Statistical Process Control System Implementation at a

Mid Size Food Manufacturing Plant

by

Anthony Schottenbauer

A Research Paper

Submitted in Partial Fulfillment of the

Requirements for the

Master of Science Degree

in

Management Technology

Approved: 2 Semester Credits

John Dzissah
Research Advisor

The Graduate School

University of Wisconsin-Stout

April, 2005

The Graduate School

University of Wisconsin Stout

Menomonie, WI 54751

ABSTRACT

Schottenbauer, Anthony R.

(Writer) (Last Name) (First Name) (Middle Initial)

SPC System Implementation at a Mid Size Food Manufacturing Plant

(Title)

Management Technology, John Dzissah, Date, April 4, 2005 42 Pages

(Graduate Program) (Research Advisor) (Month/Year) (# of Pages)

American Psychological Association, 5th edition

(Name of Style Manual Used in this Study)

The food manufacturing facility in Wisconsin that is being studied is part of a global organization that has a long term commitment to continual improvement. The installation of a Statistical Process Control (SPC) system to collect and display the data in the form of control charts to make manufacturing decisions was a key element in the continued improvement of the facility. The implementation of an SPC production and quality database will pay dividends in quality, customer satisfaction, material and labor costs. This study examines the process used to develop the software package into a tool that was specific to this facility and the training of the operators and management in the use of those tools. A survey was used to assess participants' knowledge resulting from a training session on the implementation of SPC.

Acknowledgements

I would like to acknowledge my family and friends for their support in the pursuit of all of my goals. I would particularly like to thank my Grandmother Betty, Father Robert and Son Rob who always had faith in me. A special thanks to Dr. John Dzissah who took time to meet with me in the evenings to accommodate my work schedule and to Mike Engel who both supported and mentored me through this process. The real heroes in this process were the members of the team without whom none of this would have been possible - my sincere thanks to Heidi Lammers, Brian Goettl, Rachel Lang, Toby Auth, and Ron LaCroix. There are others who I may have forgotten who undoubtedly have played a role in this project and to those I extend my thanks as well.

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Chapter I: Introduction

W. A. Shewhart was the founder of the modern quality movement with his application of modern statistical methods to mass-production in the 1920s (Wheeler, 1992, p. 4). Shewhart invented the control chart in 1924 and introduced the concept of assignable and common causes of variation. Deming, Juran, Ishikawa, and many others who followed took Shewhart's ideas and created the modern quality management movement, which grew throughout the 20th century. The notion of continual improvement can be traced back to Shewhart's publications in 1931 and 1939. Deming's wheel ("design the product, make it and test it in a production environment, put it on the market, test it in service, redesign the product in light of customer reactions, continue around and around the cycle" p. 9-10) was always referred to as the Shewhart Cycle in his writing and teaching.

Deming taught engineers and technicians statistical methods in manufacturing war materials during World War II. After finding little acceptance for his teachings in post WWII United States manufacturing, Deming went to Japan to teach his theories and statistical methods (Wheeler, 1992, p. 8). As history bears out, Deming's teachings were hugely successful in the economic reconstruction of Japan.

As United States manufacturing steadily lost ground in sales and quality to the Japanese it was recognized that the basis for success was the teachings of Dr. Deming. Beginning in the 1970's until his death in 1993, Dr. Deming brought his lectures back to the United States (LaCroix, 2004). The theme of these lectures was simply that it is good management to reduce the variation of any quality characteristic whether this characteristic be in a state of control or not.

"The definition of statistical process control (SPC) is a collection of strategies, techniques, and actions taken by an organization to ensure they are producing a consistent quality product" (LaCroix, 2004, p. 1). The SPC philosophy is to measure the process rather than inspecting the product and to prevent defects rather than detect defects.

SPC is a tool to measure, analyze, understand, control, and improve the process. To date, very few food manufacturing companies have integrated SPC and Continual Improvement into their organizations. Food manufacturing, in many ways, has been more of an art than a science. The focus has primarily been on quality control (QC) as opposed to statistical process control (SPC).

> Some of the differences between Quality Control and SPC include the following: QC uses tests of finished goods to determine if a product is in specification. SPC uses in process tests to predict if the product will be in specification. QC would make line adjustments based on experience. SPC would make line adjustments based on mathematical models. QC would make decisions based on gut feel or instinct. SPC makes decisions based on statistical knowledge. Using QC risks are unknown. SPC quantifies the risks. (LaCroix, 2004, p. 4)

The move from a QC culture to a SPC culture is necessary to continue to drive costs down, be more flexible, and improve customer service. Customer service from an SPC perspective is also known as the voice of the customer. That means the customer's specifications for the product including not only what the product looks, feels, or tastes like but when, and where it is to be delivered. The voice of the process is what the manufacturer is capable of delivering. The objective of SPC can then be thought of as the assuring that the voice of the process is capable of answering the voice of the customer.

Problem Definition

Five years ago SPC was basically unheard of in the organization used in this study with only some isolated practitioners. Today there are 24 sites (four in the U. S.) that have fully implemented SPC and 11 (including the facility in this study) working through the utilization package. There is commitment from senior management in all regions to provide the resources and support to make this implementation work. The facilities that have the SPC system fully implemented are starting to see projects that have measurable results.

Purpose of the Study

The purpose of this study is to examine the methods used to implement the SPC system at a mid sized food manufacturing facility. The method follows a general guideline that was developed during previous implementations, however the training materials, method of delivery, and specific focus areas were developed at the facility to best serve the products and people at the facility.

Objectives of the Study

1. To provide an outline or model for others to follow for the successful implementation of an SPC system/process.
2. To provide analysis of the improvements made as a result of the implementation.
3. To provide justification for implementation of an SPC system for others to consider

Definition of Terms

Assignable Causes. These are causes outside the natural variation that make the process unstable (La Croix, 2004). In manufacturing, it could be some faulty material, an untrained employee making a mistake, or a worn machine tool for example. Control charts show the existence of special causes which the operator or engineer will have to find, remove or correct to get the process back into a stable state.

Common causes. A common cause is the description given to variation in a stable process (La Croix, 2004). This can also be described as natural variation in a system – in other words – nothing unusual is happening (e.g. no assignable causes).

Control Chart. A chart with two axes, used to plot data taken from processes and products. The plotted data points on the chart illustrate 'variation' in the 'thing' being measured. The chart will also show the mean, and upper and lower control limits. The purpose of a chart is to show the existence of special causes of variation. Charts can be used for *Judgement*, which means looking back on a set of results from a process, and as an *Operation* to attain and maintain an ongoing process (La Croix, 2004).

Control Limits. Boundaries, based on past performance of a process, within, which the points plotted, can vary without the need for correction or adjustment (La Croix, 2004). Also known as the voice of the process.

Manufacturing Execution System (MES). A system which guides, initiates, responds to, and reports on plant activities as they occur from order launch to finished goods (Manufacturing Technology and Industrial Systems Task Force, 2001).

Prediction. If a process is in statistical control, then the future behaviour of that process may be predictable for the foreseeable future (La Croix, 2004).

Specifications. Boundaries, based on customer requirements, for a product or process (La Croix, 2004). Also known as the voice of the customer.

Statistical Process Control (SPC). A collection of strategies, techniques, and actions taken by an organization to ensure they are producing a consistent quality product (La Croix, 2004)

Variation. Variation in a system is based on the premise that no matter how hard we try to do something there will always be some variation in the process and the outcome (La Croix, 2004). The variation is a result of either common or special causes.

Limitations of the Study

The study is limited to the researcher's time and working experience with SPC in food manufacturing facilities

Chapter II: Literature Review

Introduction

This chapter will discuss Manufacturing Execution Systems of which the SPC system is a part, the need for SPC in manufacturing plants, studies of application, and the importance of collecting the right data.

Manufacturing Executions Systems

While the purpose of this paper is primarily to outline the journey the company involved in this study took to get SPC to the shop floor. An understanding of how an SPC system integrates with other systems is helpful. The SPC system as a part of a Manufacturing Execution System (which is a system, which guides, initiates, responds to, and reports on plant activities as they occur from order launch to finished goods) can be much more effective. Although an SPC system can stand alone, in today's manufacturing environment it is important to understand how the SPC system as a part of the MES system might fit in with the overall information systems. For example, data related to waste could be shared with materials management in order to better manage raw material inventories. It may also be linked to controls so that the data from the processes (machines) resides in the SPC system for continuing to reduce variation in the process.

Gould's (2000) model for a Manufacturing Execution System (MES) describes the MES functions and links to other systems. It shows how systems that might make up an MES system such as:

- Operations and Scheduling
- Resource Allocation
- Document Control

- Dispatching
- Product Tracking
- SPC
- Quality, Labor and Maintenance Management

might link with other systems such as supply chain, sales and service, financial and other management systems.

It is important to note that there may be multiple links based on product and need. A re-creation of the model can be found in Appendix A.

Gould (2000) provides additional explanations why MES is important for a plant to function. "MES describes an area of work says John Woods, director of Manufacturing floor systems for General Motors, a space generally critical to the operation of the plant." That space that consists of an integrated collection of applications that is between control and enterprise systems." Swanton defines MES simply as the system that knows what the order is, knows something about that order and can electronically communicate that information to people and machines.

In an overview of MES from the software provider Conseers web page (2003), the linkages are shown from the Enterprise Resource Planning Module (communicates the information to people) to Supply Chain Management Modules (knows something about the order) to the Manufacturing Execution System (communicates the information to both people and machines) of which the SPC module is a part (see Appendix B).

Nearly every type of manufacturing from large to small is using some form of MES. Some of the operative benefits of MES include reduced throughput, less production error, less data entry, and reduced setup and downtime. Some of the strategic benefits of MES are shorter lead times, lower production costs, higher productivity, lower inventory levels, and increased capacity. This is accomplished by having real time information of what is happening on the production floor.

Necessity for SPC in Manufacturing

SPC has been used in manufacturing for many years but has it been used in the right way? The goal of SPC has always been to reduce variation in the process, yet that information has typically been collected and analyzed after the fact, which allowed only a reactive response.

In Deming's 14 points, number three states: "Eliminate the need for mass inspection as the way of life to achieve quality by building quality into the product in the first place. Require statistical evidence of built in quality in both manufacturing and purchasing functions" (Wheeler, 1992, p. 85). This indicates that management needs to be looking at the process and reducing variation as it is happening.

SPC software systems such as the one that has been implemented at the facility in this study have the ability to show how the process is running real-time (or at least a soon as the information is entered). In addition, some of the automated control systems can feed data to the SPC system and make adjustments automatically based on the specifications. This allows operators and management to evaluate if the process is running to target and make any required adjustments.

Kevin Prouty, an analyst with AMR Research (Boston), who tracks the use of quality management tools in the automotive industry says;

"Every now and then, a quality problem would crop up and someone would go back and review the SPC data to see if it would help uncover the cause of the problem. To foster continuous improvement manufacturers want more real time information, they want to know things are breaking before they are actually broken." (Hill, 2003, p1) This says in a very simple way what SPC is all about-the ability to know that something is breaking before it is broken and intervening to fix the problem before it goes to the customer.

Studies of Application

An example of fixing something before it is broken would be At Steelcase Inc., a leading office furniture manufacturer in Grand Rapids, MI. Their customers have a minimum specification for paint thickness (Statsoft Inc., 2004). Steelcase has traditionally tracked millage based on average paint thickness, without giving major consideration to variation. While the averages were above customer specifications and they were happy the company was losing money in paint and powder coating application.

One of the first areas chosen an analysis project was the paint and powder coat lines (Statsoft Inc., 2004). "On these lines--used for painting desk drawers, pedestals and other components--parts go through a two-stage process; human operators spray portions of the product, and the remaining portions are covered in an automatic spray booth" (p. 1).

For the project, operators collected the paint thickness data and then entered into a personal computer (Statsoft Inc., 2004). The data was then analyzed using a program similar to the one implemented at our food company to determine and understand the sources of variation in paint millage. The next step was to develop methods to improve the process.

In the end, the project was a tremendous success. The average paint millage on one powder coat line was reduced by 15%, and the variation was reduced by 40%, he notes. While the paint process continues to meet customer requirements for paint coverage, the process changes produced significant savings for Steelcase by eliminating wasteful paint overages. (StatSoft Inc., 2004, p1)

From the Steelcase study we can see that a lot of thought was put into what data they were collecting. They were driven primarily by the desire to reduce paint costs. An important part of any SPC implementation is deciding what data to collect.

Data Collection

In the manufacturing plant involved in this study, the process of deciding which data to collect was a dynamic process. Essentially it is divided into Raw Material, Process (line speeds and settings) Quality, and Finished Good data (weights and measures). A critical step is deciding which data to collect and continuing to fine-tune the process. Ha and Morris (2003) point out that

A statistical process control (SPC) program is only as good as its data. Data can point out problems, tell their causes and how often they happen. Data can show how much variation is in the process, and when the process is out of control. It can lay the groundwork for action. (p. 1)

The next step as in the Steelcase example is to find ways to control the process. This data is collected and analyzed using information both from the process that is making the part and the part itself.

"Before collecting the data, decide which characteristics are most important for improving product quality" (p. 1). It is okay to change these characteristics at any time. In fact once a single (or set) of characteristics is brought under control you move to the next until the whole process has been analyzed from beginning to end. It is important to note that like the Deming Cycle you continue to go through the process again and again to look for new ways to reduce variation.

It is also important when analyzing each characteristic to consider the purpose, the type of data that can be gotten from it, how it will be measured and at what point of the process it will be measured. The focus can be to analyze the process or correct a problem. The purpose points the way to the kind of data needed, where to collect it and how to organize it.

In summary, while an SPC system can stand alone the ultimate benefit can be achieved by integrating the SPC system into the legacy or enterprise system. This allows improved decisions to be made in area such as Resource Planning. The idea of SPC is to reduce variation and to fix things before they are broken. In the example from Steelcase, paint consumption was reduced by 15% and variation was reduced by 40% while still meeting customer specifications. In the Steelcase example, determining what data to collect, when to collect and who is going to enter and analyze the data was one of the most important parts of the project. The purpose which was to reduce mil thickness to specification-pointed the way-which was to collect data on the thickness through each step of the process and analyze it for opportunities to reduce variation.

Chapter III: Methodology

Introduction

This chapter includes a description of the subject that was selected, the research method, and process that was used in this study. Also explained is how this study was approached using an implementation checklist (see Appendix A for the implementation checklist).

Subject Selection and Description

This study was conducted in a mid-sized food manufacturing plant (300 employees) in North West Wisconsin. The plant has been in operation since the mid-seventies, changing ownership several times. Each successive buyer has improved the operation and the most recent owner has invested capital in automation, which resulted in a 40% reduction in the workforce with increased capacity.

The focus of this paper is to show how the SPC implementation has been used to fine tune the processes and improve consistency, and quality. The company had invested in an SPC data collection system that is networked to all of its plants worldwide. The installation of the system itself took place approximately three years ago and up until the last year it had been used primarily for Quality Control (QC) data. The data was typically not entered real time and had limited analysis usage.

The researcher was part of the implementation team who instructed the relevant production employees about the principles of SPC and the use of the SPC data gathering system. Quality, Production, Continuous Improvement and Engineering were represented.

Survey Development

The instrument used in this study was a survey that was designed to focus on the specific gaps in the implementation training so that adjustments and modifications could be made for subsequent sessions. In addition, the employee's perception of the format and content of the training was questioned by asking them to check descriptive verbs (see Appendix D for the survey instrument).

Survey Distribution

The survey was given to the 61 employees who attended the implementation training. The survey was distributed after the initial training session so that the results could be tabulated and action taken prior to any subsequent training.

Chapter IV: Results

The Training Process

The first step in the process was to form an SPC utilization steering committee. The steering committee was made up of the Quality Manager, Production Manager, Continuous Improvement Coordinator, and two Production Supervisors. The steering committee members became the resident experts on the SPC software and the basics of SPC. The committee members also familiarized themselves in detail with the Project Checklist (See Appendix A) and the Project Timeline (See Appendix E).

In the second step, the Steering Committee then developed a utilization team. Because of the small size of this facility it was decided the utilization teams would consist of the users of the SPC database on each shift. The steering committee meets once a week and the utilization teams meet monthly.

The next steps (three, four and five) were to identify and resolve software and connectivity issues. The software and database reside on a remote computer system with the different divisions connecting through T-1 lines (Wide Area Network). The software issues were dealt with by two members of the utilization team becoming familiar with the software (resident experts). The resident experts would then communicate with the experts from corporate to resolve programming or software issues.

The resident expertise in this facility was due to the fact that the software and operating system had been installed about two years prior to the full implementation. As mentioned previously the quality department was using it on a limited basis as was production, so many of the projects were set up and the Quality Manager and Production

Manager had become proficient in the operation of the system. The resident experts were also key in developing the projects for collecting data at each site.

Step six was comprised of the training and implementation phase, which is the primary focus of this paper.

Implementation of Alarming and Standardization

The implementation plan (See Appendix C) started with implementation of alarming and standardization in the division for projects, colors etc. for the alarms. Projects are the infrastructure that the data is entered into that indicates the types of test according to functional area. For example, there are tests for production, quality, and packaging, to name a few. Alarming is simply a visual indicator that a process or test has exceeded a limit.

Training Development and Introduction

The next phase was to introduce the basics of SPC to the employee groups on the three shifts that were required to enter and use the data. The introductory training was split into three 45-minute sessions over a three-week period. A test was given at the end of each unit and an assignment specific to each operational area was also given to complete.

The agenda for session one included the following topics:

- What is SPC?
- Why SPC?
- Who is Shewhart?
- Who is Deming?
- SPC vs QC

- SPC Basics
- Empirical Rule
- Charts
- Voice of the Process
- Voice of the Customer
- Variation
- Shewhart's Rules
- Data Patterns
- Test
- Questions
- Assignments

Session two included the following topics:

- Empirical Rule
- Control Charts
- Voice of the Process
- Voice of the Customer
- Variation
- Chance Causes
- Assignable Causes
- Prediction
- Control Limits
- Specifications

- Test
- Questions
- Assignments

The agenda for session three included the following topics:

- Components of Control Charts
- Test
- Questions
- Assignments

Members of the SPC Steering committee worked individually with the employees that attended the training to verify that each employee was able to perform the following operations in the system:

1) How to operate and find information in Infinity
    a. How to sign on, complete data entry, find control charts to be reviewed.
2) How to edit information error correction and identification
3) How to read a control chart
    a. Line Leads and QC > % Pick-up
    b. Packaging Techs > % Giveaway
    c. SRC/SPC Techs > % EOM/Slabs
    d. Implementation of ACC/CAC and analysis of ACC's

The steering committee was meeting weekly to prepare for the next phases of the utilization. Specific projects were evaluated for the information that was being collected and to prepare lists of causes and corrective actions for those events that caused a process to exceed a limit. The criteria for evaluating the projects follow:

1) Is it relevant?

2) Does the data show variation?

3) What are the typical types of events that cause variation?

4) What are the actions that are taken to reduce variation?

Projects or data collection fields within projects that showed little or no variation were either eliminated or not set up with codes.

For the remaining projects, lists of ACC's and CAC's were developed. For instance, some of the ACC's were defective bucket, management decision, pick up too high, pick up too low, piece count too low, scale set point incorrect, scale settings, sticking at scales, tare weight, and other. CAC's include adjust scales, calibrate scales, change tare weight, lower package weight, management decision, turn off defective bucket, and other.

The next step was to introduce it to the employees. As stated previously, the utilization team consisted of the employees from each shift who were users of the system. The first meeting was a review of the assignments from the previous training and also a training opportunity to explain the ACC's and CAC's and how to enter them into the system. The agenda for the meeting included the following:

- Review % Giveaway
- Review % Pickup
- ACC/CAC Training
- Questions
- Assignments

The focus for the meeting again was ACC's and CAC's. The training began with a review of variation from the first training sessions:

- No two things are exactly alike
- Variation in a process or product can be measured
- Things vary according to a definite pattern
- There are two types of variation
- Assignable
- Common

The goal, of course, is to reduce variation. What an assignable cause is was then explained:

- Not a normal part of the system, good or bad, can be prevented or corrected by those who work directly on the process (operator error, new operator, machine adjustments, damaged equipment, change in material, etc.).
- SPC identifies when assignable causes exist; causes making the process worse can be identified and eliminated; making it better can be "locked in."

The following sources of variation were discussed:

1) Materials
2) Machines
3) Methods
4) Manpower
5) Environment

Then examples of how the ACCs would look on the system and how to enter them were discussed. As in the previous training, assignments were given to supervisors and operators to validate their knowledge and understanding. Members of the steering committee again went to each individual operator to test their understanding and clear up any of the fine points. In addition a report was generated from the system that allowed operators and management to review the ACC's and CAC's from the past 24 hours.

Results

Of the 61 surveys distributed, 36 (59%) were returned. Two areas of concern that were indicated in the survey were the understanding of assignable causes and whether control limits were given by the customer (see Table 1). It was determined that since assignable cause was to be covered in detail in later training that it was not critical to follow up at that time. The understanding of the difference between a control and a specification limit was deemed critical at this time and gone over with each of the people in the training individually by the trainers. The consensus was that the training experience was positive (see Table 2). Due to these results, it was decided it was not necessary to make any changes to the format of the training.

Table 1

Participants' understanding of training

Item	Percentage of Yes Responses
Able to apply techniques learned	100
Able to read a control chart	100
Understand difference between control limit and specification	94
Understand that causes of variation give us	94

more control over processes	
Understand how to sign on, complete data entry, and find control charts for review	94
Understand how to edit information	87
Completed assignments from training	83
Damaged equipment is an example of an assignable cause	77
Control limits are given by the customer	69

Table 2

Participants' reactions to the training

Reaction	Percentage Agreeing
Informative	31
Organized	19
Practical	16
I felt involved	12
Challenging	11
Motivating	9
Slow moving	3
Overwhelming	0
Unrealistic	0

ACC's and CAC's have been implemented for all tests in the focus areas and the training and follow up done as previously outlined. The facility has shown continued improvement in consistency and first pass quality for the first quarter of the fiscal year is at 99.8% up from 99.5% average over the previous year. In addition, there were savings in packaging giveaway where improvements were 8.5% and 47% in the two major product categories.

While it is probable that there are cost savings related to this effort as well, it would be difficult to break it out of the other ongoing efforts. Again the focus of this effort was to bring consistency to product (reducing standard deviation and running to target), and practices between the shifts and provide us with a better understanding of the capabilities and opportunities within those processes.

The next steps as we begin to understand the possibilities will be to

1) Develop specific projects to address the opportunities that we are collecting data on
2) Develop tracking mechanisms to capture the cost improvements
3) Train the operators in advanced statistical tools.

Chapter V: Summary and Conclusions

In conclusion, an SPC data collection system is a tool that may be used to improve and understand the manufacturing processes in any type of manufacturing plant. As stated in the Steelcase example, it is used to fix things before they become broken. The system may stand alone or be integrated with other systems. Ideally the best approach would be to integrate it with other systems particularly to capture a broad spectrum of processing, material, and cost data. Through this study it is shown that the keys to a successful integration of an SPC system into a manufacturing company are as follows:

1) Adequate systems support (hardware and software).
2) Step by step implementation plan and timeline.
3) Steering committee comprised of middle and senior management that include internal experts on the system.
4) Utilization teams comprised primarily of users and led by the steering committee.
5) Step by step training and individual follow up.
6) Weekly meetings by steering committee to follow up on training and systems issues.
7) Steering committee continues to drive the process forward to advanced statistical techniques and utilization of data to develop projects.

In many cases the cost savings that will initially be seen is in less reworked and returned product (happier customers). As data is collected and a better understanding of the processes develops opportunities to save in areas such as materials, machine downtime, and maintenance activity will become evident. It is important to take it slow, one step at a time, so that the employees have an opportunity to integrate one step into their daily activities before moving on to the next. Testing knowledge, following up and providing individual attention will pay dividends in trained, knowledgeable operators who understand what they are looking for and how to correct the process upstream and down.

From a cost perspective, one of the key indicators is called giveaway. This is the amount of product that is "given away" in order to meet overall weight specifications. In the two major product categories there has been an 8.5% and 47% improvement respectively. This translates into more finished product per run which impacts both material and labor costs.

In conclusion, the implementation of an SPC production and quality database has shown repeatedly that it will pay dividends in quality, customer satisfaction, material and labor costs.

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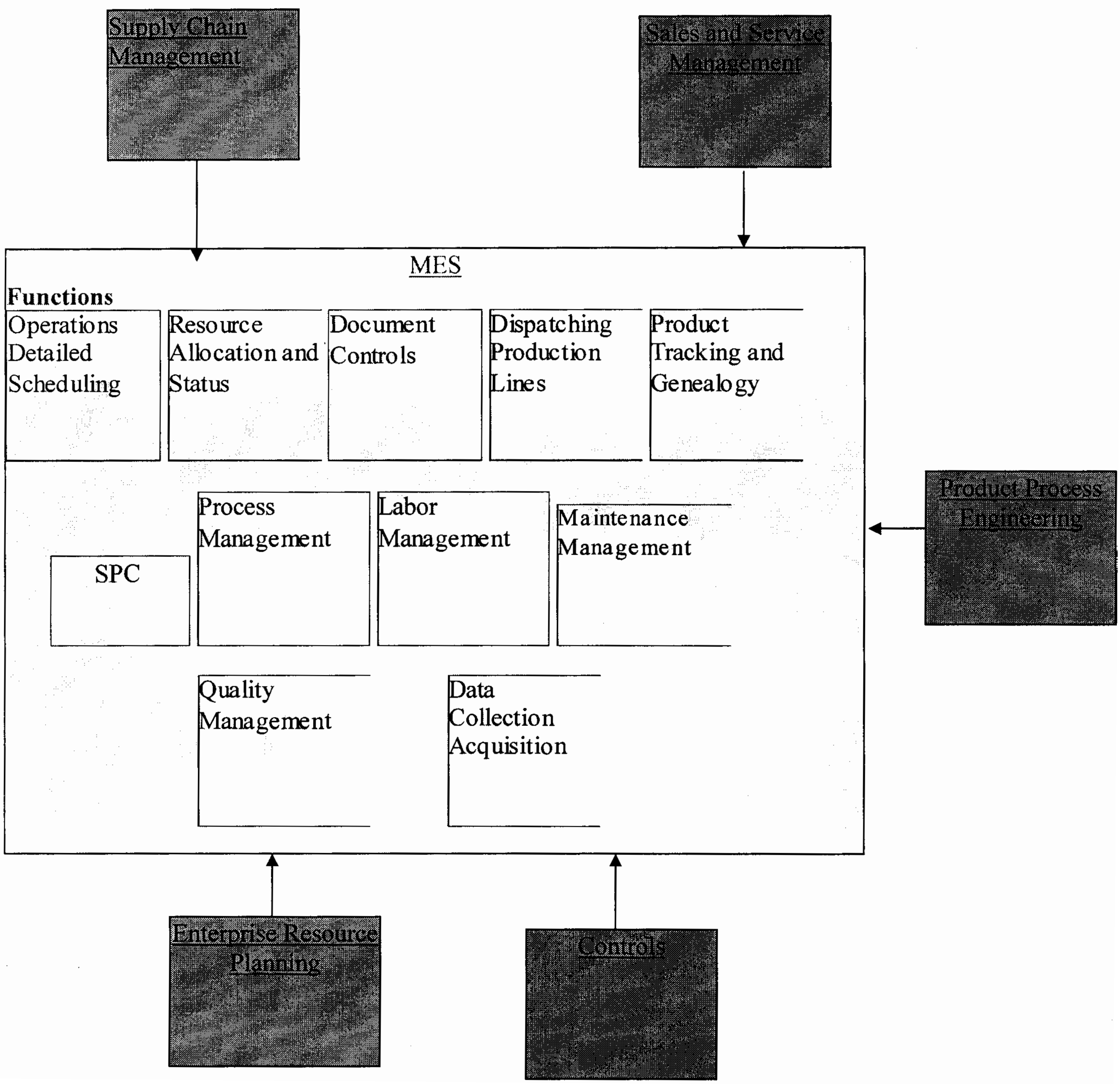
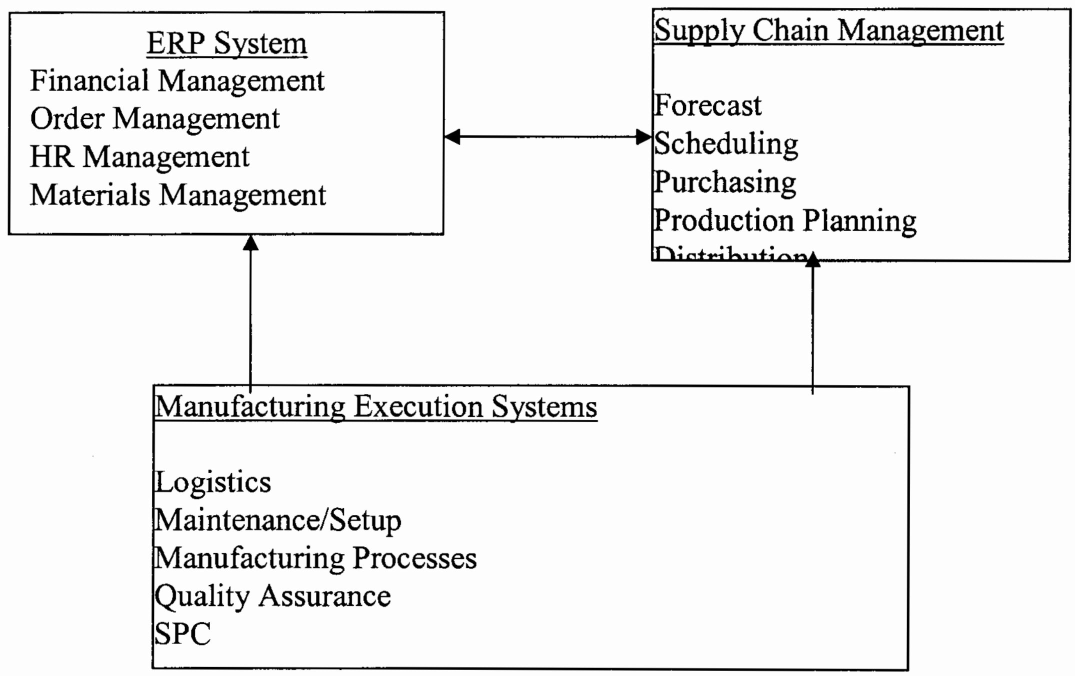
Appendix A: MES Model (Gould, 2000) Modified



Appendix B: ERP/MES Linkage Model (Conseers 2003) Modified



Appendix C: Project Plan Checklist

SPC PROJECT PLAN CHECKLIST

1	**Designate SPC Utilization Steering Committee**
1.1	Train Steering Committee
1.2	Review Utilization plan with Steering Committee
1.3	Review Roles and Responsibilities for utilization
1.4	Obtain Sign off
2	**Establish SPC Utilization Team**
2.1	Train Utilization Team
2.2	Review Roles and Responsibilities for utilization
2.3	Establish preliminary milestone dates
2.3.1	Establish milesone dates
2.3.2	Resource requirements for plant
2.4	Establish meeting schedule
3	**Post Analysis SPC Implementation Review**
3.1	Utilize SPC Implementation Review
3.1.1	Identify Software Issues and Highlight through channels
3.1.2	Identify gaps in knowledge and application
3.1.3	Develop Action Plans
3.2	Review results with Steering Committee
4	**SPC Utilization Review**
4.1	Establish monthly review schedule
4.2	Utilize SPC Utilization Review
4.2.1	Identify Software limitations
4.2.2	Identify gaps in knowledge and application
4.2.3	Develop Action Plans
4.3	Review results with Steering Committee
5	**Establish software issues follow up mechanism.**
5.1	Logging Calls to Helpdesk
5.2	Utilizing Log Sheets - Speed Issues
.6	**Utilization Milestones**
6.1	Implementation of Alarming and Standardization
6.1.1	Alarming Colors standardization
6.1.1.1	Insure all alarming color preferences are the same across division
6.1.2	Identify test, charts and projects to be alarmed
6.1.2.1	Review process flow for proactive measurements

6.1.2.2	Identify test, charts and projects to turn alarming on
6.1.3	Alarming Procedures
6.1.3.1	Review Alarming Procedures
6.1.4	Training - Alarms
6.1.4.1	Develop training schedule
6.1.4.2	Train Operators/Supervisors utilizing standard training
6.1.4.2.1	Basic Process Flow
6.1.4.2.1.1	Provide overview of Process, Key Characteristic Relationships
6.1.4.2.2	Basic Control Chart Training
6.1.4.3	Assignments - Operators/Supervisors
6.1.5	Turn Alarming on for all test, charts, and projects identified by Process Flow
6.1.5.1	Shewarts Alarms
6.1.6	Tracking mechanism
6.1.6.1	Reduction Standard Deviation (short term)
6.1.6.2	Zero Tolerance - Data Entry Errors
6.1.7	Follow-up
6.1.7.1	Supervisor Auditing/Checks
6.1.8	Keys of Success
6.1.8.1	Reduce Data Entry Errors
6.1.8.2	Reduction of Standard Deviation
6.2	Implementation of ACC/CAC and Notes
6.2.1	Standardize ACC/CAC List
6.2.1.1	Review ACC/CAC Guidelines
6.2.1.2	Review Note Guidelines
6.2.1.3	Review Current ACC/CAC List
6.2.1.4	System Administrator - Input standardized ACC/CAC List in Database
6.2.2	ACC/CAC and Notes Procedures
6.2.2.1	Develop procedure for handling ACC/CAC codes
6.2.2.2	Develop procedure for note entry
6.2.2.3	Review ACC/CAC and Note Procedures with Steering Committee
6.2.2.4	Develop Process Action Reports
6.2.3	Train Users - ACC/CAC/Notes process
6.2.3.1	Develop training schedule
6.2.3.2	Train - ACC/CAC and Notes
6.2.3.3	Train - Input ACC's/CAC's
6.2.3.4	Review Procedures
6.2.3.5	Basic Control Chart Training
6.2.3.6	Note Guidelines
6.2.3.7	Process Flow
6.2.4	Tracking mechanism
6.2.4.1	ACC = CAC
6.2.4.2	Zero Tolerance - Unassigned ACC/CAC's
6.2.4.3	Note - Guidelines Followed
6.2.5	Follow-up
6.2.5.1	Review Process Action Report

6.2.6	Keys of Success
6.2.6.1	ACC/CAC entered correctly and timely
6.3	Analysis of ACCS
6.3.1	Identify test, charts, and projects that require analysis
6.3.1.1	Review process flow for standard areas to analyze
6.3.1.2	Identify test, charts, and projects to develop analysis projects
6.3.2	Develop analysis project
6.3.2.1	Build Pareto charts
6.3.3	Train Users - ACC Analysis
6.3.3.1	Develop training schedule
6.3.3.2	Train - ACC Analysis
6.3.3.3	Train - Pareto Analysis
6.3.4	Tracking mechanism
6.3.4.1	Assignment Forms Completed
6.3.4.2	Action Implemented
3.5	Follow-up
6.3.5.1	Review Process Action Report
6.3.5.2	Review Pareto Charts
6.3.5.3	Review results with operators
6.3.6	Keys of Success
6.3.6.1	ACC/CAC entered correctly and timely
6.3.6.2	Visualization of Problems by Process
6.3.6.3	Reacting to ACC's and addressing some of the issues on a timely basis
6.4	Implementation of Forcing ACC
6.4.1	Review Procedures for forcing ACC - Document
6.4.2	Review Procedures for CAC entry - Document
6.4.3	Review test, charts and projects that have Alarming set
6.4.3.1	Review process flow for standard areas that have alarming turned on
6.4.3.2	Identify test, charts and projects to force ACC entry
6.4.4	Training - Forcing ACCs
6.4.4.1	Develop training schedule
6.4.4.2	Train Operators utilizing standard training
6.4.4.3	Follow up Training - Supervisors CAC entry
6.4.4.4	Assignments - Operators/Supervisors
6.4.5	Turn on preferences forcing ACC codes before next sample is entered
6.4.6	Tracking mechanism
6.4.6.1	Number of ACC's = Number of CAC's (1-to-1)
6.4.6.2	Zero Tolerance - Unassigned CAC's
6.4.6.3	Review Pareto and Process Action Reports - ACC/CAC entries
6.4.7	Follow-up
6.4.7.1	Supervisor adding CAC's against ACC's (1-to-1)
6.4.8	Keys of Success
6.4.8.1	Zero Tolerance - Unassigned CAC's during a Alarming Event
6.4.8.2	Review of ACCS to improve process

	Process Improvements
6.5.1	Identify specific area to track process improvements
6.5.1.1	Cutter Area
6.5.1.1.1	Reduce Variation
6.5.1.1.2	Adjust Target
6.5.1.1.3	Analysis to identify potential savings $$
6.5.2	Train Users - Tracking Process Improvements
6.5.2.1	Develop training schedule
6.5.2.2	Process Flow Draft
6.5.2.3	Advanced Analytical Tools
6.5.2.3.1	Variable Control Charts
6.5.2.3.2	Box-N-Whiskers Chart
6.5.2.3.3	Pareto Chart
6.5.2.3.4	SPC Monitor
6.5.2.4	Continuous Improvement Basics
6.5.3	Tracking mechanism
6.5.3.1	Reduction of Standard Deviation (short term)
6.5.3.2	Tracking change of mean
6.5.3.3	Tracking $$ - Cost Improvements
6.5.4	Follow-up
6.5.4.1	Operator responds to Out of Control Charts
6.5.4.2	Review variability of change of mean
6.5.4.3	Review change within Standard Deviation (short term)
6.5.5	Keys of Success
6.5.5.1	Reduce Standard Deviation (short term)
6.5.5.2	Change of mean
6.5.5.3	$$ Savings achieved
6.6	Reporting - Review Management Reports with Supervisors
6.6.1	Review Standardized Reports with Supervisors
6.6.2	Develop Reports needed by Supervisors
6.6.3	Infinity Report Training
6.6.3.1	Basics of Infinity Setup
6.6.3.2	Review generating reports
6.7	Facility identifies opportunities
6.7.1	Advanced Process Training – Opportunity Identification
6.8	Facility develops projects to address opportunities
6.8.1	Identify specific area to track process improvements
6.8.2	Train Users - Process Improvements
6.8.2.1	Develop training schedule
6.8.2.2	Process Flow Draft
6.8.2.3	Advanced Control Charts
6.8.2.4	Advanced Analytical Tools
6.8.2.4.1	Variable Control Charts
6.8.2.4.2	Box-N-Whiskers Chart
6.8.2.4.3	Pareto Chart

6.8.2.4.4	SPC Monitor
6.8.2.5	Continuous Improvement Basics
6.8.3	Tracking mechanism
6.8.3.1	Determine how results will be tracked (KPI)
6.8.3.2	Tracking $$ - Cost Improvements
6.8.4	Follow-up
6.8.4.1	Determine how follow up will occur
6.8.5	Keys of Success
6.8.5.1	$$ Savings achieved
7	**Develop End-of-Month Cost Benefit Review**

Appendix D: Training Survey Form

Training Title SPC Basics   Date: April/May 2004   Shift________

- Circle the answer that represents your reaction to what you learned from the training

   a. I feel that I will be able to apply the techniques I learned to the workplace.

      Yes   No   Not Sure

   b. I understand the difference between a control limit and a specification

      Yes   No   Not Sure

   c. Control limits are given by the customer

      Yes   No   Not Sure

   d. Understanding the causes of variation will give us more control over our processes

      Yes   No   Not Sure

   e. Damaged equipment is an example of an assignable cause

      Yes   No   Not Sure

   f. I have had the opportunity to complete the assignments from the training

      Yes   No

   g. I understand how to sign on, complete data entry and find control charts for review in Infinity

      Yes   No   Not Sure

   h. I understand how to edit information in Infinity

      Yes   No   Not Sure

   i. I understand how to read a control chart

      Yes   No   Not Sure

- Check the words that describe your reactions to the program
    - ☐ Slow Moving
    - ☐ Informative
    - ☐ Overwhelming
    - ☐ Unrealistic
    - ☐ Challenging
    - ☐ Motivating
    - ☐ Organized
    - ☐ Practical
    - ☐ I felt involved

Comments:____

Appendix E: SPC Timeline

SPC Timeline