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**ISO 9000 CERTIFICATION PROJECTS:
FOUR COMPANIES COMPARED**

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EMP - 9415

Abstract

The efforts of four companies to achieve ISO certification are profiled with emphasis on project management issues arising from the efforts. The ISO standards are a set of quality management system guidelines which are primarily implemented when a company wants to sell in the European market, to gain a competitive advantage, or to improve quality. The four companies profiled and analyzed are AT&T Submarine Systems, Inc., Calgon, Fujitsu, and Tektronix. The methodology used is to create a survey addressing the six key dimensions of project management, which is administered to four different functional positions within each company. Data is analyzed by company and by function in search of patterns. Current literature is reviewed for examples of project management methods and the ISO certification effort. Observations based on data are analyzed, and recommendations and conclusions are made.

Project management techniques are found to be effective in the ISO implementation efforts. Project structures used by all four companies are found to be similar. ISO efforts require strong management support and cross functional participation. Users of the systems must be involved in the creation of the processes and documents. Clear communication of the mission, goals, and meaning of ISO is essential for success.

I. INTRODUCTION

Over the last two years, AT&T, Calgon, Fujitsu, and Tektronix, pursued and achieved ISO 9000 certification. This paper profiles each company and examines the project aspects of their implementation and certification efforts. Information on their experiences has been gathered through personal interviews and a questionnaire. Analysis of this data presents the similarities and differences encountered by the companies. Further discussion examines these results and identifies trends within the companies and across functional organizations that are common to each of the companies. Finally, recommendations, for other companies that are pursuing ISO 9000, are given based on the results found.

A. *WHAT IS ISO 9000?*

Whether organizations sell products or services, customer expectations are usually incorporated into a set of specifications. However, these specifications are not guarantees for the consistency of a product's quality. This need for consistent quality has resulted in a series of standards, ISO 9000. The standards are basically a set of Quality Management System (QMS) practices and guidelines. However, the ISO 9000 system is not a unique "system" in itself. Implementing ISO 9000 forces a company to record its management systems in such a way that certain specific actions and procedures are not overlooked. However, the series is not intended to standardize quality systems implemented by these companies [12].

B. WHY IMPLEMENT ISO 9000 GUIDELINES?

Customer demand for better quality products and services has escalated greatly since World War II. This demand has contributed to the establishment of standards dedicated strictly to quality in many countries. While national standards may assure that compliant companies have initiated a quality program, it does not solve the problems of verification of compliance and comparison of requirements between different countries' standards. These type of issues contributed to the development of the ISO 9000 international standards [9].

In response to this demand, most European companies are certifying their quality systems to ISO 9000. The ISO 9000 series has been adopted by many nations and regional bodies and is rapidly supplanting national and industry-based standards as companies worldwide prepare to sell to the European Community (EC) [7]. Growing worldwide acceptance of ISO 9000 demonstrates the importance of becoming certified [6].

Businesses primarily implement ISO 9000 guidelines for the following reasons [8],[11]:

- * Selling in the European Community marketplace
- * Gaining competitive advantage
- * Quality improvement
- * Management policy

The resulting benefits [6],[13] of certification include:

- * Worldwide recognition by potential customers

- * Elimination of technical trade barriers in the EC market
- * Implementation of a system for continuous improvement
- * Competitive advantage gained through quality assurance
- * Cost-reduction due to proactive quality management
- * Confidence created between customer and supplier
- * Objectivity and consistency of Third party auditing
- * Supplier approvals facilitated

C. ACHIEVING ISO 9000 CERTIFICATION

ISO 9000 compliance comes from having a quality management system that is guideline compatible and adequate for a company's business. ISO 9000 does not dictate what the management system should be, but only identifies the elements that the system needs to address. The system must be adequate in that it covers all items that affect the quality of the company's product or service. Many companies have some level of quality management system in place, however, it may not meet the ISO 9000 criteria. To bring their quality systems into compliance with ISO 9000, most companies initiate some form of implementation activity. This activity typically resembles a project in that there is a defined purpose, involves multi-functional groups, and is a one time activity.

II. COMPANY PROFILES

A. *AT&T Submarine Systems, Inc.*

AT&T Corporation is a world leader in telecommunications. As of 1993, AT&T Corporation was subdivided into thirteen business units, each one individually responsible for its own financial results. AT&T Submarine Systems, Inc. (SSI) is one of these thirteen business units. SSI's organizational mission is to be the world leader in the sale and installation of high quality submarine cable systems. Although, the number of satellite and radio links continue to increase, submarine cable systems still represent over 70% of AT&T's transmission requirements for overseas calls. This percentage has been constantly growing due to the increasing demand for data, fax, and video transmission. With the advent of undersea fiber optic technology, undersea cables provide a secure high capacity highway for virtually error free transmission. The demand for undersea cables has grown by a factor of one hundred since the installation of the first fiber optic trans-Atlantic system in 1988. SSI is the sole turn-key US supplier of such systems. However, French, British, and Japanese companies are presenting fierce competition in this marketplace. SSI currently holds 60% of the market. The remaining 40% is divided among Alcatel (France), British Telecom, Cable and Wireless, (Great Britain), and KDD, NTT (Japan).

To compete with the European companies, management determined it necessary for the SSI business unit to attain ISO 9001 certification as quickly as possible. This was dictated by the Vice-President of SSI, Dick Carter, who made ISO

certification the number one priority for 1993. Mr. Carter remarked, "if we only accomplish one goal for 1993, it will be ISO certification." Due to Mr. Carter's directive, the entire management organization was committed to this goal.

SSI is structured as a matrix organization in a number of functional groups called Divisions. Each individual Division is specialized for a particular functional area. These functional areas consist of Marketing/Sales, Engineering/Construction, Financials, and Strategic Projects. Each Division is broken down into further specialized areas called Districts. The Districts are divided into discrete work groups, each headed by a Senior Manager. New cable projects are initiated and controlled through the Strategic Projects Division. Each Senior Manager (Project Manager) of the Project's Division may be responsible for several projects at any given time. These Project Managers interact among the many other functional groups through a hierarchical matrix type approach.

Initially, no formal organization was established for ISO 9000 implementation. Some, but not all of the Divisions had previously assigned Quality Managers to prepare for submission for the Malcom Baldrige Award. Attaining this award was a 1992 organizational goal that was dropped in order to pursue ISO 9000 certification. With the all out effort for certification beginning January 1993, a Quality Division was formed to coordinate the effort among SSI's functional groups. The Quality Division proceeded using SSI's normal project approach. Refer to the organizational chart in Appendix III. The Quality Division acted mainly as a support group providing direction and standardization among the functional groups for the effort. The Quality Division

coordinated all internal audits and pre-audits and was the primary interface with the ISO certifying body. The Quality Division also coordinated all training activities. As guided by the Quality Managers, each work group identified the applicable ISO processes with which they would have to comply. The work groups had the responsibility to ensure that all of the requirements of the process(es) were met. The Quality Division set the goals for the organization and were responsible for developing and tracking a time line of the process. The Quality Division was also responsible for developing the Controlled Documentation Library and Controlled Documentation Process for the entire organization.

Initially, a three member committee was formed to choose the certification body. An evaluation was performed based on customer recognition, availability, and cost. Det Norske Veritas Industry, Inc. (DNV) was chosen mainly on the basis of customer recognition. The majority of SSI's European customers either used or recognized this certifying body. Under the DNV, there are two certification schemes, the Dutch scheme, which is recognized throughout the majority of Europe, and the British scheme, which is required to do business in Britain.

The only major difference between the two schemes lies in the procedure for the certification process. For both schemes, any major discrepancy would preclude registration and would require a partial or complete re-audit of the system. For the Dutch scheme, any minor non-compliances found in the process of the audit, need only be followed up with a corrective action plan. If this plan is provided, certification will still be issued. However, the non-compliance must be corrected before the first

follow-up audit or continuation of the accreditation will be in jeopardy. For the British scheme, all minor non-compliances found need to be fully corrected and implemented before certification will be issued. Due to business reasons, it was determined to seek certification under both schemes.

After a ten month preparation effort, certification was awarded under the Dutch scheme on October, 1993. All corrective action reports were rectified by January, 1994 which permitted certification under the British scheme.

B. Calgon

The Calgon Corporation is a specialty chemicals manufacturer who sells water treatment products, paper chemicals, surface treatment products, cosmetic ingredients, and specialty biocides. In the company's seventy five year history, the primary business is the sale of water treatment chemicals. Originally, the founders of Calgon developed the product sodium hexametaphosphate which prevented the precipitation of calcium (or hardness) in water-bearing equipment. Hence, the name Calgon came from the name Cal Gone or Calcium Gone. One should also note that this is the same product that is being used in detergents to help soften water and make suds in water. Calgon developed, commercialized, and then sold their retail line which coined the slogan "Calgon take me away" for their bath beads. Over the years, Calgon has also manufactured activated carbon and water treatment equipment, but like their retail line, these have been sold during company realignments and acquisitions.

Of the company's last twenty six years, Calgon has not been an independent company. For the first twenty five of these, the company was a subsidiary of Merck and Company, Inc. and for the last year, it has been an subsidiary of English China Clays, plc. During the years with Merck, Calgon's growth stagnated. For once being the industry leader in water treatment chemicals prior to the purchase by Merck, Calgon only achieved a few percent of the world-wide market share of water treatment business. Merck changed its focus to its core business and decided to sell Calgon only after changes in the pharmaceutical industry in the early 1990's. English China Clays, a billion dollar British company, bought Calgon in 1993. In 1990, English China Clays (ECC) decided to change its focus from being both a specialty chemicals and construction materials company to primarily being a specialty chemicals company only. The purchase of Calgon fit ECC's new strategic goals. In addition, with ECC's small holdings in the United States, the acquisition of Calgon gave ECC strength in the US specialty chemicals market. Similarly, ECC's strength in the world markets gave Calgon more availability to the new markets.

To compete in the European marketplace and because of competitive pressures, Calgon decided that ISO 9000 certification was necessary. This decision was identified by Calgon's Quality Steering Team (QST). In 1991, the Calgon management team established the QST after it implemented 3M's Managing Total Quality (MTQ) process. In the MTQ terminology, the ISO 9000 certification was a corporate Quality Improvement Project (QIP) identified by the QST. For the QST, a

successful ISO 9000 certification effort would demonstrate the viability of the MTQ process at the corporate level and satisfy international business needs.

The ISO certification project was planned using the guidelines of the QI projects' guidelines in Calgon's Quality Improvement Projects' manual. Refer to the manual in Appendix IV. The project manager was identified by the Quality Steering Team as one of the R&D Directors. The team members were identified across functional areas and at different levels. This team was empowered by the QST. The mentor of the project, because it was a company wide project, was the Quality Steering Team.

Calgon determined that the certification body would be A.V. Qualite from Belgium. This approving body was selected since Calgon's European operations were based in Belgium and because of their assistance in answering questions about specific ISO elements.

C. Fujitsu

Fujitsu Computer Products of America (FCPA) is a subsidiary of Fujitsu Ltd. located in Tokyo, Japan. FCPA consists of three separate organizations, Sales and Marketing in San Jose, California, Design in Longmont, Colorado, and Manufacturing in Hillsboro, Oregon. The Hillsboro Manufacturing division is the site that is being surveyed for this project. FCPA's main products are computer memory storage devices, such as disk drives, tape drives, controllers, and Single In-line Memory

Modules (SIMMs). The Hillsboro facility opened in 1986 and currently consists of two buildings (330,000 square feet) and 450 employees.

The ISO certification project was first announced in April, 1992. A preliminary schedule was proposed, but progress was slow until October, 1992. Refer to the FCPA Hillsboro ISO 9002 Certification - Preliminary Schedule in Appendix V. In October, 1992, the ISO work group was formed. The method of implementing ISO was still very unclear, but it was beginning to take form. An ISO Action Flowchart (Appendix V) was developed to outline the method for identification and closure of gaps between the current quality system and an ISO compliant system. The National Standards Authority of Ireland (NSAI), was selected as the registrar. This was primarily because two of FCPA's largest customers used NSAI, but also due to their international recognition and acceptance. In October of 1992, NSAI was hired to provide a week long training course in audit awareness and for understanding ISO 9000 documents. This helped the ISO project leader and the work group to formulate the activities that needed to be accomplished. A plan was presented to management in late November, 1992, but management still did not fully understand the magnitude of ISO and would not approve the plan. The executive staff visited several other local companies that had successfully been registered to ISO. They began to see how formidable a task it was. In order to get a clearer understanding of the tasks that needed to be accomplished, NSAI was again hired to perform a mock audit. In addition to the mock audit, they also provided internal assessment training. The original ISO work group that was formed in October then became the Internal

Assessment Team. An ISO Audit Matrix (Appendix V) was developed defining the elements for which each auditor was responsible. The results of this preliminary audit provided a picture of where FCPA Hillsboro was and specific areas that needed to be addressed. It was clear that additional resources would be needed, and that the ISO work group would mainly be performing internal audits. Responsible personnel for each ISO element were then identified. Since these people were the Primary person responsible for each ISO element, they were referred to as the "P" for each element. Refer to Quality P Summary table in Appendix V. A steering committee was formed of selected managers to guide the Ps. The steering committee was referred to as the Management Review Team (MRT). Each MRT member was to devote 100% of their time to ISO until a successful registration audit was achieved.

The gaps identified by the NSAI audit were many and there was still no clear plan in place to identify how to resolve these gaps. Therefore, another consultant was hired. This consultant helped to develop a plan of how to audit, identify gaps, and perform corrective action to close the gaps. After this, a simple process flow map was developed for the ISO project. Refer to ISO Time Flow in Appendix V. Activities included identification of gaps, development of procedures, internal audits, corrective action requests issued and closed, and registration audit. As time went on, the project plan became more detailed, with specific dates being included.

During July, August, and September, 1993, internal audits were performed of all areas. Corrective Action Requests (CAR) were issued and resolved. The goal was to

audit all areas, and close all resulting CARs by the scheduled registration audit in November, 1993.

Late in August, a series of meetings was held where each P would present the results of a gap analysis and the actions to close the gaps. The gap analysis was performed by comparing our procedures against the ISO standard and the NSAI audit checklist. These meetings in conjunction with the internal assessments proved very helpful in identifying the activities that were still needed to have an working auditable system in place. Finally in November, 1993, the registration audit was successfully completed,

D. Tektronix

Tektronix is a world leader in the design and manufacture of electronic test and measurement equipment, television products, and computer graphics products. Primarily located in the Portland area, the company has nearly 9000 employees and gross annual revenues of about \$1.3 Billion. The largest segment of the company is Test and Measurement (T&M). Products from this segment include: oscilloscopes, waveform analyzers, signal generators, frequency domain analyzers, logic analyzers, and accessories.

In May, 1992, the T&M Quality Manager began discussions with vice presidents and general managers about the importance of having the operations become ISO certified. At the same time, he made the argument that the process of preparing for certification would lead to standardization of processes across the business that were seen as necessary for improved business performance. The Quality Manager would

convince the T&M Manufacturing Manager of the importance, who set in motion an initiative to gain certification from within manufacturing. This initiative was delegated to the Manufacturing Engineering Manager who hired a project leader from Sequent Computers to manage the certification effort. As the project began to gain momentum, the expectation was communicated from the vice president of T&M that all functions were expected to participate and comply.

Two separate projects ensued: one addressing manufacturing, and one addressing all other functions. Appendix VI shows the structure used for these projects. Two project leaders were named, one for each, with the goal to achieve ISO certification upon the first audit of the entire T&M organization. The manufacturing project was managed as a tightly controlled and supported effort with frequent visibility and review by manufacturing management. The cross-functional project was managed as a loosely run effort with varying levels of support and participation from engineering, service, and marketing. The cross-functional project was also hampered by the fact that more than 10 product lines exist within T&M, all of which have their own engineering and marketing groups who do not agree on how things should be done. The cross-functional project required much informal authority.

About six months before the audit, internal auditors were trained and deployed to test the readiness of the departments. A series of Corrective Action Requests were issued, and subsequently corrected. In May of 1994, KEMA performed an official audit and granted Tektronix T&M ISO certification.

II. METHODOLOGY

To understand how each company carried out the ISO compliance effort, a questionnaire was created which addressed six key dimensions of project management:

- * Mission and Objectives
- * Project Organization
- * Management Support and Resources
- * Planning and Scheduling
- * (Project) Results
- * Project Completion

The plan was to use the questionnaire to survey different people from each of the four companies. The people surveyed were to be from specific functional areas that the authors thought to be key areas for ISO implementation. The survey gave these people an opportunity to share their views on the ISO certification effort, and gave them the chance to communicate in what ways such an effort could be improved. Refer the questionnaire shown in Appendix I for detail.

In addition to answering the questionnaires, the respondents were interviewed by one of the authors. Table 1 shows the interview strategy used to create the survey.

Participating Functional Areas of Companies

Function	Materials	Quality	Manufacturing	Engineering
Companies				
AT&T	+	+	+	+
Calgon	+	+	+	+
Fujitsu	+	+	+	+
Tektronix	+	+	+	+

Table 1.

III. DATA ANALYSIS

The responses to the questionnaire and interviews provide the data for this paper. The "raw" data for each of the six key project dimensions are presented in their respective tables in Appendix II. After gathering, the data was summarized by company and by function. It was then analyzed for patterns within a company, and within a function across all companies. The resulting patterns, if any, are summarized in the tables in this section. Given that all data taken was of an empirical nature, no statistical analysis was performed.

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ISO 9000 Certification Projects: Four Companies Compared

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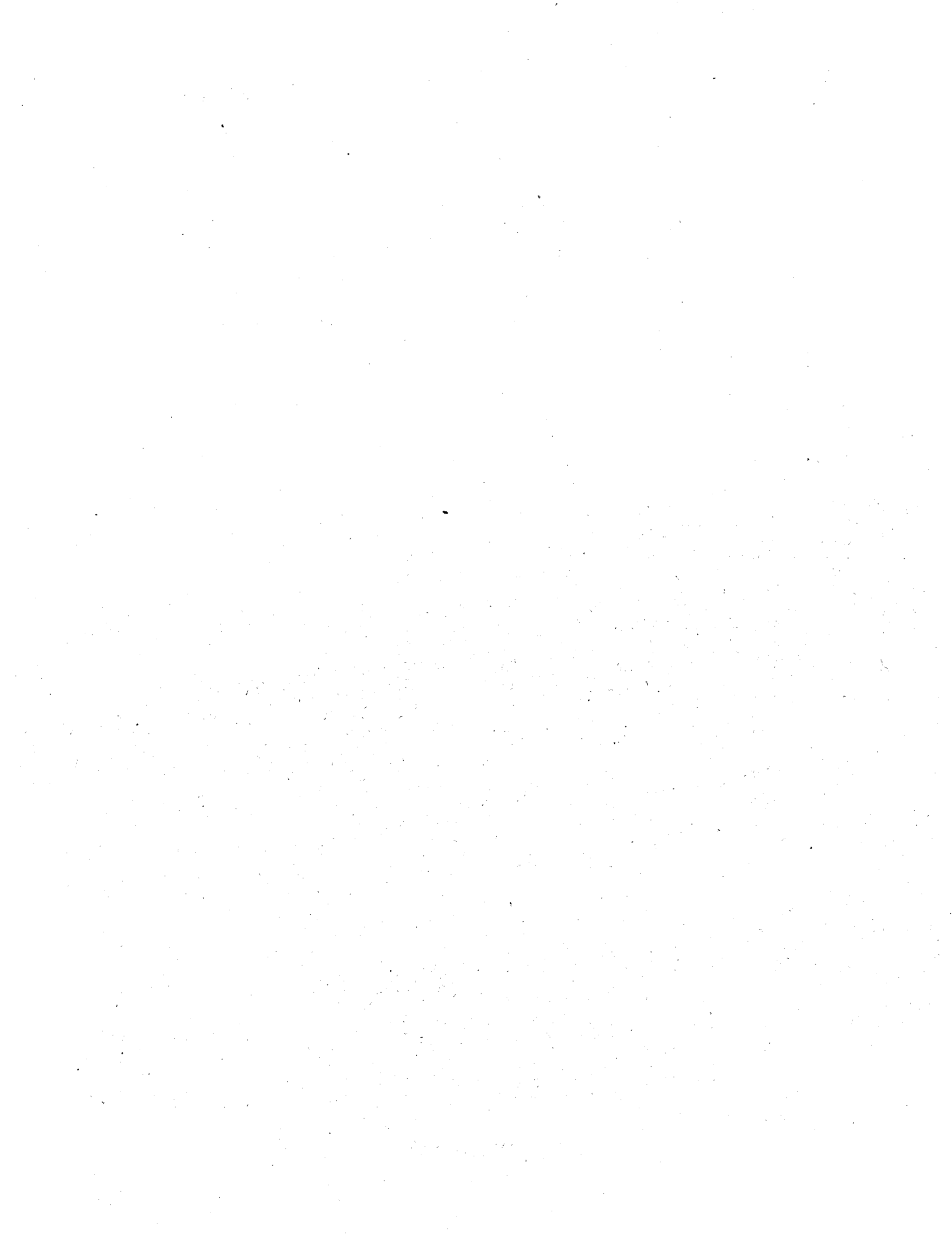
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A. Mission and Objectives

1) Why did your company seek ISO 9000 certification?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Competitive reasons, customer requirements, quality improvements
Calgon	Global business, sell to European market
FCPA	Customer requirement
Tektronix	Requirement for business, systems improvement

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Materials	Customer requirements
Quality	Customer request/business requirement
Manufacturing	Responses were mixed and therefore inconclusive.
Engineering	Responses were mixed and therefore inconclusive.

2) From what level of management did the mission/objectives come from?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Executive quality council consisting of President and direct reports.
Calgon	President, quality steering committee.
FCPA	General manager and senior staff.
Tektronix	Responses were mixed and therefore inconclusive.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Materials	Executive staff
Quality	President/Senior Staff
Manufacturing	Responses were mixed and therefore inconclusive.
Engineering	Responses were mixed and therefore inconclusive.

3) How was the registrar chosen, and who was that registrar?

COMPANY RESPONSE

COMPANY	HOW CHOSEN	REGISTRAR
AT&T	Committee formed to perform cost/benefit analysis	DNV
Calgon	Familiar to customers	AV Qualite
FCPA	Same as largest customers.	National Standards Authority of Ireland
Tektronix	Same as Tektronix Holland facility used.	KEMA

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Materials	Responses were mixed and therefore inconclusive.
Quality	Familiarity to customers or company.
Manufacturing	Familiarity to customers.
Engineering	Familiarity to customers or company.

4) How did lower levels of management communicate the ISO project?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Training sessions.
Calgon	Team approach.
FCPA	Staff/area/employee meetings.
Tektronix	Driven from middle management.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Materials	Responses were mixed and therefore inconclusive.
Quality	Responses were mixed and therefore inconclusive.
Manufacturing	Responses were mixed and therefore inconclusive.
Engineering	Department meetings.

5) How much of your company participated?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	The ISO mission affected the entire organization.
Calgon	The entire organization except R&D and Sales.
FCPA	The entire organization except finance.
Tektronix	The ISO mission affected the entire organization.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Materials	The entire organization.
Quality	The entire organization.
Manufacturing	Everyone except finance.
Engineering	Responses were mixed and therefore inconclusive.

B. Project Organization

1) How was the work for ISO 9000 compliance structured?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	The work was structured along the processes listed in the ISO guidelines.
Calgon	The work was structured as a project.
Fujitsu	The work was structured as a project with ISO element responsibilities headed by a Primary person.
Tektronix	The work was structured as functional teams assigned to their respective ISO element.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	The work was structured as a project with members having responsibility for a process.
Quality	The work was structured as high level teams.
Manufacturing	The work was structured as functional teams assigned to their respective ISO element.
Engineering	The work was structured as functional teams assigned to their respective ISO element.

2) Who was in charge of the overall effort? Where did their authority come from? Was the authority granted sufficient to ensure success?

COMPANY RESPONSE

COMPANY	IN CHARGE	AUTHORITY SOURCE	ENOUGH AUTHORITY?
AT&T	Quality Mgr	Quality District	Yes
Calgon	R&D Director	Steering Committee	Yes
Fujitsu	Management Rep (Quality Mgr)	Executive Staff	Yes
Tektronix	Quality Project Mgr	Steering Committee	Yes, informally

FUNCTIONAL RESPONSE

FUNCTION	IN CHARGE	AUTHORITY SOURCE	ENOUGH AUTHORITY?
Materials	Quality Mgr	District, Executive Staff	Yes
Quality	R&D Director, Quality Manager	Steering Committee, Executive Staff	Yes
Manufacturing	Upper Management	Executive Staff	Yes
Engineering	Quality Mgr	Steering Committee, Executive Staff	Yes

3) Describe the ways all members affected by ISO 9000 efforts were united?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Members were united through a project management organization that interfaced in a matrixed format with the functional organization.
Calgon	Members were united as teams in a work matrix.
Fujitsu	Members were united through a hierarchical matrix of independent projects.
Tektronix	Members united as teams under a hierarchical organization.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Responses were mixed and therefore inconclusive.
Quality	Members united through matrixed organizations.
Manufacturing	Members united under a hierarchical organization.
Engineering	Members united as project teams under a hierarchical organization.

4) Did the effort evolve in structure, emphasis, priority, or approach over time?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	The effort was the #1 priority, ahead of daily responsibilities. Effort accelerated at the end.
Calgon	The effort was the #1 priority. Intensity increased towards the end.
Fujitsu	The effort started slowly, but emphasis increased as the target date approached.
Tektronix	The effort went according to plan with no real changes.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Responses were mixed and therefore inconclusive.
Quality	Responses were mixed and therefore inconclusive.
Manufacturing	The effort accelerated towards the end.
Engineering	The effort went according to plan.

C. Management Support and Resources

1) What was the level of management support for the effort at the beginning?
At the end?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Support was high, and new quality departments were even formed as necessary.
Calgon	Support was sufficient, and increasing with time.
Fujitsu	Reports varied, but support was sufficient and increasing with time.
Tektronix	Support was consistently strong.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Support was sufficient.
Quality	Support was sufficient and increasing with time.
Manufacturing	Support was consistently high.
Engineering	Support was sufficient and increasing with time.

2) Were the necessary funds made available?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Yes.
Calgon	Yes.
Fujitsu	Yes.
Tektronix	Yes.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Materials	Yes.
Quality	Yes.
Manufacturing	Yes.
Engineering	Yes.

3) Were the necessary personnel made available?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Yes, but some negotiation required and people did double duty.
Calgon	Yes, but was lacking at first.
Fujitsu	Yes.
Tektronix	Yes, but negotiation was required and individual efforts were significant.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Yes.
Quality	Personnel was an issue, negotiation was required, and project was not sufficiently staffed up front.
Manufacturing	Yes, and specific job knowledge was sometimes required.
Engineering	Yes.

4) What were the responsibilities of management? And how did they fulfill those?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Set goals and take responsibility for processes.
Calgon	Review project and supply perspective.
Fujitsu	Author quality manual and resolve issues.
Tektronix	Steering the project and communicating value.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Responsibility for processes and resource issues.
Quality	Communicate value of ISO, review project.
Manufacturing	Steer the project, author quality manual.
Engineering	Steer the project, document current processes.

5) Were any difficulties encountered in carrying out the effort?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Documentation of processes was a large job.
Calgon	Control and time commitment.
Fujitsu	Prioritization and having management listen to internal feedback.
Tektronix	Priority conflicts and lack of understanding of ISO.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	More work than anticipated, management didn't listen to workers.
Quality	Lack of understanding of project, and time commitments.
Manufacturing	Prioritization of tasks and breaking of paradigms.
Engineering	Responses were mixed, and therefore inconclusive.

D. Planning and Scheduling

1) How did your company determine what work needed to be done to achieve certification?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Internal Pre-audits and consultants were used.
Calgon	Internal pre-audits.
Fujitsu	Work was determined using internal pre-audits, gap analysis, and the use of outside consultants.
Tektronix	Pre-audits.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	All indicated pre-audits with no other similarities.
Quality	All indicated pre-audits with no other similarities.
Manufacturing	All indicated pre-audits with no other similarities.
Engineering	All indicated pre-audits with no other similarities.

2) Was a plan developed with objectives, goals, strategies, or activities identified?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	All respondents said yes. No similarities about where the plan originated or its focus.
Calgon	Yes, by all respondents. The Quality Improvement Team established the plan using consultants and their planning computer software.
Fujitsu	Four of five respondents noted that a plan was used. One stated it was hierarchical plan and another said it was a high level flow chart.
Tektronix	All respondents said yes that a plan was used.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Responses were mixed and therefore inconclusive.
Quality	All respondents stated yes a plan was used.
Manufacturing	All respondents stated yes a plan was used.
Engineering	All respondents stated yes a plan was used.

3) Was one or more time lines identified? Who created the time lines?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Of two respondents, both stated time lines were used; however, one stated it was created by the ISO team and the other stated the Quality Manager.
Calgon	The respondents noted a time line was used.
Fujitsu	All respondents stated the time lines were used; however, there was no consensus on who created the time line.
Tektronix	All stated yes. No one stated who created the time lines.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	All stated yes with no other similarities.
Quality	All stated yes with no other similarities.
Manufacturing	All stated yes with no other similarities.
Engineering	All stated yes with no other similarities.

4) What was the actual elapsed time from start to finish of the effort? What was planned?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	One responded by stating it took 17 months.
Calgon	Actual time was 12 months, and the planned time was 12 months.
Fujitsu	Responses varied from 8 to 13 months actual, and the planned time was 13 months.
Tektronix	Actual 24 months. Planned 18 months.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Responses were mixed and therefore, inconclusive.
Quality	Responses were mixed and therefore, inconclusive.
Manufacturing	Responses were mixed and therefore, inconclusive.
Engineering	Responses were mixed and therefore, inconclusive.

E. Results

1) Did your company receive certification? Were there CARS or conditions?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Certification was attained on first attempt. 27 CARS were issued, in which all were corrected by first follow-up audit. 80% of findings dealt with document control.
Calgon	Certification was achieved on first attempt. 2 to 5 minor remarks were received from each location.
Fujitsu	Certification was achieved w/minimal CARS.
Tektronix	Certification was also attained on first attempt. 3 CARS written and closed during audit. Had 13 remarks. Auditors comment one of the cleanest they had seen.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Certification was attained on first attempt. All received CARS or remarks.
Quality	Certification was attained on first attempt. All received CARS or remarks.
Manufacturing	Certification was attained on first attempt. All received CARS or remarks.
Engineering	Certification was attained on first attempt. All received CARS or remarks, with the exception of one response from Tektronix.

2) What element was the most difficult to achieve?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Documentation and the process of controlling the documentation, also control of purchasing and calibration.
Calgon	Documentation process and control, also contract control, management responsibility, and calibration.
Fujitsu	Establishing and implementing corrective action process, meeting cross functional needs, and establishing documentation and following newly established procedures.
Tektronix	Document control, following newly established processes, and management responsibility.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Documentation, meeting cross functional needs, and corrective action.
Quality	Documentation control, control of purchasing and calibration, and management responsibility.
Manufacturing	Documenting process and control, and meeting cross functional needs.
Engineering	Establishing processes, contract control, documentation, training, and following newly established processes.

3) Did the audit process go as expected?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Half thought audit was easy and went better than expected, other half surprised with CAR for non-conforming product and attention to detail.
Calgon	Was not surprised with audit.
Fujitsu	Was not surprised or thought was easier/went better than expected.
Tektronix	Was not surprised or thought was easier/went better than expected.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	All thought was easier than expected.
Quality	Majority were not surprised, only one was surprised with CAR for non-conforming product.
Manufacturing	Were not surprised or thought went better than expected.
Engineering	Majority were not surprised, only one was surprised at attention to detail.

4) Did the ISO effort change the way you do business, or simply solidify your methods?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Half thought that it changed business practices due to clarification, other half thought that it merely clarified and solidified practices. Differences lie in interpretation of question.
Calgon	Thought that it solidified methods and increased effectiveness.
Fujitsu	Mixed, thought that both solidified methods and changed business methods.
Tektronix	Thought that it changed practices and solidified methods.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Majority thought that it changed practices, only one thought that it only solidified methods
Quality	Mixed, solidified methods and changed business practices.
Manufacturing	Thought strongly that it changed business practices and clarified methods.
Engineering	Mixed, solidified methods and changed business practices.

5) What is the effect of ISO on customer quality, business financial results, or continuous improvements? What metrics were used to detect change?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Feel that improved results or has great potential to do so. No metrics in place. Noted that certification is a current contract requirement.
Calgon	Established mode for continuous improvement, made company industry role model for quality, and before and after results showed dramatic decreases in errors and off spec. material.
Fujitsu	Internally great improvements noted in number of non-compliances and employee moral. Set path for continuous improvement. No metric in place before certification. Noted that certification is a customer requirement.
Tektronix	Increased employee moral, feel that financial results will follow. Noted decreases in deficiencies. Also noted as customer requirement.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Provides method for continuous improvement and has improved results. Noted that certification is customer requirement.
Quality	Forms method for continuous improvement, set company as role model, dramatically decreased errors of off spec. materials, increased moral, and feel that good results will come.
Manufacturing	Found to improvements were made both internally and externally. Noted as customer requirement.
Engineering	Established modes for continuous improvement, decreased number of deficiencies, and improved employee moral.

6) Are you able to perform in accordance with your processes as approved?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Mixed, half have no problem while one noted that it is cumbersome at times (in urgent situations) but feels that it is for the better, and another cannot perform in accordance due to a recent organization change--this is in the process of correction.
Calgon	Easily.
Fujitsu	Mixed, most note some problems, with one response noting no problems with better efficiencies.
Tektronix	All believe that are, but continual development will be necessary.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Majority notes some form of problem, one feels that there are no problems with better efficiencies.
Quality	Majority feels no problem, with continual development.
Manufacturing	All feel there are no problems meeting procedures.
Engineering	Mixed, half feel no problem, half recognize some problems.

F. Project Completion

1) At what point was the effort considered complete?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Project ends at the completion of certification, but the process is never complete.
Calgon	Once the certification has been granted, and the first re-audit has been passed.
Fujitsu	At certification.
Tektronix	At certification.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	At certification.
Quality	At certification.
Manufacturing	At certification.
Engineering	At certification.

2) Are any activities continuing past the end of the effort?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Maintaining documentation, self audits.
Calgon	Approval of more sites.
Fujitsu	Responding to Corrective Action Requests, practicing continuing improvement, maintaining documents.
Tektronix	Process internal CARs, performing internal audits, polishing documentation.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Materials	Maintaining documentation.
Quality	Continuous improvement and expanding scope of ISO certification.
Manufacturing	Maintaining documentation via CAR process.
Engineering	Continuous improvement and follow-up audits.

3) What would you have done differently, and what impact would that difference have?

COMPANY RESPONSE

COMPANY	RESPONSE
AT&T	Start the process sooner, with better initial organization of the project.
Calgon	Start sooner and try for more demanding certification.
Fujitsu	Make the process start up faster, educate teams on ISO sooner.
Tektronix	Better architecture of Quality Manual, better definition of project roles, start process sooner.

FUNCTIONAL RESPONSE

FUNCTION	RESPONSE
Material	Longer lead times and faster start-up.
Quality	Better top-level management support.
Manufacturing	Little change, just running groups in parallel.
Engineering	Start the process sooner.

IV. OBSERVATIONS AND DISCUSSION OF DATA

A. Mission and Objectives

The data gathered from the four companies in this survey show that the main reasons for becoming ISO certified are customer requirements and competitive advantage. It was also noted in two responses, that ISO would improve the companies' quality system. The responses were consistent from company to company and position to position within a company. This is to be expected since the literature search also found a consistent theme. In the literature it was found that the reasons for pursuing ISO were: selling to the European community, ISO certification is a competitive advantage [1], customer requirements [3], and necessity for international business [4]. The literature also suggests that while ISO does not guarantee product quality, it is a step towards implementing a Total Quality Management Program. ISO instills the discipline necessary to document what you are doing [2]. Since the undertaking of ISO registration is such a tremendous effort, the reason for registering must be well known. If there is not a strong reason, Geof Cox points out that it makes more sense to introduce a TQM process, and then get the ISO 9000 registration when necessary [2].

Of the four companies surveyed, it was almost unanimous that the mission of the ISO project was driven by top management. The only exception was the response of a Manufacturing Engineering Manager at Tektronix. He responded that the Quality Manager picked up the ball and started the ISO project. The Quality Project Manager

at Tektronix stated that President Jerry Meyer authorized the project. This information may not have been communicated to all at Tektronix. Since all four companies achieved certification, it is no coincidence that all had top management commitment. The literature states that the very first step in the ISO implementation process is gaining management support [3]. Management commitment is important because the ISO implementation project requires resources that only top management can allocate.

After management has committed to support the ISO project, how is it communicated throughout the organization? This question was answered differently by each company and within a company in some cases. Eckersberg states that the ISO work groups must be made up of the people who actually get things done at a company, the company's resources [3]. It is important that everyone is informed. At AT&T, Calgon, and FCPA, the communication efforts were more structured and driven from the top down. The most common method was formal training courses. This was then supplemented by newsletters, group meetings, memos and the reading of documents. The supplemental information varied from department to department. At Tektronix, there was no evidence of formal training classes to communicate ISO to the work force. Instead it was driven from the bottom and by middle level managers that had to proactively keep informed and pass information on to their staff. Both training and management responsibility were noted as being the most difficult elements to obtain. This lack of formal communication and training of the general workforce may have contributed to the longer project implementation than other companies.

Tektronix implementation time was two years, Calgon one year, FCPA nine months and AT&T ten months.

When asked how much of the company participated in the ISO effort, the answer was consistently, all of the company. There were a few exceptions noted, such as Finance. The ISO standards cover most all aspects of a company, but not Finance. At Calgon, the R&D and Sales departments were not included, because of the complexity of processes and difficulty in documenting them. FCPA, AT&T and Tektronix indicated that all departments participated to some extent and at FCPA even Finance employees were involved. The literature suggests that the employees that make the product, or provide the service should always be consulted when developing documentation [3]. This would indicate that everyone should be involved, even if just to provide input or review.

In order to support the mission of the ISO project, it is critical that the appropriate registrar is chosen. If the reason that a company is becoming ISO certified is to sell product in Germany, then it would be wise to select a registrar accredited by the German Accreditation Board [3]. Although each company selected a different registrar, logical methods were used in the selection process, and the responses were consistent from department to department at each company. The responses from AT&T were consistent in that a committee was formed to perform a cost benefit analysis. DNV was selected based on name recognition to the customer, cost, service and availability. At Calgon, A.V. Qualite was chosen because of familiarity to customers. At FCPA, NSAI was chosen mainly because they were the

same agency used by the customers. A Quality Engineer also added that NSAI was selected based on several additional criteria, such as cost, relationship and international acceptance. Tektronix did not perform a formal analysis to select their registrar, but used the same registrar as a similar Tektronix plant in Holland. KEMA was selected because of commonality and name recognition. The literature concurs with the reasons identified by these four companies. From the literature search it was found that the reasons for selecting a registrar are: accreditation and recognition, reputation, availability, cost and acceptance by customers [5].

B. Project Organization

The companies agree that the work is structured along the functional elements as listed in the ISO 9002 guidelines. Companies formed teams (project or functional) to implement the necessary processes and procedures. The functional groups' answers are similar to the company responses. Each group agrees that functional teams were formed to work on specific ISO elements. This appears to be the typical approach recommended by the literature [4],[5].

When viewed from the company perspective, three companies understood that their Quality Manager was in charge of the project. Calgon was the exception since its R&D Director was in charge of their certification project. However, the functional perspective indicates some disagreement or misunderstanding as to who was in charge. Manufacturing's responses of "Upper Management" seemed to indicate that they were either "out of touch" or "distanced" from knowing who really was in charge.

Manufacturing may typically respond in this way to the many programs that "Upper Management" pushes upon them. All responded that the source of authority was either the executive staff or a management steering committee. This is understandable since Upper Management plays a key role in driving ISO implementation [3]. All responded that there was enough authority granted to assure success. However, responses from Tektronix implied that peer pressure for succeeding augmented the informal authority that the Project leaders had. This may not be such a surprise answer since all four companies had successfully achieved ISO 9000 certification. The answers may have been more interesting and diverse had the question been asked at the beginning or during the project instead of after a successful completion.

When asked the ways all members affected by ISO 9000 efforts were united, the Material's group responses were mixed and did not seem to fit any pattern. However, all of the other responses indicated that teams were formed either as part of an ISO project group or under the established functional hierarchy of the company. This agrees with the first question in this section and further demonstrates the key role that (project) teams had in ISO implementation.

Except for Tektronix, all responded that they started off slowly. As things came together and as the certification target date approached, the efforts increased. From the authors' experience, this appears to be typical of many projects. Tektronix was able to stay on track through the efforts of a dedicated project leader who had the weekly attention of a steering committee of managers who controlled the resources.

C. Management Support and Resources

All those interviewed expressed an increase in management support as the deadline for the project approached. In each of the four companies, those interviewed expressed different levels of management support for the project. It appears a common theme among the managers to see themselves in support of the principles of pursuing ISO, but for the team members actually implementing the project tasks to see a waning of that support in the form of scarce resources. Resources required for the projects consisted mainly of money and manpower. All interviewees at the four companies reported funding as sufficient to complete the project. Manpower was not quite so simple. All companies reported sufficient manpower devoted to the tasks, and some companies even hired temporary documentation personnel. Personnel interviewed from the Quality organizations at Tektronix, Calgon and Fujitsu all reported a shortage of resources at the beginning of the project, but that sufficient manpower was applied by the end.

However, even if resources were available, the priority of other tasks made it appear that the management support for the project was there only if the project did not interfere with other business. Negotiation was required to get manpower, especially from the point of view of the Quality personnel at each company. Mentioned by Tektronix, the idea of temporary employees who can assist in the documentation process was considered. The manufacturing personnel found that specific job knowledge was required to document processes correctly. A great deal of

new documentation is generated by the effort in addition to the overhauling of many existing documents.

When asked about the roles and responsibilities of management, no two people from any one company gave the same answer. Responses also varied in scope. Some saw management as being reviewers, others saw management as the resolver of resource conflict, while others saw management as being responsible for communicating the value of the project. Much confusion was detected from each company about what role management played, and who was responsible for what. This suggests that the project needs to be well thought-out and unambiguously communicated through the management ranks. The quality organizations saw management as being generally responsible for communication of the project and setting overall directions, where the engineering and manufacturing organizations expected management to take more active roles in steering the project and creating parent documents.

Difficulties encountered included prioritization issues at Tektronix and Fujitsu, while AT&T found documenting the processes a notable difficulty. Calgon found contracts control and finding the time to do the work as the key difficulties. Quality personnel saw a lack of understanding of the project and time commitments as key difficulties, and material personnel found that management did not listen effectively to the workers doing the tasks. Manufacturing found it difficult to break the paradigms when faced with making changes to their processes.

D. Planning and Scheduling

Planning and scheduling is an integral part of the ISO certification process. When compared, the survey results of the four companies were very similar. Comparing across functional areas also produced similar results.

From the company perspective, all of the organizations developed a plan. All of the organizations used some type of planning and scheduling software programs. The benefit of developing and maintaining a plan can be seen since each company achieved ISO certification according to their schedule.

All four organizations used some type of time lines. These time lines were not noted as coming from the same functional area of the organization.

All organizations were consistent with doing pre-audits and gap analysis. The audits noted distinct deficiencies in the companies' documentation. Two audits were performed by registering bodies. Pre-audits with gap analysis was also a necessary element for all of the organization's success. This proved to be of special importance in regards to process documentation. Also noted is the fact that outside audit teams were not necessary for a successful pre-audit. Internal pre-audits were also an effective tool in identifying problem areas. The actual time for the completion of the projects varied among the organizations. Fujitsu was the shortest with nine months, and Tektronix was the longest with 24 months. The company responses generally agreed as to the completion time of the project. The functional responses, however, could not agree since each would be particular to its company.

E. Results

Comparison of the four companies shows that they all had similar results. All four companies were successfully accredited on the first registration assessment attempt. All had minor discrepancies which did not affect registration after the proper follow-up plan was in place. All used similar management methods for ISO 9000 implementation. Since the responses for each question were similar, the survey results support that the projects were well implemented throughout each company. Everyone knew exactly what was needed to be done, and took the responsibility to ensure that it was completed.

The leading area that was found to be the most difficult to achieve by all four companies was the process of establishing the necessary quality manuals and controlling the associated documents. Written quality guidelines and documents existed in all four organizations before the ISO effort, however, all lacked the comprehension and control required for ISO 9000 standards. Revising these documents and making them meet the ISO 9000 standards represented a major effort.

The next most difficult area was ensuring that all personnel were properly following the documented procedures as written. Other areas which were noted as being difficult were the calibration element, contract control, and management responsibility (the responsibility and accountability of management throughout the process).

It is interesting to note that individuals from AT&T and Tektronix said that motivation was difficult to achieve at first, since many people saw the process as

another Malcom Baldrige Award effort. In both companies, this effort was dropped in favor of pursuing ISO 9000 certification.

In two guides recommending the "road map" to ISO 9000 Registration, both warned that the documentation phase is the most expensive and time consuming, and is the largest portion of the implementation effort [3],[4]. No information was provided by any of the companies regarding the actual cost of the ISO 9000 effort. Literature states that the actual cost of registering is approximately \$20,000. This is paid to the Registrar for the audit and paperwork processing. However, the total cost can actually reach several hundred thousand dollars depending on the man hours, training, and documentation necessary to bring a company's quality system into compliance [1],[4],[6].

Nearly every individual thought that the final assessment went better than expected. In one case, an individual was actually disappointed with the audit. He felt that the auditors "only glanced over his quality procedures." Apparently, this was a let down for the amount of time and effort which he put into it. However, he commented, "that when an organization has everything in order, and is well prepared for the audit, this is easily recognized by the auditor the moment he walks through the door." Only one individual interviewed was surprised by the audit. He found it to be "more of a paper chase, where the auditors were interested in finer detail than expected." It is interesting that this person was issued a Corrective Action Request for one of his procedures. The fact that nearly every individual reported that the final audit went better than expected, further supports that all the companies were very well prepared.

However, this raises the questions of whether they were over prepared. This may indicate that the companies did not fully understand the limitations of the ISO requirements and may have spent too much effort in preparing for them. From the responses, it can be inferred that this was not the case. All respondents felt that the work was well worth the effort and had positive effects on the overall quality of the company.

All of the companies have not been certified long enough to recognize any quantifiable results in customer quality or bottom line financial performance. Tektronix and Calgon both had some quality metrics in place before ISO 9000 certification, and did note significant customer improvements. This corresponds to the literature as well [1],[3],[4]. One article reported the following findings of ISO 9000's benefits:

- * An electronics plant realized a \$300,000 cost reduction in the molding section, a savings due in large part to the ISO calibration requirements.
- * Calibration of process control equipment at another electronics plant resulted in cost savings of \$440,000. The key lessons learned were applied elsewhere in processing operations resulting in additional savings.
- * At a diagnostics plant, improvements were realized in a number of areas, including reductions in justified complaints (down 26%), corrective actions (down 62%), quality assurance specification reviews (down 52%), in depth investigations (down 22%), and scrap materials (down 40%).

- * A site reduced its number of test procedures from more than 3,000 to 1,100 during the registration process [4].

It was clear to every individual that the completion of the ISO 9000 effort has solidified, clarified, and structured their organizations in a very positive way. Many saw that defining their processes, provided a good vehicle for future continuous improvement. The interpretation of whether or not it changed the companies business practices varied among the responses. About half saw these improvements actually changing the way that they do business. This was primarily due to the greater efficiencies achieved by solidification and clarification of procedures. After all, the goal is to document what you are doing, not develop what you should be doing.

F. Project Completion

All companies considered the project to be complete once the certification was granted, and all companies received certification on their first attempt. At least one interviewee from each company noted that the ISO effort is "never over", and that the process is one of continuous improvement. The end of the project does not signal the end of the ISO effort. To remain certified, a company must undergo periodic audits where an increasing level of compliance to ISO standards and refinement of internal documents is expected. All companies run the danger of having each department wander off in a unique direction if one group does not take some coordinating

responsibility. In some cases, the Quality group arranges for ongoing audits and subsequent visits from the ISO contractor.

Follow-on activities were divided into two categories. At Calgon, the post-project goal is to get more sites certified. At the remaining three companies the goal is to continually improve documentation and processes in preparation for the next audit. Fujitsu and Tektronix use Corrective Action Requests to instigate action, and all perform ongoing polishing of documentation. The quality personnel see continuous improvement as extremely important.

As a final question, each interviewee was asked what they would do (or have their company do) differently. All four companies reported the desire to start earlier and ramp the project up more quickly. Calgon would pursue a higher level of ISO certification (ISO 9001). Fujitsu would place more emphasis on ISO goals, the project, and getting earlier management support. Tektronix would start a formal process of auditing areas and generating Corrective Action Requests sooner. This is seen to spur action, since the CARs are visible to everyone in the management chain. Tektronix also responded that they would prefer moving several similar groups through the process in parallel to spread the opportunities for learning. They allowed a single engineering group to document their process as a straw man to be used for other engineering groups. This ended up requiring a great deal of negotiation and extensive rewrites to occur. The quality organizations see upper-level management support as an issue, and would increase the commitment from those managers earlier next time.

V. RECOMMENDATIONS and CONCLUSIONS

It is concluded through the study of the four companies efforts to obtain ISO certification and supported by current literature, that the implementation of the ISO quality standards is best completed through a project management approach. The effort agrees with the recognized characteristics of a project, that being it represents "a single, definable purpose, utilizes skills and talents from multiple professional organizations, is a unique one time effort, is somewhat unfamiliar, is a temporary activity, and is a process to achieve a common goal" [10]. To successfully carry out a project such as ISO certification, it is critical that the five steps of a project, consisting of conception, definition, production, operation, and divestment, are clarified and adequately developed throughout the project life cycle.

Literature suggests that obtaining management commitment, forming clear and definable project plans, and implementing the functional organization in matrix organizational form are the critical elements to obtaining ISO 9000 success. The results of this paper's surveys nearly paralleled the experiences and recommendations described in other current literature. It was interesting that all four companies used very similar methods, and had very similar responses.

The results emphasize the following recommendations:

1. Top management commitment at project conception is critical for total organization buy-in. Typically, management does not understand the impact of

the effort at the beginning of the project, and fails to provide sufficient visible support to get the project started rapidly.

2. A cross-functional matrix or hierarchical matrix type organization for implementation of the effort is recommended. Project managers will be required to negotiate for resources and compete with everyday tasks, even if given authority to prioritize the ISO project.

3. Defining of process(es) and documentation of procedures must be performed internally to promote ownership of the process, and to insure the process will deliver high quality results.

4. Pre-audits (either by outside teams or done internally), gap analysis, and early implementation of a corrective action plan are all helpful tools for raising the awareness and urgency felt by all functional areas. Upper-level management review of the Corrective Action Requests is certain to draw attention rapidly to areas needing attention.

5. The documentation effort represents the major man-hour effort of the project, so be prepared to utilize resources accordingly. Temporary help can be obtain for assistance in compiling information; however, majority of effort needs to

come from functional line managers as described in item 3 above. This will most likely tax resource constraints.

6. Clear communication of the mission, goals, and meaning of ISO throughout the project life cycle are essential for success. Considerable rework effort can be saved by providing education on the elements of the ISO standard in advance of the creation of documents.

7. Documenting the processes as they are is preferable as a first step, as compared to documenting the processes as things are desired to be in the future. Once certification is granted, efforts to systematically refine processes can follow.

No substantial findings or factors could be determined in relation to the ISO implementation across functional areas. This is representative of clear, common goals throughout the entire organization which is one of the critical factors for ISO success.

The ISO certification process can provide the organization with a tool for continuous improvement, which can provide the potential for great long term benefits and rewards. When project management techniques are properly initiated and followed, as shown by four successful examples, ISO certification can be obtained within constraining time frames and with limited resources.

VI. FUTURE WORK

Further studies which were identified in the area of ISO Certification include:

1. Determination of and development of tracking actual costs of the ISO implementation process.
2. A comparison of the effectiveness of the different ISO registrars.
3. A likewise study of unsuccessful ISO certification efforts.
4. Further study into the recognized and measurable benefits of ISO certification, both in quality and financial results.
5. Expand the scope of the study to include more companies with emphasis on developing a networking type user group of past ISO success factors.

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