Design and Development of an Internal Quality Audit System for AWC

by

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ABSTRACT

Quality management systems have been recognized as a successful management strategy long before Japan emerged as a manufacturing world power, particularly in the technology market. American quality pioneers such as Juran and Deming realized early on the potential quality control could offer to increase productivity and profits. many American firms however, failed to fully implement quality management systems in the previous decades.

AWC is facing two critical challenges: A changing market that is demanding more customized products and the loss of production know-how as their personnel retire. Therefore, the company decided to implement a new quality management system. However, without an effective quality audit system, the application and implementation of the new Operational Quality System has proven to be insufficiently monitored.

The purpose of this project is to develop and document the audit process that once realized, will assure that the quality system is properly implemented and operating efficiently. In order to design an effective quality audit system, the literature review will not solely be limited to quality audits, but will also include quality management systems in general.

Based on the literature review and the requirements of AWC, the researcher will develop a quality audit system, consisting of an audit process procedure and audit checklist. To assure compliance with the company requirements and to verify the compatibility with the overall quality project, the researcher will meet regularly with the primary contact person at AWC. In order to assure a controlled and timely development process, project management methodology will be applied.

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Chapter I: Introduction

To maintain a competitive advantage in today's constantly changing environment, companies are forced to continuously re-examine the way they do business. Historical business practices that were successful in the past might be inadequate to suit the current market needs. In the past, companies implemented high volume operations to satisfy the growing demand for products. Manufacturing processes were highly specialized to produce vast numbers of the same product. Now some markets are saturated and customers request more customized products in increasingly shorter time.

AWC has been responding to this trend for the last five years and has been moving more and more to "make-to-order" production instead of producing "make-to-stock" product. However, this new method of manufacturing complicates the production processes and requires better monitoring and control mechanism. Thus far AWC has no formal quality management system in place. Its current quality control activities based on inspection of parts and final products are left to the discretion of the operators and the product line personnel. AWC has an excellent brand reputation; customers perceive its quality as very good and they have the largest market share in their industry. However, this market advantage cannot be sustained or even improved without changing the current quality system.

Simultaneously, AWC is facing another problem, time. Their mature workforce is mostly from the Baby Boomers generation and is starting to retire. Their existing quality procedures emerged over time and became general company know-how or institutional knowledge preserved only in the minds of its dedicated workers. Because vital processes have never been properly documented, AWC is at risk of losing this knowledge as its

workforce retires.

After carefully evaluating their options, AWC chose to replace their patchwork of small quality control systems with a completely new quality management system, called "Operational Quality System" (OQS) according to the existing company terminology. The system consists of five critical elements, representing the "OQS Blueprint":

- Clarity of requirements
- Process documentation
- Part & process performance
- Non-conformance
- Metrics

Tools and procedures are being developed by several cross-functional groups under the umbrella of the OQS department. However, the application and implementation of the system will be done within the different plants with their own personnel.

Statement of the Problem

The application and implementation of the new Operational Quality System in the different plants is currently insufficiently monitored. There are no clear criteria to what level the system has been implemented or whether the implementation has been successful. The various departments and auditors do not know what to look for and, due to the lack of a company-wide standard, audit results cannot be compared between plants and valid conclusions cannot be drawn. The successful implementation and operation of the new Operational Quality System is at risk.

This project will develop and document the quality audit process that, once put into operation, will assure that the quality system is properly implemented and operating

efficiently.

Purpose of the Study

The objective of this project is to develop a five-level internal quality audit system to assure that all departments and business units are measured against the same criteria and follow the objectives and processes of the Operational Quality System. This study will:

1. Develop an internal audit process: Describe the procedure to conduct an internal audit, explain gap reconciliation/response, develop scorecard, and communication tools.
2. Provide plain audit criteria to evaluate achievement level of the implementation of the Operational Quality System.
3. Encompass the entire OQS Blueprint: Clarity of requirements, process documentation, part & process performance, non-conformance, and metrics.

Assumptions of the Study

1. The scope and the basic conditions of the Operational Quality System at AWC will not dramatically change during this study.
2. The contact person at AWC is readily available.

Definition of Terms

Operational Quality System. AWC-internal term for a corporate-wide quality management system.

OQS. AWC-internal abbreviation for Operational Quality System.

OQS Blueprint. AWC-internal term that encompasses all elements of the quality management system.

Limitations of the Study

The objective is to develop a quality audit system, with the implementation to be carried out by company personnel afterwards. Thus, the effectiveness and successful operation of the system cannot be evaluated and verified within this study. Preliminary conclusions will be drawn from the literature review and the requirements of AWC.

Methodology

To design an effective quality audit system it is essential to fully understand the purpose and the strategy of a functioning quality management system. Most of the current literature regarding quality management refers to the early leaders in the field of quality. Thus, the literature review of quality management systems in general will be limited to the works of Juran, Crosby, Feigenbaum, Deming, and Shewhart. Literature will be reviewed that explicitly addresses quality audit systems in a subsequent section.

Based on the results of the literature review and the requirements by AWC, the quality audit system will be developed. In regular meetings, the results will be reviewed and changes recommended. To assure a controlled and timely development process, project management principles are going to be applied.

Chapter II: Literature Review

This chapter is a review of literature in the field of quality. The review is structured into two parts: The first part will outline the views of experts about company-wide quality management systems in general, particularly in regard to the impact on an organization, its processes and organizational structure. The second part will examine the means quality audit systems have been set up to be effective assessment and control tools. It will demonstrate the benefits of a proper internal quality audit system and the risks of misuse.

Quality Management Systems

This part is comprehensive review of the works of the following renowned quality experts:

- Joseph M. Juran, including co-author Frank M. Gryna
- Philip B. Crosby
- Armand V. Feigenbaum
- W. Edwards Deming
- Walter A. Shewhart

This rather unconventional approach was chosen because most of the more recent literature refers to the works of those five quality experts. The order in which the five experts are listed is completely coincidental, but will be maintained throughout the following review. The following questions will be addressed:

- What defines quality
- What is quality management?
- How does a quality management system affect business processes?

- What are the requirements for the organizational structure?
- What is the role of management?

What defines quality?

The term quality has is a subjective analysis and open to interpretation. Each person has his/her own concept of quality and even our experts, introduced different definitions for quality. Juran & Gryna (1993) point out that quality is not new: "Metrology, specifications, inspection – all go back many centuries before the Christian era" (p. 1). Juran (1988) defines quality simply as "fitness for use", but quickly expands that definition to distinguish between "product performance and freedom from deficiencies" (p. 6). In the significance of performance, he relates quality to product features: "Customer satisfaction is a result achieved when product features respond to customers needs. It is generally synonymous with product satisfaction" (Juran, 1992, p.7). Product features, he writes, compete with each other in the market place and are a decisive factor for the external customer to buy a product. In this sense, product satisfaction is related to sales revenue. Product deficiency, on the other hand, is a product failure that results in customer dissatisfaction and has an impact on the costs, due to rework, following up on customer complaints, etc. Juran summarizes, "the main lessons for the manager are: Product features impact sales. As to this kind of quality, higher quality usually costs more. Product deficiencies impact costs. As to this kind of quality, higher quality usually costs less" (Juran, 1992, p. 9).

Crosby (1984) states "the definition of quality is conformance to requirements" (p. 59). He measures quality by the cost of nonconformance to the requirements and points out that it is more cost effective to do things right at the first time. However,

Crosby (1979) indicates that measurements should be established both for measuring the overall cost of quality and for determining the status of product or process compliance. Based on his definition for quality, Crosby stresses the importance of setting clear requirement standards and especially criticizes management for failing to do so.

Feigenbaum's (1991) understanding of quality is "The total composite product and service characteristics of marketing, engineering, manufacture, and maintenance through which the product and service in use will meet the expectations of the customer" (p. 7). This definition focuses clearly on customer expectations as the key parameter. Indeed, he measures the quality in the degree or level to which the product or service meets this total composite and encourages companies to identify all customer requirements as explicitly as possible.

Deming (1992) however, writes from a different perspective and emphasizes the negative consequences of lack of quality, in regard to productivity, cost, and competitiveness. He illustrates clearly how increased quality reduces production cost due to less rework and waste. However, he notes that quality should be aimed at the needs of the customer and "can be defined only in terms of the agent" (p. 168).

Shewhart (1980) defines quality quite extensively and identifies two common aspects of quality:

> One of these has to do with the consideration of the quality of a thing as an objective reality independent of the existence of man. The other has to do with what we think, feel, or sense as a result of the objective reality. (p. 53)

Shewhart indicates that the subjective measures are of commercial interest

because they represent the needs and wants of the customers. However, he also states that to ensure quality control in manufacturing, quality must be expressed in terms of quantitatively measurable properties; either as a set of characteristics, or as attributes of a product.

What is Quality Management?

Not every one of our experts uses the term quality management. Juran (1988) uses the term "The Juran Trilogy" to describe the "three basic managerial processes through which we manage for quality" (p. 11). The three interrelated processes are:

1. Quality planning
2. Quality control
3. Quality improvement

Juran lists the purposes of quality planning as to identify the customers and their needs, to develop a product that corresponds to those needs, and to develop and implement a process able to produce that product. He uses the term 'customer' equally for anyone who is impacted by processes and products, internal and external to the company. The next two processes of the Juran Trilogy take place during production. The goal of quality control is to consistently manufacture products according to the required specifications, while quality improvement focuses on the production processes by identifying opportunities for improvements. The results of both activities provide the planners with feedback and establish the foundation for new, improved processes.

Crosby (1984) states "the system of quality is prevention" and defines quality management as "systematic way of guaranteeing that organized activities happen the way they are planned" (1979, p. 22). He describes management in general as "the function

responsible for establishing the purpose of an operation, determining measurable objectives, and taking the actions necessary to accomplish those objectives" (p. 26). Crosby lists quality control, reliability, quality engineering, supplier quality, inspection, product qualification, training, and testing, as the tools to be applied to solve a particular problem across the whole organization. He argues that quality management is needed to control the increasingly complicated business processes.

Feigenbaum (1991) defines:

> Total quality control is an effective system for integrating the quality development, quality-maintenance, and quality improvement efforts of the various groups in an organization so as to enable marketing, engineering, production, and service at the most economical levels which allow for full customer satisfaction. (p. 6)

Feigenbaum places total quality control outside the traditional inspection-and-test-oriented quality-control departments and relates total quality control as an important responsibility of management. However, he points out that sound technological methods such as reliability testing, vendor rating methods, sampling-inspection techniques, and process control methods, are equally important. He defines control in general as a four step process: Setting standards, appraising conformance, acting when necessary, and planning for improvements. "Emphasis is on defect prevention so that routine inspection will not be needed to as large an extent" (p. 12). According to Feigenbaum a quality management system encompasses four characteristics:

1. It represents a point of view for quality that identifies both how well each component individually works and how well they all work together.

2. It provides the basis for a coherent documentation.
3. It is the foundation for making the various quality activities of the company manageable.
4. It is the basis for systematic improvement throughout the major quality activities.

Deming (1992) does not define quality management, but his "14 points for management" (p. 24) create a system that allows the transformation of a company into a quality oriented organization:

1. Create constancy of purpose toward improvement of product and service.
2. Adopt the new philosophy.
3. Cease dependence on mass inspection.
4. End the practice of awarding business of the basis of price tag alone.
5. Improve constantly and forever the system of production and service.
6. Institute training.
7. Adopt and institute leadership.
8. Drive out fear.
9. Break down barriers between staff areas
10. Eliminate slogans, exhortations, and targets for the work force.
11. a) Eliminate numerical quotas for the work force.

    b) Eliminate numerical goals for people in management.
12. Remove barriers that rob people of pride of workmanship.
13. Encourage education and self-improvement for everyone
14. Take action to accomplish the transformation.

Some of these points still seem a radical departure from the norm. Yet, in Deming's elaboration of the fourteen points, it becomes clear that a complete implementation of these points will lead to an effective quality management system.

Shewhart (1980) looks at the control of quality from the viewpoint of statistical control, a science which he significantly influenced. His book "Economic Control of Quality of Manufactured Product" was originally published in 1931 and contains in regard to statistical methods, probability and distributions, fundamental insight. He states "a phenomenon will be said to be controlled when, through the use of past experience, we can predict, at least within limits, how the phenomenon may be expected to vary in the future" (p.6). He believes that there is an economic state of control of quality by using statistical data and is strong opponent of the traditional 100 percent inspection of parts. He expects the following advantages of statistical quality control (p.34):

1. Reduction in the cost of inspection.
2. Reduction in the cost of rejection.
3. Attainment of maximum benefits from quantity production.
4. Attainment of uniform quality even though the inspection test is destructive.
5. Reduction in tolerance limits where quality measurement is indirect.

Shewhart however, makes clear that the first step of quality control is to identify what the customer wants and needs, and then translate these attributes into physical characteristics. "In taking this step, intuition and judgment play an important role as well as broad knowledge of the human element involved in the wants of individuals" (p. 54).

How does a company-wide quality management system affect business processes?

Juran (1988) understands 'process' in much broader terms than generally found in

the respective literature, where it relates to manufacturing processes only. He defines process as "a systematic series of actions directed to the achievement of a goal" (p. 169). He points out that this generic definition can be applied to processes in all functions within a company and includes personnel as well as equipment. Thus, all processes have to meet following requirements:

- Goal oriented
- Systematic
- Capable
- Legitimate

Within a company-wide quality management system each process must fit into the broader process to avoid sub-optimization. Juran (1992) distinguishes between "macroprocesses" (p.334) for cross-functional processes and "microprocesses" (p. 335) for activities that are generally carried out within a single functional unit. Companies work primarily through macroprocesses, involving several functions to achieve the desired result. Yet companies tend to work within the individual departments without input from the one to follow: "Many designers develop new products, and then deliver the product specifications to the manufacturing department" (p. 3), creating chronic waste during the subsequent operations. Therefore, he suggests that macroprocesses must be developed by representatives of all involved functions, for example a team of line managers for an interdepartmental process.

Crosby's (1979) idea of a process is not as broad as Juran's; he uses the word only for manufacturing processes. He focuses more on functions than on processes. However, he equates activities, like translating shop orders or programming computer tapes, with

procedures and cites them equally to products and processes. He therefore mandates that new and revised procedures have to be tested and verified just as any other manufacturing process to prevent problems.

Feigenbaum (1991) states clearly "total quality control includes in depth not only the activities of the quality-control function, but most importantly the interdependent multifunctional quality activities throughout the organization" (p. 12). He explicitly includes general management, marketing, design engineering, production, industrial relations, finance, and service as well as the quality function itself. He criticizes traditional quality control systems of being limited to production processes only. "The determination of both quality and quality cost actually takes place throughout the entire industrial cycle" (p. 12). He highlights the positive effects that a functioning quality management system may have on the profitability of the business:

- Enhanced salability of the product through meeting the customer's requirements in both the satisfactory function and the price.
- Improved producibility and reduced manufacturing costs through corresponding product design and manufacturing capabilities.
- Increased productivity through reduced rework and scrap.

"Every activity, every job is part of a process" writes Deming (1992, p. 87) and explains that a process is divided into stages, whereas the stages are not individual entities, but part of the whole process. According to Deming the following two activities should happen at every stage:

1. Production, change of state
2. Continual improvement of methods and procedures towards better satisfaction

of the customer at the next stage.

Deming insists that each stage should work with the former and latter to provide short feedback loops and to avoid sub-optimization within the whole process. Such operation assures that all business processes will be improved continuously over time.

Shewhart (1980) states simply "broadly speaking, the object of industry is to set up economic ways and means to satisfy human wants and in so doing to reduce everything possible to routines requiring a minimum amount of human effort" (p. vii). In this sense, he emphasizes the need for continual research about materials and products, and how they behave in manufacturing and in use. Utilizing statistical control, quality management must constantly search for ways to improve processes and procedures not only on the manufacturing floor, but also in research, development, design, and purchasing.

What are the requirements for the organizational structure?

Juran (1992) expresses the concerns "that most quality planning has been done by amateurs – by people who have not been trained in the use of the quality disciplines" (p. 3). He states that some companies failed to resolve this problem by employing quality specialists as consultants. Instead, he suggests sufficient training of the respective personnel. He further claims that most companies are still organized into individual functional organizations headed by managers with the clear responsibility to oversee execution of that function. Therefore, a macroprocess has to travel through multiple functional organizations. This incompatibility between the vertical functions and horizontal processes led some companies to implement a matrix structure or a project organization. Yet, macroprocesses remain insufficiently controlled due to lack of

ownership. Juran therefore suggests implementation of several organizational concepts to solve this problem:

1. An assumed owner, i.e. a manager from the dominant function within the macroprocess owns the entire process.
2. A designated owner, i.e. someone within the macroprocess is dedicated as owner of the whole process.
3. A staff owner, i.e. a manager who is involved in preparing a cross-functional plan like a product manager or a reliability manager.
4. A team ownership, where managers from all involved departments share the responsibility for the macroprocess.
5. Organizations built around macroprocesses. He points out that here a "fulfillment manager" takes responsibility for the entire process.

He indicates however, that the responsibilities of ownership were still undergoing field testing and experimentation at the time the book was written.

Crosby (1979) argues "that quality is too important to leave it to the professionals" (p. 27) and refutes the erroneous assumption that quality originates in the quality department. He writes "unfortunately, most quality professionals feel that they are responsible for quality in their company" (p. 20). He deems the responsibility of the quality manager as instructing awareness for quality – especially to top management, and advising on problem prevention. To do so, Crosby demands that the quality manager is on the same hierarchical level as any other senior manager. Additionally, he advocates that quality functions need to be organizationally separate from the operation they inspect in order to make unbiased decisions and recommendations. Inspectors must also be

trained properly. Crosby assumes that inspectors who report to the lines supervisors do not receive adequate training and will "serve as sorters, go-fers, and general flunkeys" (p. 71). Nevertheless, he believes "if everyone did the job right, you wouldn't need a quality department at all" (p. 272). Since this is rarely the case, he suggests a strong quality organization within each company and describes the roles and responsibilities in detail:

1. Product acceptance, consisting of inspection and testing during production.
2. Supplier quality relating to both quality engineering and purchased goods acceptance, i.e. inspection and testing. Crosby suggests that supplier quality engineering needs to cooperate with purchasing for supplier identification, examination, and development.
3. Quality engineering's broad scope covers data analysis and status reporting, corrective actions, quality planning, qualification of products, processes, and procedures, audits, and quality education. Crosby strongly recommends that quality engineering work closely with both design engineering and manufacturing engineering to best determine how the product should be inspected, tested, and controlled during its complete life-cycle.
4. Quality improvement is the action of initiating and managing quality improvement programs.
5. Consumer affairs includes activities such as identification, investigation, resolution, and future prevention of customer's complaints.
6. Product safety "is not a legal problem, it is an ethical one" (Crosby, 1979, p. 84).

"Experience shows that as much as 80 percent and more of the fundamental

quality problems requiring improvement today are outside of traditional quality-control departments" declares Feigenbaum (1991, p. 151). He explains that those problems may exist because of deficiencies in areas like manufacturing, product development, marketing, customer service, or management. He states that in the past companies often created a quality organization as a short-term response to interdepartmental deficiencies and overlooked the organization-wide impact of quality. So were portions of quality control activities performed by several functional groups in addition to their regular work, included in existing quality-control departments, or divided into new functional quality-control organizations. He notes that other businesses created "a function whose job has been handsomely described as 'responsibility for all factors affecting product quality'" (p. 158) and describes colorfully why these experiments had a very short life span. He recommends pursuing two quality organizational principles. "The first principle is that quality is everybody's job in a business" (p. 158). Therefore, he advocates that the respective quality responsibilities and accountabilities be emphasized to all company employees. He draws total quality control as a horizontal process, crossing all vertical oriented functional units. "The second principle of total-quality-control organization is a corollary to this first one: Because quality is everybody's job in a business, it may become nobody's job" (p.158). To prevent this outcome, he recommends to clearly structuring the organization by creating a "Relationship chart" (p.161). The quality control function however, represents the majority of the quality control responsibilities, while the other organizational units hold mostly a contributing role. The quality control function itself holds the responsibility and accountability for "its three sub-functions quality engineering, process-control engineering (including also inspection and testing),

and quality information equipment engineering" (p. 162). His focus is on closed feedback cycles. Therefore, he views "quality control, whose very life blood is the fast, automatic response of the feedback loop to help company personnel prevent poor quality ..." (p. 181) preferably within a single organizational unit with clear cut responsibilities.

Deming (1992) places emphasis on cooperation and recommends teamwork not just throughout the company, but also between customer and supplier. In his fourth point he advises companies to "end the practice of awarding business on the basis of price tag alone" (p. 31). He explains that purchasing has to change its focus from seeking lowest initial cost to minimizing total cost by working with a single supplier. Deming suggests that a team composed of experts from the supplier together with their own knowledgeable personnel work together to develop the most cost-effective solution. In his ninth point he proposes to "break down barriers between staff areas" (p. 62) to avoid that each area is sub-optimizing its own work. He reasons that team results are always better than the results of individuals: "There is no substitute for teamwork and good leaders of teams to bring consistency of effort, along with knowledge" (p. 19).

In regard to the quality function, Deming illustrates that previous business practices lead actually to increased defects instead of improved quality as expected. He mentions the example of companies performing multiple inspections on the same products. Since every inspector assumes the previous or next inspector would cite the defects, nobody actually did it. "Divided responsibility means that nobody is responsible" (p.30). Another example of decreased effectiveness is the overdependence of some companies solely on their quality control department to assure quality. Deming states "You can not inspect quality into a product" (p. 29) and points out that "quality control

departments have taken the job of quality away from the people that can contribute most to quality" (p.133). He makes clear that everybody in the organization is responsible for creating quality products and processes, and that the function of quality assurance is too often just to provide hindsight to management.

Shewhart (1980) does not address the organizational aspects of quality control. As physicist, engineer and statistician he assigns to the engineers the main responsibility for control of quality, although in a very broad sense.

What is the role of management?

All cited experts assign management – especially senior management – the main responsibility for quality control in the organization. Juran (1992) states "it is now clear that upper managers have a vital role to play in the quality planning process. This role requires extensive personal participation. It cannot be delegated, since major change in company culture is needed" (p.24). To underscore the importance, he dedicates the whole epilogue in his book to management. According to Juran, the responsibilities of upper management include various activities such as:

- Provide personal leadership
- Train managers and specialists in how to plan for quality
- Set and deploy strategic quality goals to various levels in the company
- Mandate participation by those impacted and assign clear responsibilities
- Provide resources
- Establish measures for progress, and review progress regularly
- Participate in quality audits

The list makes clear that upper management is involved in every aspect of quality

management. Exhortation is "not leadership but cheerleading" (Juran, 1988, p. 249).

Crosby (1979) clearly places the responsibility into the hands of all managers, especially those of upper-level management, and not just the quality manager. He states that "[Quality] professionals must guide the program, but the execution of quality is the obligation and opportunity of the people who manage the operation" (p. 28). Like Juran, he demands that management has to participate in rather than merely support any quality efforts. "Management has to get right in there and be active when it comes to quality" (p. 8). Crosby considers management attitude as an important factor for the success of any quality effort and disagrees with the common assumption that quality problems originate by the workers. "Workers are like mirrors. The reflection you see is your own" (p. 273).

Feigenbaum (1991 states "[the quality management system] requires fundamental leadership by company and plant management, whose commitment to quality must be thoroughly communicated and understood by all members of the organization" (p. 84). Indeed, he makes top management accountable for leading and communicating all quality programs in the company. He describes the crucial roles of top management:

- Recognizing the customer's definition of quality at different stages of the product cycle.
- Document and communicate to all employees clearly and specifically the quality structure of the company.
- Implement the managerial and technical customer-oriented quality activities.

According to Feigenbaum the quality manager is however, still responsible for the effective operation of the quality management system and the three quality control sub-functions.

"Support is not enough, action is required" (p. 21) asserts Deming (1982) in relation to the responsibility of top management regarding quality. He too, advises management to participate rather than simply announce a quality program. Furthermore, he writes "the job of management is not supervision, but leadership" (p. 54) and requests that managers must provide the tools to achieve a quality product. "The workers are handicapped by the system, and the system belongs to management" (p.134). He also points out that upper management should be concerned about the profitability of the company in three or more years, rather than focus on short-term profits, since they are no index of ability of success. Finally, his 14 points are aimed directly at management.

Shewhart does not discuss any organizational and operational responsibilities in his book "Economic Control of Quality of Manufactured Product" (1980).

Summary

The five experts Juran, Crosby, Feigenbaum, Deming, and Shewhart share many of the same believes regarding quality control. They generally demonstrate a clear focus on the customer and measure quality in the degree of compliance to customer satisfaction, expectations of the customer, needs, wants, or at least compliance to specifications. Each expects quality management to provide significant benefits for the company, such as cost reduction, increased salability, and productivity. However, they stress the importance to approach quality systematically and recommend measures to achieve the desired result. It is apparent that the use of statistical methods and the proper distribution of the findings are necessary for effective process control. The experts point out that quality programs profoundly affect business processes and the organizational structure of the companies. They firmly believe that every employee in the company has

to take responsibility for quality, particularly top management, and not just the quality department. While Juran and Deming assign the various quality control responsibilities to the line personnel and emphasize cooperation between organizational units, Crosby and Feigenbaum still assign the majority of the quality control activities to the quality department, although with an empowered quality manager in charge.

AWC's Operational Quality System with its five elements follows to a large extent the philosophy of Juran and Deming. "Clarity of requirements" describes the process of obtaining and understanding customer requirements, translating them into product specifications, and designing a product that matches these specifications as well as the present manufacturing processes. "Process documentation" consists of process documentation control, format, and associates training, while "Part and process performance" includes process capability activities, such as SPC, product audits, and error proofing of product and processes. One complete element is also dedicated to "Non-conformance", explaining how non-conforming parts and products have to be separated, evaluated, corrective actions defined and initiated, and feedback provided to the respective functions. Last but not least, "Metrics" closes the control loop with finished product audits, field data analysis, internal process and procedure audits, and "first pass yield" calculations. As mentioned in the previous chapter, the responsibilities for quality control are equally distributed between the plants and the central OQS department. In accordance with Juran and Deming, plant management's main responsibility is product and process compliance, while the OQS department is responsible to provide the tools and the structure, as well as organization-wide coordination and control in the form of standard procedures and internal audits.

Quality Audits

Deming (1982) and Shewhart (1980) do not mention quality audits in the literature reviewed. Therefore, information from additional professional sources will be included.

Juran & Gryna (1993) define a quality audit "as an independent review conducted to compare some aspect of quality performance with a standard for that performance" (p. 567), indicating that an independent auditor should not have any direct responsibility for the area he/she is auditing. Juran (1992) understands audits as "the main tool for guarding against deterioration of a control system" (p. 292). He distinguishes between audits at technological levels and at managerial levels. He indicates that most audits are conducted on the technological level, primarily procedural audits and product audits. He further suggests that quality performance relative to strategic quality goals should be audited by upper management, since auditors who conduct technological audits generally do not have the knowledge and experience needed. He mentions that in some Japanese companies, even the president personally participates in a quality audit. Juran advises companies to plan audits well in advance, in particular at the managerial level, since they require extensive preparatory work.

Crosby's (1979) definition for audit is a "planned examination of a function, carried out either by determine conformance to procedures in process or by critical analysis of the product or service that is the result of the process" (p. 79). Although he is not fully convinced of the benefits of an audit, he mentions that "there is no method more fruitful in exposing the shoddy, inattentive, or misguided" (p. 79). Crosby suggests training key quality department personnel to lead audit teams instead of employing

specialists of the function to be audited, since they are more likely to be biased. He recommends that audits should be specifically planned, conducted by independent and unbiased auditors, and finalizes with a written report. Also, he suggests that operations can conduct periodic self-audits and make the necessary corrective actions themselves. These audits however, should be monitored periodically by quality department individuals.

Feigenbaum (1991) believes in the growing importance of quality audits and defines them concisely as follows: "Quality audit is evaluation to verify the effectiveness of control" (p. 290). He emphasizes that "the purpose is not duplication of product or process control but assurance that there is control" (p. 290). Based on the purpose, he distinguishes between several audit types:

1. Product audit to measure effectiveness of product control, usually performed by process-control engineering and other technical plant personnel.
2. Procedures audit, to examine and verify quality planning and execution; conducted by quality-control engineering or audit team.
3. Quality-system audit, to assess the effectiveness and operation of the quality system; usually performed by a multifunctional team, including top management.
4. Other areas of audit, such as product service audit, quality measurement audit, process audit, vendor quality practice audit, and laboratory reliability testing audit.

Although Feigenbaum recommends regularly scheduled, publicized audits, he also suggests that companies periodically conduct unscheduled procedures audits to avoid

that them becoming too routine. He emphasizes that audits need to be properly planned, conducted by experienced personnel, and recorded. Key personnel must then identify and implement the required corrective actions.

Sayle (1988) uses the term quality assurance interchangeably with management and thus defines a management audit as "an independent examination of objective evidence, performed by competent personnel" (p. 1-6). He proposes that the "aim is fact finding not fault finding" (p. 1-6). He characterizes three audit types: Internal audit, which includes a self-audit, external audit, and extrinsic audit, i.e. the evaluation of suppliers and sub-suppliers. Regardless of the audit scope, he objects to the idea of an informal or unannounced audit, as he claims they consume unreasonable time and may embarrass auditees. He recommends detailed audit planning, starting with the appropriate checklists, the audit preparation, and the entry interview. For conducting the audit, he insists on a systematic, top-down approach of seven steps:

1. Organization
2. Quality management system
3. Compliance
4. Deciding on the system's effectiveness
5. Improvement or simplification potential
6. Quality cost monitoring
7. Improvement opportunities

According to Sayle, the audit ends with the exit interview and the audit report. He does not address corrective action determination and implementation; his considerations are from the perspective of the auditor only.

Russell (2003) states "an audit is some type of formal independent examination of a product, service, work process, department of an organization" (p. 2). He differentiates between external and internal audits and discusses the following audit types:

- The product audit has the narrowest scope. It simply determines if tangible characteristics and attributes of an object are being met.
- A process audit may examine a particular task or sets of processes. It determines if process requirements are being met, specifically whether inputs, actions, and outputs are in accordance with the established plan.
- A system audit determines if a set of interrelated processes meet established system requirements, such as quality manual, policy, and standards.

Russell too, recommends planning and performing audits systematically and identifies key audit principles. Starting with the assignment, he submits that auditors must be free of interest and competent. However, he admits with internal audits, it is impossible to avoid conflicts of interests, particularly in smaller companies. The scope of the audit determines the resources needed, i.e. number of auditors and time allotment. To avoid miscommunication and to confirm the audit schedule, scope, and objectives, he recommends contacting the auditee well in advance of the upcoming audit. He begins the audit with an opening meeting to review the audit plan, schedule, and logistics, and to confirm the exit meeting. Russell (2003, p. 2) divides the physical audit process into four steps:

- Identify plans (what employees are supposed to do)
- Make observations (what employees are actually doing)
- Evaluate the facts collected (sort the evidence)

- Report the results (conformance or noncompliance with established plans)

He highly recommends using audit checklists as an aid for the auditor in the gathering and recording of information. Russell insists the audit end with an exit meeting to present findings, particularly nonconformities and overall conclusions. The records of the meeting will then be included into the final report, while leaving out minor imperfections, names of individuals, and emotional words and phrases.

Summary

The examined literature presents to a large extent agreement regarding planning, execution, and closing quality audits. All authors follow the same basic methodology and deviate only in a few minor points. Therefore, the following conclusions can be made:

- Audits are an independent review of products, procedures, processes, and systems.
- They are an essential tool to avoid deterioration of an established system.
- Audits should be planned well in advance and properly communicated with the auditees.
- Auditors are preferably independent from the area of audit, competent to perform the audit, and unbiased.
- The audit process starts with an opening meeting, followed by the observations, and ends with the closing meeting.
- A written audit report must be provided to responsible personnel, in order for corrective actions to be developed and properly implemented.
- Audit checklists are recommended as a helpful tool for the auditor.

Although authors generally state that unscheduled audits should be avoided,

Feigenbaum suggests performing periodic unscheduled procedure audits. However, he emphasizes that "the objective is not policing but that the audit not become too routine a matter" (p. 294). Depending on the scope and objective, the authors recommend selecting key personnel, including top management to form the audit team. Crosby and Feigenbaum however, identify members of the quality department as auditors, entirely in compliance with their overall quality organization philosophy.

Chapter III: Methodology

AWC is replacing their patchwork of small quality control systems with a completely new quality management system, the Operational Quality System. Tools and processes are being developed in several cross-functional teams under the umbrella of the OQS department.

The application and implementation of the new Operational Quality System in the different plants is insufficiently monitored. There are no criteria detailing what level the system has been implemented or whether the implementation has been successful. Due to the lack of a company-wide standard, audit results cannot be compared between plants, and valid conclusions cannot be drawn. The successful implementation and operation of the new Operational Quality System is at risk.

The objective of this project is to develop a five-level internal audit system to ensure that all departments and business units are measured against the same criteria and follow the objectives and processes of the Operational Quality System. The detailed methodology of the development process is outlined below.

Project Selection

AWC presented a proposed project overview, showing the scope of the overall Operational Quality System project and describing a two-part sub-project. In the initial stage the researcher was to work in conjunction with one project team for a particular product line and create and implement ideas for the communication and visual management portion. The second stage was to identify and research companies that have recently undergone transformation with their quality culture, summarize their successes and challenges, and compare with AWC to identify gaps in their Operational Quality

System.

Although the proposal appeared to be an interesting project, it carried risks:

- The proposed cooperation with the project team at AWC could cause delay of the project, particularly since a clear start and end date had not been established.
- Researching companies that had recently undergone transformation with their quality culture would involve visiting their plants. AWC did not want to disclose the affiliation with the researcher.

Following further examination by AWC, the objective was altered to reflect the existing project. This allowed some independence from the quality project and enhanced the probability of completion within the allotted time. Before the actual project start, the researcher was able to visit AWC's production site, in particular the plant that was chosen for the pilot project, to gain insight into their production processes and quality activities.

Project Initiation

The verbal project proposal was translated directly into a project charter (see Appendix A), without creating an initial document of understanding (IDOU). The project charter, sometimes also called DOU (document of understanding) is generally signed by the project sponsor, in this case the manager of the Operational Quality System. This document contains the complete description of the project in the following sections:

1. Project contact and approval information.
2. Updates and approval log.
3. Business analysis, i.e. problem description, scope, benefits, and impacts of

making no changes, internally as well as externally. Special attention was paid to the questions:

- What is the problem? – Reveal the symptoms.
- What is the real problem? – Identify the underlying causes.
- Whose problem is it? – Identify who is involved.
- Why do we want to solve the problem? – Provide the purpose.

4. Phases and major deliverables. The activities listed could be implemented directly into the project plan as work breakdown structure (WBS).
5. Project vital signs, such as schedule, assumptions, risks and contingency plan, and cost. The schedule overview will be reflected in the project plan.
6. Project staffing, which was formed solely by project sponsor, project leader, and primary contact.
7. Project management approach, including roles and responsibilities, status reporting, and change management, i.e. major changes in the project scope must be approved by the project sponsor.

Project Planning

A project budget was not created, for the following reasons:

- There were no actual costs involved.
- It was assumed that the project leader, in this case the researcher, has unlimited time resources. This is only true within a certain range, but appropriately reflected the flexibility of the researcher.
- The work breakdown structure (WBS) was sufficiently defined in the project charter.

The project plan was developed in the 3-month trial version of Microsoft Project Professional 2003. The original project plan (see Figure 1) was based on the assumption that the project would be completed by the end of March 2006. Benchmarking, originally intended as an additional research option, was limited to the identification of potential companies, because the literature review provided sufficient information.

The project is delayed however, due to a debate about the five achievement levels of the implementation of the Operational Quality System. The discussion had been initiated by a series of proposals from the researcher. An elucidation of this incident will follow under paragraph audit checklist (p. 34).

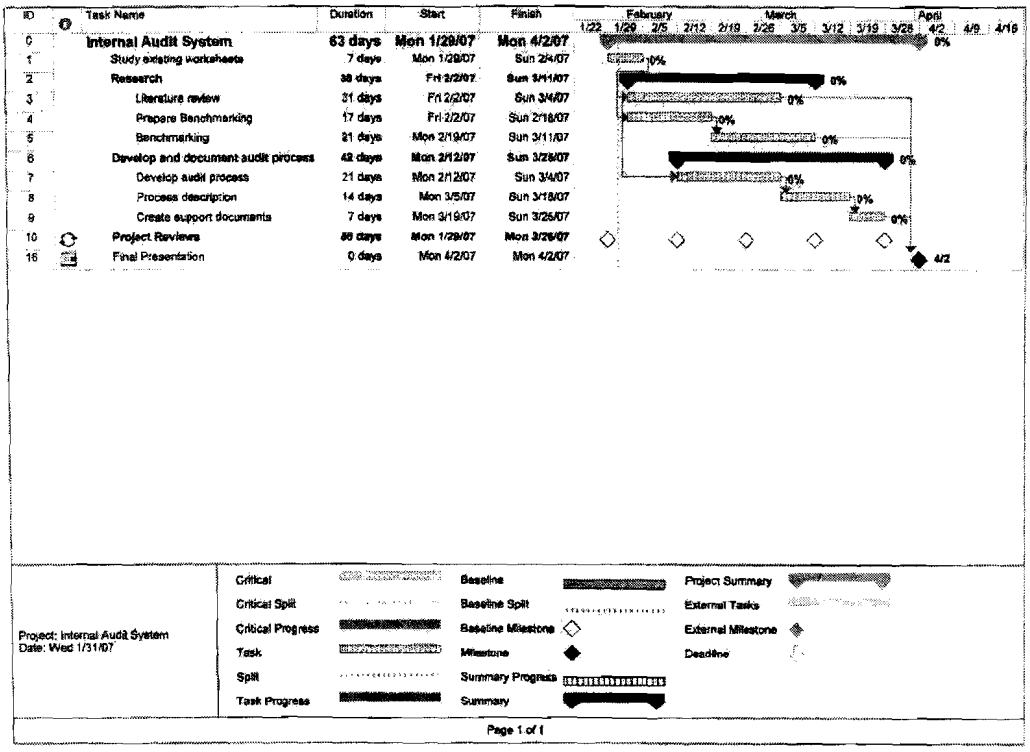

Figure 1. Project Plan for the Development of the Internal Audit System

Development Process

The development of the audit system and the audit tools was based on the following conclusions of the literature review and the requirements of AWC:

Conclusions of the literature review

- Audits are an independent review of products, procedures, processes, and systems.
- They are an essential tool to avoid deterioration of an established system.
- Audits should be planned well in advance and properly communicated with the auditees.
- Auditors are preferably independent from the area of audit, competent to perform the audit, and unbiased.
- The audit process starts with an opening meeting, followed by the observations, and ends with the closing meeting.
- A written audit report must be provided to responsible personnel, in order for corrective actions to be developed and properly implemented.
- Audit checklists are recommended as a helpful tool for the auditor.

AWC's requirements

1. Describe the procedure to conduct an internal audit, explain gap reconciliation/ response, develop scorecard, and communication tools.
2. Provide plain audit criteria to evaluate achievement level of the implementation of the Operational Quality System.
3. Encompass the entire OQS Blueprint: Clarity of requirements, process documentation, part & process performance, non-conformance, and metrics.

To assure compliance with the requirements and to verify the compatibility with the overall quality project, the researcher met with the primary contact person at AWC on a bi-weekly and weekly basis. In addition to monitoring the project progress, the

company representative also reviewed various versions of the checklist, discussed changes, and informed the researcher on the current state of the development and implementation of the Operational Quality System.

Audit procedure

The audit process procedure (see Appendix B) was developed first. The most critical change was the expansion to a three-tiered audit system that encompasses multiple audit types:

1. Self-audit through plant personnel
2. Internal OQS audit
3. External audit by third party firm

AWC gave final approval to the procedure on May 7, 2007, and released it to the plants for testing.

Audit checklist

The audit checklist (see Appendix C) underwent the most significant changes. Without comprehensive knowledge of AWC's roadmap for the implementation of the Operational Quality System, the researcher was not able to define level-by-level audit achievement criteria. The several loops of trial-and-error however, led finally to the re-evaluation of the broad scope of the quality project and to the development of the five steps for the implementation of AWC's Operational Quality System. The attached checklist represents a preliminary version of the final audit checklist.

Summary

The project followed in general project management methodology, consisting of project charter, project plan in form of a Gantt-chart, and the actual development process.

The audit system and the audit tools were developed based upon the conclusions of the literature review and the requirements of AWC. To assure compliance with the company requirements and to verify the compatibility with the overall quality project, the researcher met with the primary contact at AWC regularly. While the audit procedure has been approved by AWC and released for testing, the audit checklist is being revised.

Chapter IV: Results

AWC is implementing a new Operational Quality System to replace their patchwork of small quality control systems. However, the application and implementation of the new quality system are insufficiently monitored. Due to the lack of a company-wide standard, audit results cannot be compared between plants and valid conclusions cannot be drawn. The objective of this project was to develop a five-level audit system that, once put into operation, will assure that the quality system is properly implemented and operating efficiently.

The development of the system was based on the conclusions of the literature review and the requirements of AWC. To assure compliance with the company requirements and to verify the compatibility with the overall quality project, the researcher met with the primary contact at AWC regularly.

Audit Procedure

The audit procedure (see Appendix B) is a reference document for personnel involved in quality audits at AWC. It informs auditors, auditees, supervisors, and managers about the purpose and the scope of internal audits. It also explains which procedures are to follow when performing such audits. The paragraph numbers indicated in the following argumentation refer to the audit procedure found in Appendix B.

Paragraph 1.0 "Purpose" reiterates the problem statement of the project. It also explains why this procedure was developed. Paragraph 2.0 "Scope" includes AWC's requirement which encompasses the entire OQS blueprint and specifies to what audit level the procedure is to be applied. The definition of the 3-tiered audit process can be found in paragraph 3.0, along with audit specific terms and acronyms.

Paragraph 4.0 not only describes how to conduct an audit, but also specifies the requirements for internal quality auditors and how an internal quality audit needs to be planned. The purpose and the scope of internal audits are explained in the introduction of this paragraph.

AWC recruits members of the central Operational Quality System group as well as from plant personnel for their internal quality auditors. The training of new quality auditors takes place either through experienced members of the Operational Quality System group or through attending quality audits with experienced auditors. The responsibility of training auditors for level-1-self-audits is shared by the plant manager and the quality coordinator.

The audit plan comprises all audit dates within the applicable planning horizon. This procedure refers to level-2 internal audits only; self-audits are planned and conducted through the individual plants. In this case the plant manager together with the quality coordinator is responsible for creating an audit plan. Depending on the application and practicability, the area of audit can either be an organizational area or a business process that crosses multiple organizational units. In contrast the audit area of a self-audit is typically a work center or a work station. The names of the designated lead auditors are displayed in the audit plan to assure their availability.

For the audit preparation process special attention is paid to provide an extensive communication between the lead auditor and the responsible manager, or supervisor respectively.

The audit is to be conducted according to the applicable process descriptions, work instructions, or checklists. For self-audits however, process descriptions and

specifications are sufficient to perform the audit.

During the closing meeting, auditees and their supervisors have the opportunity to correct incorrect findings due to misinterpretations by the auditors. Thus, unnecessary discussions during the gap reconciliation/response process can be avoided.

The audit report should accurately reflect the audit and the discussions during the closing meeting to avoid unwanted surprises. Gap reconciliation/response follows problem solving methodology to assure the elimination of the actual causes of non-conformance instead of fighting the symptoms. The effectiveness of the corrective action is verified during the review process through the responsible manager. Maintaining a database allows for proper tracking and follow-up as needed.

Audit Checklist

The audit checklist (see Appendix C) is structured according to the OQS Blueprint and contains the complete audit criteria. The achievement levels are divided into percentages to obtain tangible measures. Therefore, the audit process is separated from the different personalities of the auditors and the risk of bias is reduced.

The requirements of the scorecard and the communication tool were accomplished by assigning points to the different achievement levels. The attained points then have to be transferred to the right column and a sub-total can be calculated for each group. The final score is established by adding all sub-totals and the degree of implementation can be determined by circling the respective field in the arrow. Thus, the results can be easily compared and communicated.

Conclusion

Although test results are not yet available, it can be assumed that the quality audit

process will achieve the desired results. All of the requirements have been met and the audit process has been described in enough detail to ensure that audits will be conducted in a very similar manner by the various plants. Thus, the results of the audits can be compared with each other and allow valid conclusions about the level of implementation and operation of the new quality management system.

Chapter V: Discussion

The purpose of this study was to develop and document a five-level internal quality audit system for AWC that, once put into operation, will assure that the quality management system is properly implemented and operating efficiently. The objective of the quality audit system is to ensure that all departments and business units are measured against the same criteria and follow the objectives of the Operational Quality System.

To be able to design an effective quality audit system, it was essential to fully understand the purpose and the strategy of a functioning quality management system. Therefore, the review of literature was not limited to quality audits, but included the works of five experts in the area of quality in general.

Project management principles were applied to assure a controlled and timely development process. To guarantee compliance with the company requirements and to verify the compatibility with the overall quality project, the researcher met with the primary contact at AWC on a regular base.

Limitations

The objective was to develop a quality audit system, with the implementation to be carried out by company personnel. The two documents meet the requirements of AWC and follow the advice of the quality experts as discussed in the literature review.

Observations

AWC's efforts in regard to quality are aligned with the recommendations of Juran and Deming. The OQS blueprint encompasses all areas that the cited experts indicated to be critical. "Clarity of requirements" explains the process of obtaining and understanding customer requirements, translating these requirements into product specifications, and

designing a product that matches these specifications as well as the present manufacturing processes. "Process documentation" consists of documentation control, format, and training, while "Part and process performance" includes process capability activities, such as SPC, product audits, and error proofing of product and processes. "Non-conformance" explains how non-conforming parts and products have to be separated, evaluated, corrective actions defined and initiated, and feedback provided to the respective functions, while "Metrics" closes the control loop with finished product audits, field data analysis, internal process and procedure audits, and "first pass yield" calculations.

In the new Operational Quality System the varied quality control responsibilities are distributed among the associates. In-process inspections are to be performed by the operators, complete units are tested by plant personnel, and scrap reporting and analysis are performed by the same performance engineering group that generates sampling plans and control plans. As recommended, the responsibility for the Operational Quality System is designated to the Plant Manager along with a Quality Coordinator. The quality management system however, is not yet completely developed.

These circumstances had a definite impact on this study. The development of the audit checklist with the five achievement levels raised questions that the project team at AWC was not able to answer. Although the team was knowledgeable about how to approach the implementation of the Operational Quality System, during further investigation it became apparent that certain conditions in one OQS element would have to be fulfilled before an activity in another element could be started. This discovery resulted in a complete overhaul of the content of the proposed audit checklist and a

fundamental review of the achievement levels.

Next Steps

When feedback from the audit test runs is available, the OQS project team at AWC will review the audit procedure and initiate changes as necessary. Close attention will be paid to keep the audit process aligned with the Operations Quality System to avoid sub-optimization and loss of effectiveness. During further development of the Operations Quality Systems changes of the subordinate audit system are inevitable and necessary.

Once the project team at AWC establishes a detailed overview of the OQS implementation levels, the checklist can be updated to reflect the altered circumstances. If the implementation levels are divided into distinctive OQS elements, the achievement levels in the existing form can be eliminated. Nevertheless, it can be presumed that the project will be completed in the very near future.

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Appendix A: Project Charter

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PROJECT CHARTER

Project Contact and Approval Information			
Project Name	Developing an Internal Quality Audit System		
Sponsoring Organization	AWC		
Project Sponsor	**Name:** [redacted] **Phone:** [redacted] **Office Address:** [redacted] **Email:**		
Project Leader	**Name:** Karin Stricker **Phone:** 715-222-4232 **Office Address:** 92 206th St. New Richmond **Email:** strickerk@uwstout.edu		
Principal Contact	**Name:** [redacted] **Phone:** [redacted] **Office Address:** [redacted] **Email:**		
Date Chartered: 01/31/07	**Project Start Date:** 01/29/07	**Target Completion Date:** 03/31/07	
Revision: --	**Date:**		
Sponsor Approval Signature:	**Date:**		

Updates & Approval Log		
Revision	**Date**	**Sponsor Approval Signature**

1.0	BUSINESS ANALYSIS
1.1	**Business Problem/Opportunity** **What is the problem:** Lack of an internal quality audit system **What is the real problem?** Development and implementation of the new Operations Quality System in the different organizational units is insufficiently monitored. There are no clear criteria to what level the system has been implemented and if the implementation has been successful thus far. Departments and auditors don't know what to look for / look at. **Whose problem is it?** All organizational units throughout the corporation, including Operations Quality System. **Why do we want to solve the problem?** To assure the successful implementation and operation of the Operations Quality System.
1.2	**Project Scope/Objective** The goal of this initiative is to develop a 5-level internal quality audit system that can be used throughout AWC. **In Scope:** 1. Audit process, consisting of – Description of how to conduct an internal audit – Area of audit – Things to look for / look at – What "proof" consists of – Gap reconciliation / response – Scorecard and communication tool 2. Definition of audit achievement criteria – Level by level criteria – Clear distinction between levels – Clear criteria to evaluate 3. Covering "OQS Blueprint": – Clarity of requirements – Process documentation – Parts & processes – Non-conformance – Metrics **Out of Scope:** There will be no direct correlation to the existing production processes.
1.3	**Benefits & Potential Value(s)** Tool for monitoring and controlling the progress of developing, implementing and maintaining the new operations quality system.

1.4	**Impacts of Doing Nothing – Internal to the Business** The successful implementation and operation of the operations quality system cannot be assured. Efforts of the project team might not be utilized and time and money is wasted.
1.5	**Impacts of Doing Nothing – External to the Business** Customers might move to other manufacturers who have a better control over their manufacturing processes.

2.0	**PHASES & MAJOR DELIVERABLES**
2.1	**Deliverables** Complete audit documentation, i.e. 1. Process description ("procedure"), incl. responsibilities, reference to support documents, etc. 2. Support documents (forms, work instructions) as necessary
2.2	**Activities (list in sequence order if known)** 1. Study existing worksheets 2. Research (literature review and benchmarking, if applicable) 3. Develop and document audit process 4. Create support documents

3.0	**PROJECT VITAL SIGNS**
3.1	**Overview of Schedule** **Start:** **1/29/07** **Required Delivery:** 3/31/07 **Timing Concerns:** Project to be used for plan B paper (thesis due date 5/16/07)
3.2	**Assumptions / Dependencies** – Principal contact available when needed – No major changes in scope after projected start date
3.3	**Major Quality Assurance Reviews and Roles** Bi-weekly project reviews for schedule, scope and quality.
3.4	**Risks and Contingency Plans to Cover Them** Primary contact is not available: Project sponsor will ensure sufficient and competent covering.
3.5	**Estimated Labor Costs (# Hours)** "Principal contact" approx. 2 hours every two weeks.
3.6	**Estimated non-Labor Costs** None.

3.7	**Interdependencies with Other Projects** Other quality assurance initiatives will not be affected immediately, since the audit process will be held general and process neutral.
3.8	**Functional Areas Impacted by Request** Door Assembly Documentation Accessibility, Training, & Manual Process Monitoring & Performance Non-conformance Other:

4.0	**Project Staffing**
4.1	**Project Staffing and Time Commitments** Project staffing is located on cover page, time commitments can be found under "3.5 Estimated Labor Cost (# Hours)"
4.2	**Special Resources Needed** Not known at this time
4.3	**Project Organization (Roles & Responsibilities)** See "5.1 Project Management Approach"

5.0	**Project Management Approach**
5.1	**Approach** Project Leader: Reports directly to "Principal Contact" Develops internal audit system independently. Keeps track of project progress. Principal Contact: Reviews project status and informs Project Sponsor about possible issues. Assures project scope is met. Project Sponsor: Approves changes in the project scope. Provides resources as needed.
5.2	**Status or Progress Reporting Plan** Project leader reports project status and indicates possible issues.
5.3	**Change Management Approach** Major changes in the project scope have to be approved by project sponsor.

Appendix B: Audit Procedure

Note: This is an unformatted and company-neutral version, because the actual document contains AWC-proprietary information.

1.0 Purpose

The purpose of this procedure is to standardize the internal quality audit process within the whole corporation, to assure that all departments and business units are measured against the same criteria and follow the objectives and processes of the Operational Quality System.

2.0 Scope

This procedure describes in detail level 1 and 2 of the 3-tiered quality audit process and provides guidelines for external contractors conducting level 3 audits. Together with its supporting document, the checklists, the procedure encompasses the whole "OQS Blueprint":

- Clarity of Requirements
- Process Documentation
- Parts & Process Performance
- Non-conformance
- Metrics

3.0 Definitions

3-tiered Audit (describes the three audit levels):

1. Self-audit through plant personnel to assure that all existing Process Procedures and Work Instructions are properly applied and followed. The plant manager is responsible that these audits are conducted at least twice a year.
2. OQS audit, focusing on the degree of the implementation and operation of the Operational Quality System. The OQS manager assures that such audits are conducted at least once a year for each plant.
3. External audit, conducted approximately once every 2 years. This audit is conducted by an external firm to evaluate the effectiveness of the Operational Quality System and to measure against the current industry standard.

Audit-specific terms

Quality audit: A systematic and independent examination to determine the effectiveness of a company's quality management system.

Lead Auditor: Experienced auditor holds overall-responsibility for the audit

Co-Auditor: Additional auditor(s) properly trained and qualified to conduct internal audits

Auditee: Person to be audited

Degree of implementation: Audit and supporting documents consider the degree of implementation of the Operational Quality System in five steps from 1 = Start of implementation to 5 = Implementation completed and system operational.

Acronyms

CTQ	Critical to Quality
DFMA	Design for Manufacturing and Assembly
FPY	First Pass Yield
MRB	Material Review Board
PLM	Product Lifecycle Management
TPM	Total Productive Maintenance

4.0 Procedure

Quality audits are used to evaluate, monitor and assure the proper implementation and operation of the Operational Quality System and do not release the supervisor from the responsibility of managing his/her daily business. Audits focus on the business processes and are intended to discover major gaps in the system. They should therefore not be conducted without timely notification of the involved personnel.

Requirements

- Lead auditor and co-auditors have to be qualified to conduct internal quality audits through either training and/or experience.
- To maintain the required objectivity, the lead auditor must be from outside the audited department whereas co-auditors may be assigned from within.
- Lead auditor and co-auditor(s) need to have knowledge of the processes to be audited and should conduct the audit in a way to keep interruptions of the production process at a minimum.

Audit Plan

OQS together with the individual plant managers creates an audit plan for the AWC, comprising audit dates, area of audit, and names of the lead auditors.

Audit Preparation

Minimum of 5 days before the audit:

- Lead auditor and responsible manager/supervisor discuss the area of audit, and define time and personnel to be audited.
- If not already determined, the lead auditor appoints appropriate co-auditor(s) and creates a detailed audit schedule based on the area of audit and previous gap/deficiency reports.

Minimum of 3 days before the audit:

- The lead auditor sends the audit schedule to each auditee, to the respective manager/supervisor, and to the co-auditor(s).

Day of audit:

- Lead auditor and co-auditor(s) hold opening meeting to discuss audit procedure with involved personnel and to resolve possible time conflicts.

Audit Conduct

Lead auditor and co-auditor(s) conduct the audit based on the relevant processes and according to the appropriate audit checklist(s) at the workplace of the each

auditee. Gaps are marked in the checklist to be discussed during the closing meeting.

Closing Meeting
Lead auditor and co-auditor(s) hold a closing meeting with all auditees and their supervisor to discuss the findings of the audit. Grade of fulfillment, outstanding performances, and gaps are brought up and potential misunderstandings by the auditors can be corrected.

Audit Report
The lead auditor is responsible that the results of the closing meetings are being included into the audit report and that the gap/deficiencies are entered into the database. The report consists of the following:
- Author name and date
- Summary
- Audit findings

A copy of the report, together with revised audit schedule if applicable, and gap/deficiency reports has to be sent to the involved managers(s)/supervisor(s), the for the audit responsible manager, and to everyone who is responsible for gap reconciliation and response.

Gap Reconciliation and Response
Gap reconciliation/response should to be performed according to the following methodology:
1. Analyze the problem
2. Determine possible/potential causes
3. Select and implement solution
4. Evaluate the solution and follow up if necessary
5. Report successful gap reconciliation to the for the audit responsible manager

Review
The responsible manager or his/her designated representative reviews and approves the gap/deficiency report or returns report to the originator, if the problem is not adequately solved. Results of the review must then be entered into the database for follow up as needed.

5.0 Additional Documents
Checklist

Appendix C: Audit Checklist

Note: This is an unformatted and company-neutral version, because the actual document contains AWC-proprietary information.

Clarity of Requirements

Product Definition

Are product requirements (appearance, performance, operation) clearly understood?

1. Voice of the Customer incorporated:
   ☐ No (0 points) ☐ Pilot exist (1 point) ☐ ≥ 50% of all product lines (2 points) ☐ ≥ 85% (3 points) ☐ 100% (4 points) _____
2. FMEA performed:
   ☐ No (0 points) ☐ Pilot exist (1 point) ☐ ≥ 50% of all product lines (2 points) ☐ ≥ 85% (3 points) ☐ 100% (4 points) _____
3. Cause-and-Effect Matrix created:
   ☐ No (0 points) ☐ Pilot exist (1 point) ☐ ≥ 50% of all product lines (2 points) ☐ ≥ 85% (3 points) ☐ 100% (4 points) _____

Product Design

Does product design match manufacturing processes?

4. Datum points of documentation match practice:
   ☐ No (0 points) ☐ Pilot exist (1 point) ☐ ≥ 50% of all product lines (2 points) ☐ ≥ 85% (3 points) ☐ 100% (4 points) _____
5. Product development group is partnered with value stream:
   ☐ No (0 points) ☐ Yes, explain:_____ (4 points) _____

Is product documentation reflective of new documentation strategy?

6. New drawing standard applied:
   ☐ No (0 points) ☐ Pilot exist (1 point) ☐ ≥ 50% of all product lines (2 points) ☐ ≥ 85% (3 points) ☐ 100% (4 points) _____

Quality

7. Clear Quality vision from management received:
   ☐ No (0 points) ☐ Yes, explain:_____ (4 points) _____

Total points "Clarity of Requirements" (ideal score 28 points) _____

Process Documentation

Format

Do documents follow standard format and templates?

8. Process Procedures:

☐ No	☐ Pilot exists	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

9. Work Instructions:

☐ No	☐ Pilot exists	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

10. Control Plans:

☐ No	☐ Pilot exists	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

11. Standardized Work:

☐ No	☐ Pilot exists	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

12. Visual Aids:

☐ No	☐ Pilot exists	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

Content

Does process documentation match part/product specification and practice?

13. Process Procedures:

☐ No	☐ ≥ 10%	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

14. Work Instructions:

☐ No	☐ ≥ 10%	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

15. Content Approval for Control Plans:

☐ No	☐ ≥ 10%	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

Training and Monitoring

Are associate training systems in place?

16. Standard training matrix exists:

☐ No	☐ Pilot exists	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

17. Standard training matrix being utilized:

☐ No	☐ Pilot	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

Is a consistent audit process in place?

18. Standardized work audit performed:

☐ No	☐ Pilot	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

Total points "Process Documentation" (ideal score 44 points) _____

Part & Process Performance

Process Capability

Are SPC systems for part and process CTQ's established?

19. SPC training for associates provided:

☐ No	☐ Pilot	☐ ≥ 50%	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

20. Manual charting:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

21. Manual control charting:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

22. Electronic SPC:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

23. Demonstrated process capability through SPC:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

Error Proofing

Are predictive tools or error proofing in place to ensure/sustain capability in a proactive manner?

24. "4 Stages of Error-Proofing" displayed:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

25. Visual aids available to minimize defects:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

26. Jigs/fixtures created to avoid defects:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

Total points "Part & Process Performance" (ideal score 32 points) _____

Non-Conformance

Is a traceability system in place to track parts and products throughout the manufacturing process and during service life?

27. Nonconformance system clearly defined and active:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

28. Container Strategy implemented:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

Total points "Non-conformance" (ideal score 8 points) _____

Metrics

Are all associates aware of metrics and understand where the data comes from?

29. Standardized calculation for FPY implemented:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

30. Finished product audit performed and results shared with associates:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

31. Clear metric for air/water performance established:

☐ No	☐ Pilot exist	☐ ≥ 50% of all product lines	☐ ≥ 85%	☐ 100%	
0 points	1 point	2 points	3 points	4 points	_____

Total points "Metrics" (ideal score 12 points) _____

Summary

Scores

1	Clarity of Requirements (ideal score 28 points)	_____
2	Process Documentation (ideal score 44 points)	_____
3	Part & Process Performance (ideal score 32 points)	_____
4	Non-conformance (ideal score 8 points)	_____
5	Metrics (ideal score 12 points)	_____
	Final Score (ideal score 124 points)	_____

Degree of Implementation (circle one):