From Theory to Implementation", 2004.
- [12] Department of Trade and Industry (DTI), British Standards Institute (BSI) TickIT-making a better job of software. Guide to Software Quality Management System Construction and Certification using EN 29001. Issue 3.0. (DTI, BSI, London, 1995).
- [13] Dien D. Phan, Joey F. George, Douglas R. Vogel "Managing software quality in a very large development project", information and management, Vol.29, (1995), pp.277-283.
- [14] Dirk Stelzer, Werner Mellis and Georg Herzwurm, A critical look at ISO 9000 for software quality management, Software Quality Journal 6, (1997), pp. 65-79.
- [15] F. Coallier. How ISO 9001 fits into the software world, IEEE Software, 11, 98-100, 1994.
- [16] G. Bellin and D. Stelzer. Softwarequalitymanagement gemaeß ISO 9000. Ergebnisse einer empirischen Untersuchung zertifizierter Qualitätsmanagementsysteme. (Studien zur Systementwicklung des Lehrstuhls fuer Wirtschaftsinformatik der Univeritaet zu Koeln, Koeln, 1995).
- [17] G.J. van der Pijl, G.J.P. Swinkels & J.G. Verrijdt, "ISO 9000 versus CMM standardization and certification of IS development", PrimaVera Working Paper 97-09, May 1997.
- [18] Gamsby, S.O., Mize, J.D., and Reid, R.A., "A project management focused framework for assuring quality work process", Proc., 27th Annu. Sem. /Symp., Project Management Institute, Boston, 1996, 1010-1016.
- [19] Humphrey W.S., Characterizing the software process, IEEE Software, March 1988.
- [20] Humphrey W.S., Managing the software process, Addison Wesley, 1989.
- [21] ISO 9000, Encyclopedia of Business, 2 Ed.
- [22] ISO 9000-1, "Quality management and quality assurance standards", Part 1: Guidelines for selection and use (ISO, Geneva, 1994).
- [23] ISO 9000-3, quality management and quality assurance standard, 1997 part 3: guidelines for the application of ISO 9001 to the development, supply and maintenance of software.
- [24] ISO 9000-9004 quality management and quality assurance standard, (1987).
- [25] ISO 9001, "Quality systems: Model for quality assurance in design, development, production, installation and servicing", (ISO, Geneva, 1994).
- [26] ISO 9004-1, "Quality management and quality system elements", Part 1: Guidelines (ISO, Geneva, 1994).
- [27] ITQS European Information Technology Quality Auditor Guide (ITQS, Brussels, 1992).
- [28] J. Herbsleb, A. Carleton, J. Rozum, J. Siegel and D. Zubrow. Benefits of CMM-based software process improvement: initial results (Technical Report, CMU/SEI-94-TR-13. ESC-TR-94-013, Pittsburgh, 1994).
- [29] Juran J.M., Juran on planning for quality, McMillan, New York, 1988.
- [30] Kishu Manghani, "Quality assurance: Importance of systems and standard operating procedures", PMC, Vol.2(1), 2011
- [31] M. Vering and V. Haentjes. Ist ISO ein geeignetes Werkzeug fuer Process Engineering? Ein Erfahrungsbericht aus der SAP-Entwicklung. Management & Computer, 3 (2), 85-90, 1995.
- [32] Monika Yadav, Kaushik Kumar, "ISO 9000-3 or CMM: Which is more extensive for the quality systems in a software industry?" IJAREAS, Vol.3-NO.1, (2014), pp.21-23.
- [33] Nee, P.A., "ISO 9000 in Construction", Wiley, New York, 1996.
- [34] P. Haynes and S. Meyn. Is ISO 9000 going to put you out of business? American Programmer, 7 (9), 25-29, 1994.
- [35] Paul A. Nee, "ISO 9001: Quality systems model for quality assurance".
- [36] Paulk M.C., Curtis B., Chrissis M.B., Capability maturity model for software, Software engineering institute, CMU/SEI-91-TR-24, DTIC Number AD240603, August 1991.
- [37] Paulk M.C., Cusrtis B., Chrissis M.B., Weber C.V., Capability maturity model for software, Version 1.1. Software engineering institute, CMU/SEI-93-TR-24, August 1993.
- [38] Pearson M.J., McCahon C.S., Hightower R.T., Author, "Total quality management: are information system managers ready?" information and management, Vol.29, (1995), pp.251-263.
- [39] T. Matsubara. Does ISO 9000 really help improve software quality? American Programmer, 7 (2), 38-45, 1994.
- [40] Y. Iizuka. Is TQM effective for Software Quality?, in Proceedings of the First World Congress for Software Quality, 20-22 June, 1995, San Francisco, CA, American Society for Software Quality-USA (SSQ), Union of Japanese Scientists and Engineers (JUSE) (eds.) (ASQC, San Francisco, 1995) pp. 1-10.