The Application of Value Stream Management Principles In a Batch Production Environment

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Submitted to Sloan School of Management and the Department of Civil and Environmental Engineering in partial fulfillment of requirements for the degrees of

Master of Business Administration
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Abstract

The need for continuous improvement within a value stream is very necessary in today's business environment and can be one of the key sources of competitive advantage. As a company learns and implements the tools and practices of a Lean system, the underlying management and leadership methods become critical to sustaining fundamental operational change. A Value Stream Manager provides this leadership and is responsible for increasing the ratio of value to non-value by eliminating waste in the overall value chain from start to finish.

The scope of the responsibilities of a value stream manager should cover at least two domains. First is the plant domain, that improves the value stream between the four walls of the plant; including the inbound and outbound logistics to/from the plant. The second domain is to consider the value stream at the enterprise-level. At the enterprise-level, the value stream manager is responsible for eliminating waste throughout the extended value stream, including channel partners such as suppliers and customers.

This thesis will examine the operations of the ABB Wessel Cable plant in Longford, Ireland and analyze the application of Value Stream Management principles during a six and a half month internship period. By involving all the employees at ABB Wessel we were able to reduce WIP and Finished good levels down to historic lows holding scrap below 4% and increase overall equipment effectiveness by almost 30%. By concentrating on velocity of flow through the factory with reduced overtime, the business stopped losing money. In the proposed future state, additional performance enhancing changes are identified and discussed as a going forward plan for the future.

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I thank my project supervisor, Tom Flynn, the Operations manager of ABB Wessel Cable Ltd., for his support and willingness to share information. I would also like to thank the managers and employees of the ABB Wessel Longford plant for their helpfulness and real desire to improve their competitiveness.

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Most importantly, I would like to thank my wife, Sheila, for her support and sacrifices not only during the internship, but the entire two-year Leaders of Manufacturing Program. She has enabled this to be a wonderful once in a lifetime experience.

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SECTION 1: INTRODUCTION AND OVERVIEW

1.1 Introduction

This thesis is based on research that was conducted at the ABB Wessel Cable plant in Longford Ireland as part of an internship project for the Leaders for Manufacturing Program, Massachusetts Institute of Technology, Cambridge Massachusetts. The internship was sponsored by the ABB Corporation Central Research Center and the ABB Wessel Industries Ltd. of Dublin Ireland. The research examines the operations of the Longford plant and analyzes the opportunities for the application of Value Stream Management principles, Lean Manufacturing and Six Sigma tools and concepts. This project will also review current material flows and scheduling practices using Value Stream Mapping and Profitability Mapping to identify potential improvements. Based on this information, and the supplemental research, a future state of operations will be recommended.

1.2 Motivation and Objectives

The primary motivation of the internship was that the senior management of ABB Wessel needed to turn their company around, because it had been steadily been losing money since 1996 when the Irish Telecom industry was privatized. They needed a sustainable way to be profitable again. They knew that their company would need to be fundamentally different in culture, organizational structure and strategy/philosophy, and that it would require an outside catalyst to start the transformation. It was understood that this internship period of six and one half months was the critical foundational phase of what would be a two to three year transformation. To this end, Tom Flynn (General Manager) and I sat down and made the following project objectives:

- Start the cultural transformation from Hierarchal to Team-based
- Create a customer-focused organization
- Lower the operating costs by eliminating waste within the entire Value Stream
- Create the capacity for new business growth
- Attract Corporate investment
- Help ABB Wessel prove to themselves and others that they could change, improve and become competitive again.

1.3 Background

Value Stream Management requires the ability to be able to step back and view the entire value stream from a broad perspective. It involves understanding what does and does not create value from the customer's perspective, rather than the perspective of individual departments or organizations. A Value Stream Manager is a person that is responsible for increasing the ratio of value to non-value by eliminating waste throughout the entire value chain, including moving beyond traditional buyer/supplier roles to unlock trapped value and ensuring that the product meets or exceeds the customer's requirements.

The ABB Wessel plant in Longford had had little or no exposure to modern manufacturing principles such as Lean or Six Sigma; and in many ways was like a time capsule from the early 1980's. This setting offered a unique opportunity to apply Value Chain Management principles and teach/implement Lean Manufacturing techniques and material flow within the plant.

1.4 Reader's guide to Sections and Thesis

Section 1 Provides an introduction to the thesis and an understanding of the scope and motivation for the project. It also provides relevant background to the thesis.

Section 2 Provides background on the setting for the thesis and important issues affecting it. It provides an insight into the ABB Wessel Cable Company and the competitive environment it faces today. It also describes the ABB Wessel Cable Company in its current form and gives an overview to the ABB Wessel production facility in Longford Ireland.

Section 3 Describes the ABB Wessel facility operations, customers, suppliers and current management practices. It provides an overview of the basic material flow and the cable manufacturing process.

Section 4 Provides an overview of the organizational transformation roadmap that was used for this project and also describes several alternative organizational transformation models and their processes.

Section 5 Describes and analyzes the current state of the ABB Wessel operations. This Section also describes how the Value Stream Mapping process was used at ABB Wessel and details the operations of the facility through description and data. It also highlights the key challenges and issues with the current operations.

Section 6 This Section investigates the topic of leadership and cultural change and describes the processes that were used.

Section 7 Describes the process of teaching Lean principles and Six Sigma tools and concepts. It also describes the transition to a Lean continuous improvement environment of teamwork.

Section 8 Describes the current Supply Chain at ABB Wessel and details the challenges and improvement approach utilized.

Section 9 Outlines a proposed future state and how it is being implemented at ABB Wessel. This Section also addresses key issues and challenges to this implementation plan.

Section 10 This Section summarizes the objectives, accomplishments, conclusions and lessons learned during this 6.5 month internship.

SECTION 2: PROJECT SETTING

While the main emphasis of this thesis is on Value Stream Management processes, steps, improvement techniques/tools, and the lessons learned during this critical phase of the turn around initiative conducted at ABB Wessel in Longford, Ireland, it is first crucial to understand the context and setting where this work was done. To do this it is necessary to understand the company and major issues that have influenced the current environment; for it is my belief that it is just as important to know how ABB Wessel got into this condition as it is to know how to get out of it. For this project, the two most relevant influences are the culture and the business environment of the ABB Corporation. The following Section gives a description of ABB's past and their present business goals and objectives.

2.1 ABB Corporation

The ABB Corporation (Asea Brown Boveri Ltd) was formed in 1988 as a result of a merger between ASEA (Allmanna Suenska Elektriska Aktiebolaget) and BBC (Brown, Boveri and Cie). ASEA was one of the top ten power technologies companies in the world, specializing in nuclear power plants and robotics. BBC was a leader in power transformer technology and hydroelectric power generators. The history of these two companies before the merger to form ABB goes back 120 years to the late nineteenth century, and has a long and illustrious record of innovation and technical leadership in many industries around the world.

ABB has recently streamlined its divisional structure to focus on two core businesses: Power Technologies and Automation Technologies. The Oil, Gas and Petrochemicals Division has been slated for divestment. ABB's Power Technologies Division serves electric, gas and water utilities as well as industrial and commercial customers, with a broad range of products, systems and services for power transmission and distribution. ABB's Automation Technologies Division blends a robust product and service portfolio with end-user expertise and global presence to deliver solutions for control, motion, protection, and plant integration (ABB Wessel is part of the Power Technologies division).

According to the ABB corporate website their current business strategy is simple: Offer more value for customers while building a leaner organization. A few years ago ABB expanded its holdings through acquisitions and its portfolio had grown to almost 900 plants. As a result, it found that it had also gotten away from its core competencies. Today they are down to a little more than 700 facilities in over 100 countries world wide. At one point last year they could have been facing bankruptcy due to a potentially ruinous asbestos settlement in the United States which was fortunately capped at $1.2 billion by the US courts.

2.1.1 ABB Culture

ABB is a company of many cultures; it is as diverse as its global holdings. This is sustained in many ways by its decentralized approach to managing their holdings as loosely coupled bundles of assets. The glue that holds this global organization together involves the overall information reporting system (reporting performance measures to the top executives from each of the businesses and profit centers) and a softer kind of bond, the ABB policy bible, which includes the firm's mission, values and expectations, along with guidelines for overall behavior. In other words, it is used as a guide to the corporate culture. Having said this, it was evident during this project that the culture was changing, especially in the area of Human Resource Management, where they are becoming more focused on internal people development and processes to grow the bottom line rather than acquisitions.

2.1.2 Competitive Environment

The competitive landscape in the Power Transmission and Distribution and Automation industries has changed dramatically in the past decade, largely due to technological revolution, globalization, and increased utility privatization. ABB's main competitors in these industries are a who's who of industrial giants, companies such as GE, Fugi, Hitachi, Eaton, Seimens, Pirelli and Emerson, just to name a few. As industry boundaries continue to be blurred or eliminated, the fight for market share continues to be fueled by fewer distinctions between industrial and service businesses, major advances in communications and logistics, and many government trade tariffs and policies which are being removed have also exasperated this phenomenon. ABB is currently striving to reduce cost through ever greater efficiency and economies of scale and scope.

ABB has, until recently, responded to these changes through strategic consolidation and divestiture. They are now refocusing their resources on core activities and a renewed dedication to developing human capital and intellectual property. Additionally, ABB is under pressure from it shareholders to improve operational performance in several areas. This has led them to embrace Lean as their manufacturing philosophy, although it is still in its implementation infancy, there is increasing interest and resources being made available to eliminate waste throughout the enterprise.

2.2 ABB Wessel Cable Background

ABB Wessel is in the business of manufacturing and selling low-voltage energy cables, telecoms/network cable, and some specialty cables. The Longford plant was constructed in 1981 by a Swedish company Wessel Cable Ltd., in partnership with the Irish Development Association (IDA), which still owns 25% of the business. The plant was originally designed as a high-volume telephone cable manufacturing plant to supply telephone cable to the fast-growing, nationally-owned telephone company (Eircom). The plant was primarily outfitted with used equipment purchased from cable manufacturers in the UK and Northern Europe who were either getting out of the business or moving their operations to low-cost locations in Asia or Eastern Europe.

Until the end of 1999, the company had shown considerable profitability even though it was very inefficient. At which time, their market collapsed, due to the Irish telecom industry being privatized. In addition to the privatization, many entry barriers were lifted by the government of Ireland causing severe price competition.

The ABB Corporation had obtained Wessel Cable Industries in 1996 and even though ABB Wessel has increased their production by 25%, revenues continued to decline. Since 2000 the contribution margin has dropped by more than 50% and the company presented a loss of 13 million USD, during the period of 2000 to 2002. The projected losses for 2002-2003 are 3 million USD primarily due to a decrease in the price of copper. Based on this current financial situation, there was a high risk that the company would run out of cash before the end of 2003.

In the past, ABB Wessel had been run independently of the ABB group. They did not brand their products as ABB nor did they sell to other ABB businesses. The focus of ABB over the past three years has been on trying to sell the business, however that has proved elusive. As a consequence, strategic and operational issues were neglected within ABB Wessel, as well as any restructuring and process improvements. As a result, the organization, processes, and cost structure are unable to compete within the market. The cost structure is far too high; the organization had many duplications, internal competition, and inefficient processes.

ABB Wessel produces approximately 250 SKU's of telecom and low-voltage cables primarily for the Irish and UK markets (see figure 2-1 below). They are the largest telecom and low-voltage cable manufacturer in Ireland (59% of total volume). They operate out of two separate and independent plants, located in Dublin and Longford. The primary internship site was Longford, a 60,000 sq ft facility with 84 employees that operates a three shift, five days/week production schedule.

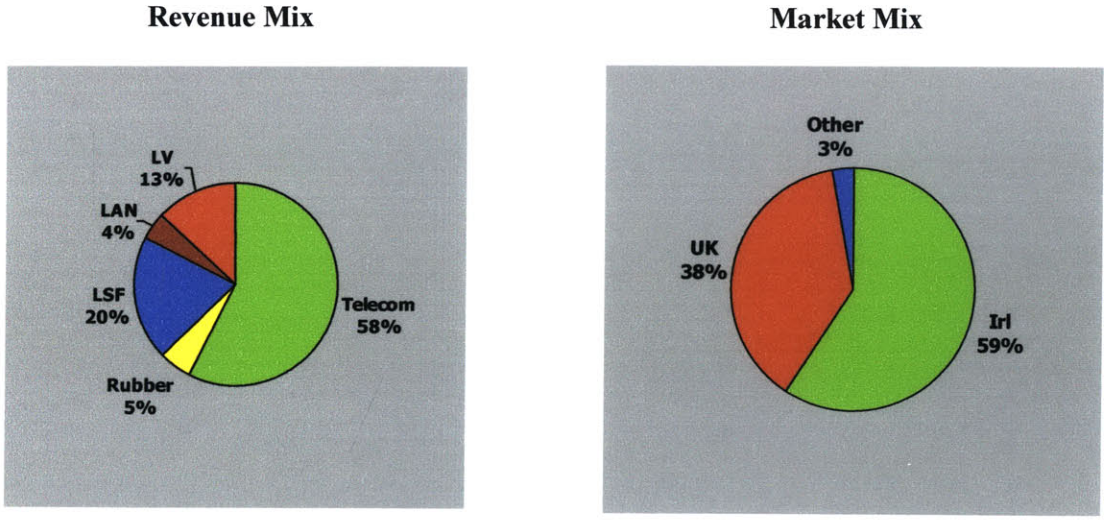


Figure 2-1 Revenue and Market Mix

ABB Wessel has numerous competitors worldwide. As a result there is considerable spare capacity in the cable industry. This industry has continued to contract for the last 5 years, and many competitors are still trying to right-size their facilities. Increased competition from Southeast Asia (possibly as a result of very low shipping costs and creative consignment purchase agreements) has decreased an ever-shrinking market share. Telecom and low-voltage

cable of the kind ABB Wessel manufactures have become a commodity item and considered relatively low technology. Everyone in this market would like to raise prices, but there is always a supplier who upsets the balance and lowers prices, trying to capture volume to spread cost over more products, this keeps the prices low. The telecom and low-voltage cable industry is not an attractive industry at this time.

2.2.1 Plant Description

Physically, the ABB Wessel plant in Longford is located on a hill overlooking the small town of Longford and the beautiful rural farms surrounding it. It is not uncommon, early in the morning, to be stopped on the road to the plant as the dairy cows from the surrounding fields are herded down the road to be milked at a local farm. The factory itself is quite compact and constructed of steel structural members and polystyrene insulated corrugated steel panels. The entire operation (60,000 sq ft) is housed under one roof. The front of the building, facing the road, is where the offices and employee parking is located - and at the back and sides of the building, much of the finished goods storage is located (See figure 2-2 photograph of Longford Plant). The shop floor is laid out in an orthogonal grid with three main aisle ways running north-south and one running east-west. In general raw materials are received at the south end and finished goods are loaded and shipped out of the north end.

Figure 2-2 ABB Wessel Longford Plant

2.2.2 Culture and Organization

As previously mentioned, ABB Wessel was very profitable during its first 16 years of its existence, while they had a virtual monopoly in the telephone cable market in Ireland. This past economic success in many ways helped to cover up a multitude of problems and reinforce, in the employees' minds, poor practices and behaviors. ABB Wessel has always been very hierarchical, with authoritarian managers that ran the plant with very little oversight from corporate headquarters and with little input from the employees; the goal was always to produce more and more volume. Employees were just supposed to carry out managements instructions, not to take part in the decision process.

There are two distinct groups at the plant, management and the unionized workforce. Traditionally there has been very little cooperation or teamwork between them. A good example of this is the seating arrangement in the lunch room, where management has its own table well away from the direct reports. Christmas parties are held separately for management and union workforce. Historically, almost all hiring was done by the plant manager, whose lack of HR training and practices had led to very little diversity (all white Catholic males, many of whom are related). The average age of the workforce is very high, 30% of employees are over 55; 24% are 45-55; 22% are 35-45; and 24% are under 35. The turnover of employees is quite low and the average length of service is 16.7 yrs, with extremely high absenteeism, between 6-8 %.

ABB Wessel's largest customer (Eircom) was at one time 80% of their business. Not surprisingly, the Eircom business has dominated the business strategy of ABB Wessel. The fear of losing the account to a competitor (prisoners' dilemma) has affected all decisions/policies for many years. The prisoners' dilemma is a classic example of game theory and it illustrates the problem faced by most oligopolistic firms. Due to this dependence on Eircom, ABB Wessel has slowly seen the profits in this sector erode, while offering ever increasing services and discounts to Eircom. As a result, resources (people and money) wasn't made available to help grow other parts of the business and the company is suffering the consequences of these decisions today.

The organizational structure was fairly typical for a small plant. The management structure was very flat with very few layers of management, which one would expect in an operation of 84

people. (See figure 2-3 below). Floor supervisors typically would have 10-20 employees reporting to them depending on the shift.

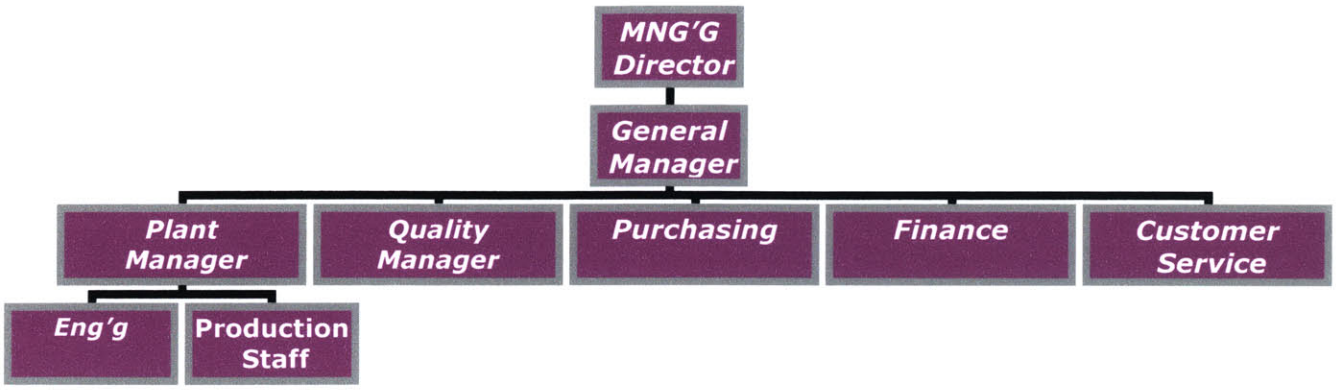


Figure 2-3 Organizational Structure

SECTION 3: ABB WESSEL OPERATIONS

The intent of this Section is to describe the operations at the ABB Wessel Cable plant and to give the reader an idea of the environment. This Section will also provide a basic overview of manufacturing processes; describe the facilities, flow of materials, and information that support that process. It will also describe elements of the work environment that are relevant to the operations and culture within the plant.

3.1 Cable Operations

The ABB Wessel plant in Longford Ireland is one of the largest single employers in the area, not to mention related jobs with suppliers and support services. At the time of this research ABB Wessel produced approximately 3,000-4,000 km of cable daily. This cable is produced on 4 basic production lines: Telecom, Low-Voltage Power, Rubber and Data.

3.1.1 Customers

ABB Wessel has seventeen primary customers that fall into six major categories, they are: National Telecoms, National & Regional Utilities, OEMS, Installation Companies, Wholesalers/Distributors, and internally (sister plant in Dublin). As previously mentioned, an overwhelming majority of revenues (currently over 50%) comes from business with one customer, the Irish national telecom company, Eircom. In recent years ABB Wessel has been actively trying to reduce this dependence by expanding their presence primarily in the UK with wholesaler/distributors such as Hagemayer who sell low voltage cable (House Wire and Low smoke and Fume LSF) cable to contractors and installers. Another key customer is the Irish power company ESB. This company used to purchase much more product from ABB Wessel, prior to privatization.

3.1.2 Suppliers

Traditionally, ABB Wessel's procurement policy was that of having a broad base of suppliers and always having multiple sources for every item. This was thought to be a logical approach since most, if not all, raw materials and supplies required were essentially commodities. Over

time this model changed, as it became more popular to have a few key suppliers (relationship purchasing), and since ABB Wessel does not purchase extremely large quantities they tried this approach. There have been problems though, primarily due to the lack of a supplier management strategy, selection qualification criteria, performance measurements and a reluctance to share key data, such as production forecasts.

The direction today is to go back to the broad base transactional purchasing model, which is thought, by the procurement department, to ensure competitive pricing and allows flexible purchasing practices, in most cases month-to-month with only verbal agreements and very little documentation.

The key supplier to the Longford plant is their sister plant in Dublin. This facility supplies the main ingredient for these cables (copper). Deliveries are usually three times a week and the copper is supplied in 1.5 ton large baskets or bobbins in three different diameters, depending on whether or not it is going to be drawn down to a smaller diameter. Even though the copper is originally purchased on the commodities metal markets, because these plants are considered solely independent tax entities, there is negotiated transfer pricing involved.

3.2 Manufacturing Operations

The manufacturing process in a cable plant is relatively simple and consists of five basic manufacturing processes, Drawing, Extruding, Stranding, Twisting and Sheathing. All of these processes utilize specialized machines and a relatively small amount of touch labor to produce the finished product. The telephone cable process is depicted below in figure 3-1.

Copper is typically delivered to the plant in the form of 2.6 mm diameter wire, which is drawn down to the needed diameter and insulation materials, plus color, is extruded on to it. This wire will become the basic building block for many other products as it goes to the next process where it is paired by color combination, and stranded into pairs and subassemblies of multiple pairs. The next step in the manufacturing process is to twist these subassemblies into larger final assemblies prior to sheathing with protective materials and coating such as PVC and polyethylene. Quality is insured by in-process capacitance and conductive spark tests in addition

to 100% functional testing after the Stranding and Twisting processes and a 10% sampling after Sheathing.

All of these processes are what would be considered fast cycle time processes and can be run at speeds from 100-400 m/s. This means that once the process is running correctly for a given product, a lot of product can be made in a relatively short time. Traditionally, fast cycle time processes have been run in very large batches that maximize the amount of time the equipment is actually producing product. Since the time to change setups and to get proper alignment generally creates significant scrap and lengthy periods of down time, it was considered common sense to reduce setup costs by running the biggest lot size possible.

Work in Process (WIP) and finished goods are primarily transported through the series of processes on large drums up to 1.6 meters in height and weighing as much 5 tons. Due to the size and bulkiness of the drums, forklifts are required to move them. Proper factory flow design and limited WIP storage areas are essential to an efficient operation of this design.

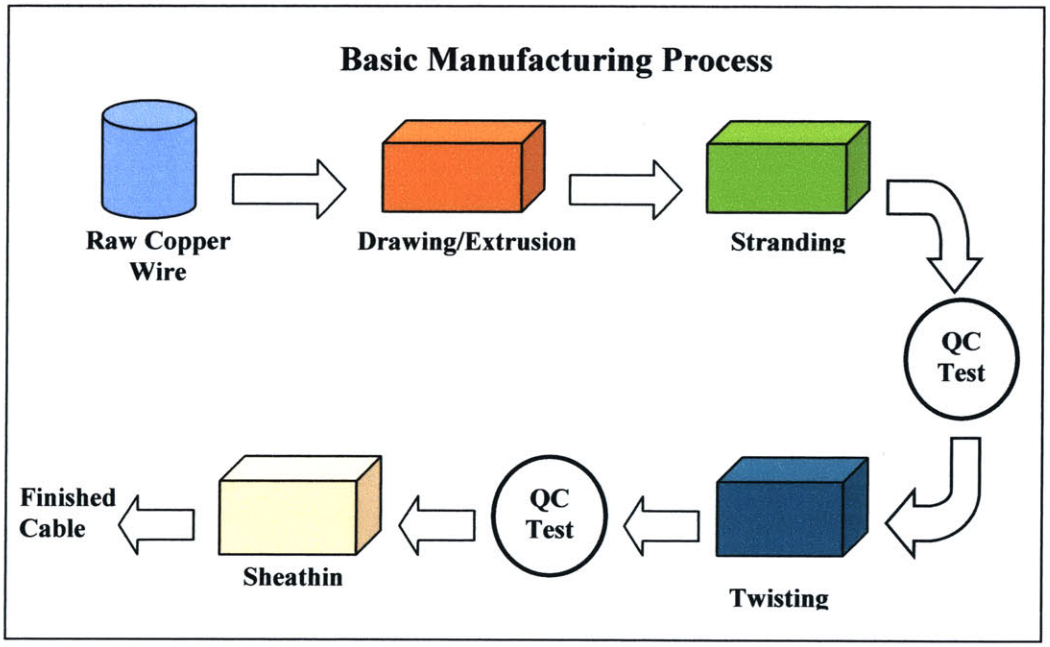


Figure 3-1 Basic Manufacturing Process

3.2.1 Production Planning and Scheduling

Production planning and scheduling at ABB Wessel was a very manual process with hardly any system support; it was primarily based on the personal experience of the planner and plant manager. Demand planning was based on sales forecast, finished goods stock levels, and historical data (26 wk average). The production planning suffered greatly from the quality of sales forecasting. This was a simple historical average over a particular period (i.e., 4 weeks or 12 months) and the fluctuations in demand which could vary greatly and had some seasonality. In addition, the rate of absenteeism and the unreliability of machines led to problems of reaching the planned production schedule. Economic batch sizes were typically not defined and the focus was on long batch runs and achieving high machine utilization.

There were no daily production meetings with stakeholders (such as floor supervision, production planners, management, and operators) conducted to discuss the production plan, priorities or challenges. Better communication and a production scheduling system was greatly needed to help optimize WIP based on lot sizes to meet the demand within capacity constraints, and to help identify bottlenecks to prevent late shipments or infeasible schedules.

3.2.2 Facilities Layout and Basic Operations

Figure 3-2 shows a detailed layout of the cable manufacturing operations and a simplified view of material flow to support the telephone cable operations. The plant itself is very self-contained, with raw material storage and maintenance co-located on the shop floor.

Most raw materials (except bulk polyethylene and wooden drums) arrive at the south receiving dock where they are entered into stores inventory and placed on racks or moved directly to point-of-use locations on the shop floor. In the case of copper and plywood reels, often times they are stored outside due to a lack of proper storage space inside. Movement of the raw materials is primarily performed by forklifts, which often creates a bottleneck. The product moves generally south to north, but the flow is not ideal because of the location of several machines which cause the flow to double back on several times before being completed.

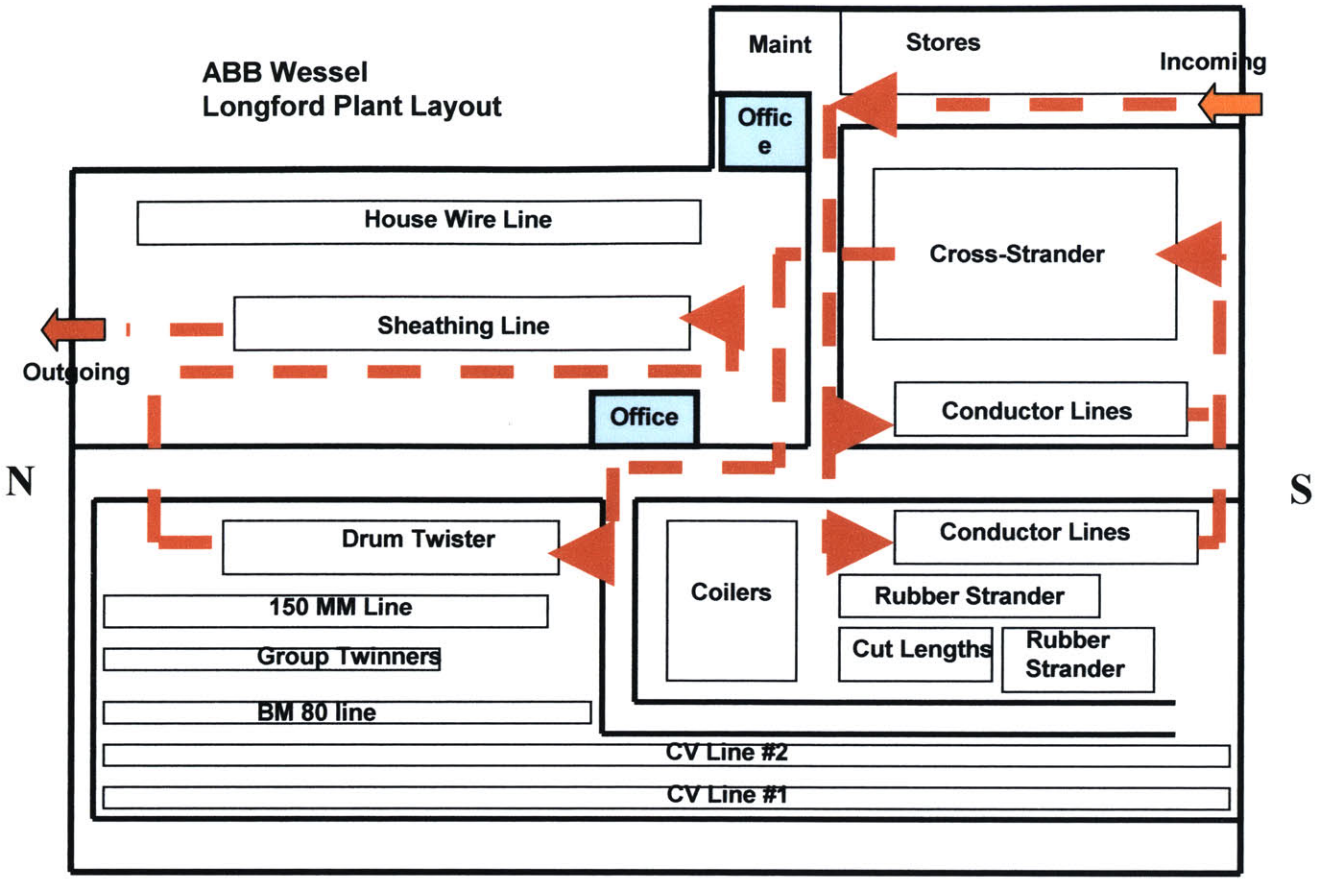


Figure 3-2 Facilities Layout and Basic Operations

3.3 Manufacturing Environment

The manufacturing environment at the ABB Wessel Longford facility was not what the average person would expect for a plant as new as this one. Even though the plant was built in 1981, it basically had been run into the ground after years of pushing for greater and greater volume, followed by 4 years of neglect and cannibalism of parts and supplies. The plant was on its last legs. Housekeeping in the facility was virtually non-existent. For example, garbage, scrap, old WIP, and dirt could be found everywhere on the premises. Work areas did not have waste bins, brooms, or dust pans. Oil, water, and lubricants could be seen on the floor from leaking machines, forklifts, and roof. The floor was littered with cigarette butts and plastic tea cups. In addition, the machines were dirty and often missing key components, tooling and setup instructions, and product specifications as well as quality sheets were not maintained.

Employee health and safety had been a problem for a long time. At the time of this research there had been over 20 accidents in 2003, resulting in several very lengthy employee absences and a great deal of lost productivity. The people were not trained to act responsibly and were not encouraged to report accidents or near misses or wear safety equipment, such as safety glasses or hearing protection. Emergency exits were frequently blocked by WIP, surplus equipment, disused electrical wiring, and leaking water and stream pipes were virtually everywhere.

Basically, there was no preventative maintenance performed on the machines. Machines were run until they broke down. All maintenance or overhauls were executed during the yearly two-week shut down. No history of maintenance or performance problems were kept, therefore root cause analysis of breakdowns was not conducted. In addition, not all shifts were covered by maintenance personnel. The Longford plant had no electrician on evenings and nights and no mechanic on nights. The engineering/maintenance staff was not adequately trained in the repair of machines and often would have to rely on an outside consultant company to come in to perform diagnosis and instruct them on how to fix the problem.

Overtime was the norm. It occurred almost daily for most operators, and was used by supervision as a reward system. In addition to weekend shifts, overtime was necessary during the week to cover absences or catch up because of machine breakdowns. Since there are very few salaried and management employees supporting the constant operations, often the plant operated without supervision or a member of management on the premises.

SECTION 4: ROADMAP TO TRANSFORMATION

The objective of this section is to present several examples of organizational transformation models and their processes and highlights there strengths and weaknesses. An overview of the roadmap to organizational transformation that was used for this project is then provided.

4.1 The Importance of a Roadmap

Having a good roadmap is important from the standpoint that it will help to guide an organization through the transformation process and help keep it from getting side tracked or derailed along the way. Once an organization decides it needs/wants to transition to a lean operation, or under take a substantial change initiative. There are potentially many roadmaps available. The literature is rich in this area and just about every book or paper on Lean and culture change will provide one. I have selected a couple here for reference. One particularly complete one is the Lean Aerospace Initiative (LAI) transition to Lean roadmap shown here in figure 4-1. It is very good at outlining the tactical and functional aspects of a lean transition from a production operations perspective. I do have some minor criticisms of it though, from the stand point that it does not try to represent the interaction or influence that a Lean transformation has with a company's culture and the process to take when expanding the Lean transformation out into the internal and external supply chain. This aspect of the transition to Lean is what a major portion of this thesis addresses.

A slightly more simplified roadmap is presented in a book by James A. Jordan Jr. and Frederick J. Michel titled "The Lean Company- Making the Right Choices". It depicts a company's Lean transformation as a change process (see figure 4-2 Lean Company Robust Change Process). This idealized diagram shows many of the same steps or phases found in the LAI roadmap; again it does not address the supply chain, but perhaps is more cognizant to the cultural aspect of Lean transformations.

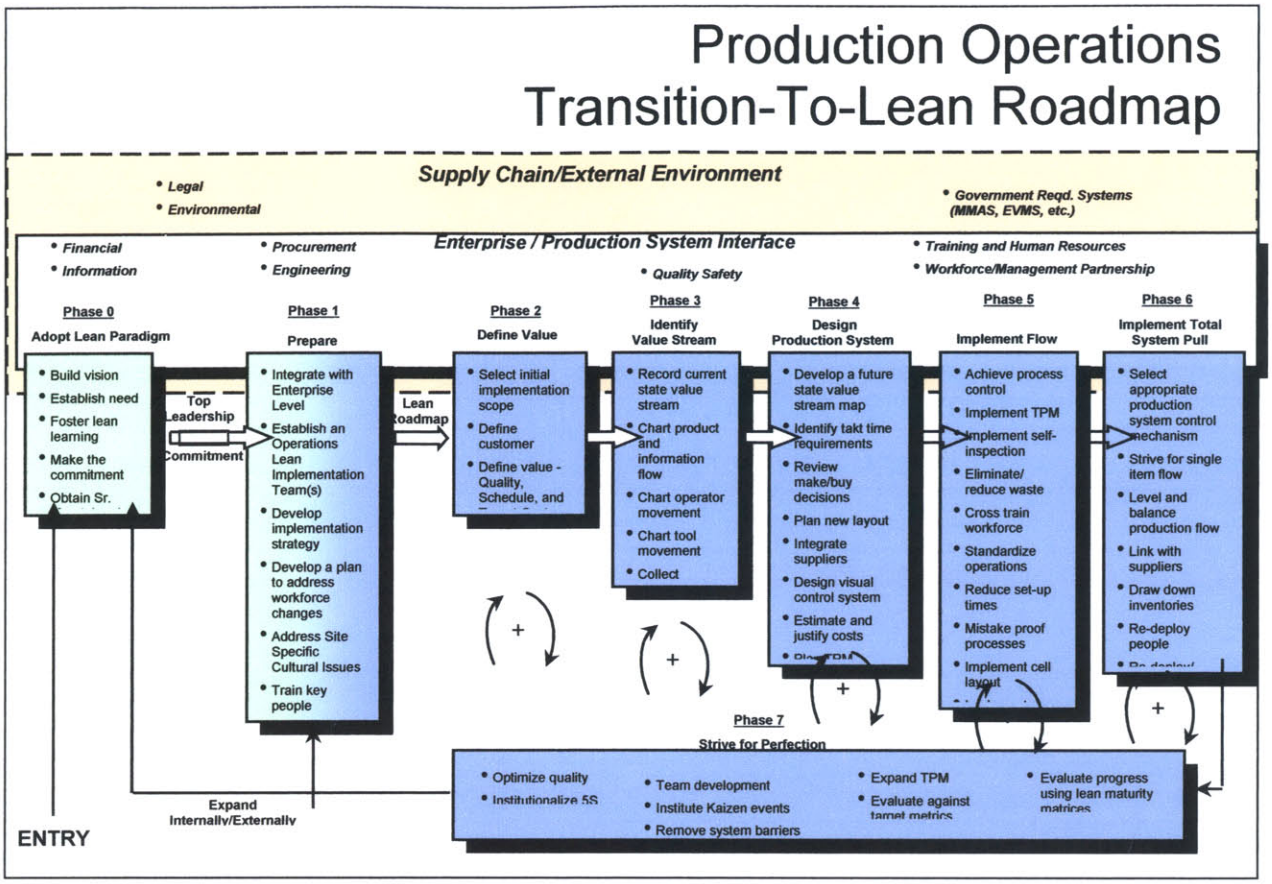


Figure 4-1 LAI Transition to Lean Roadmap

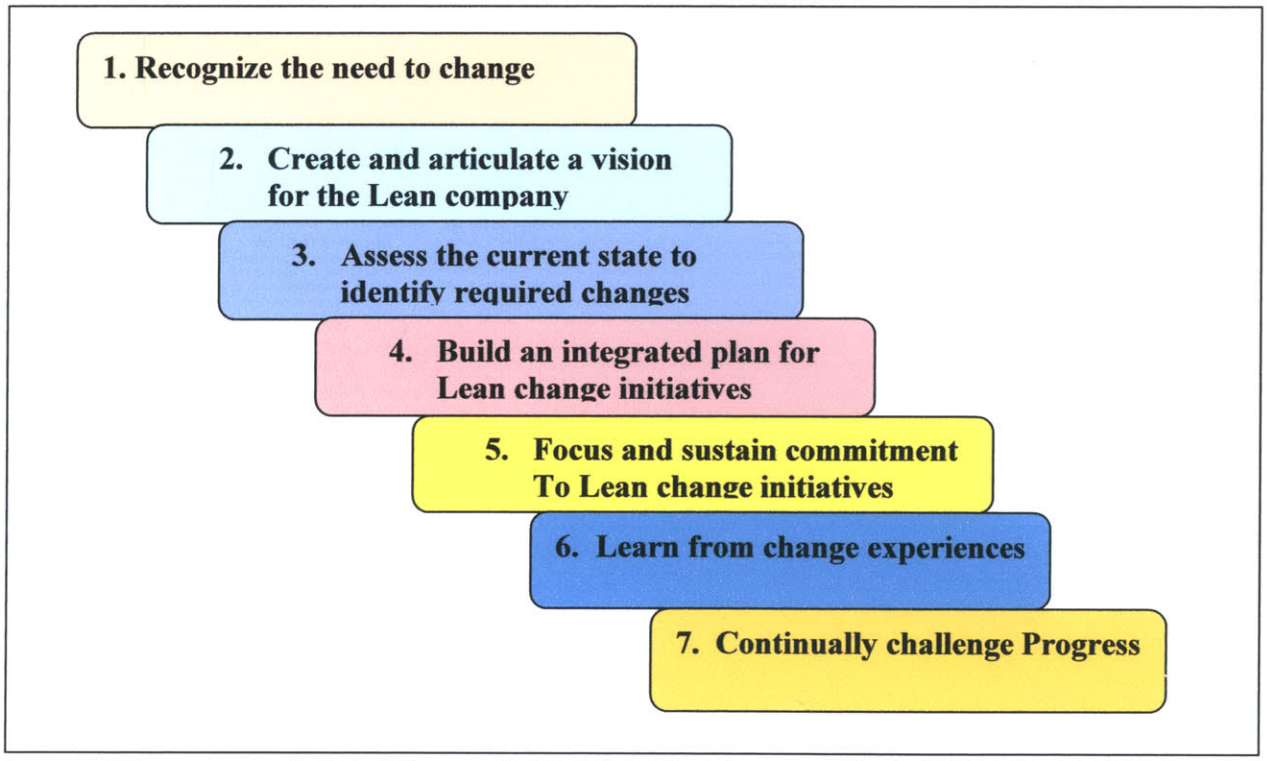


Figure 4-2 Lean Company Robust Change Process

4.2 Overview of Roadmap Used

For the ABB Wessel project I developed a roadmap that included many of the same attributes of these examples and included the aspects of supply chain and cultural environment. This graphical representation was helpful to upper management to visualize the process and its components and is offered here to assist the reader in following the developments of the project as he or she reads this thesis and to further fuel thought on this subject.

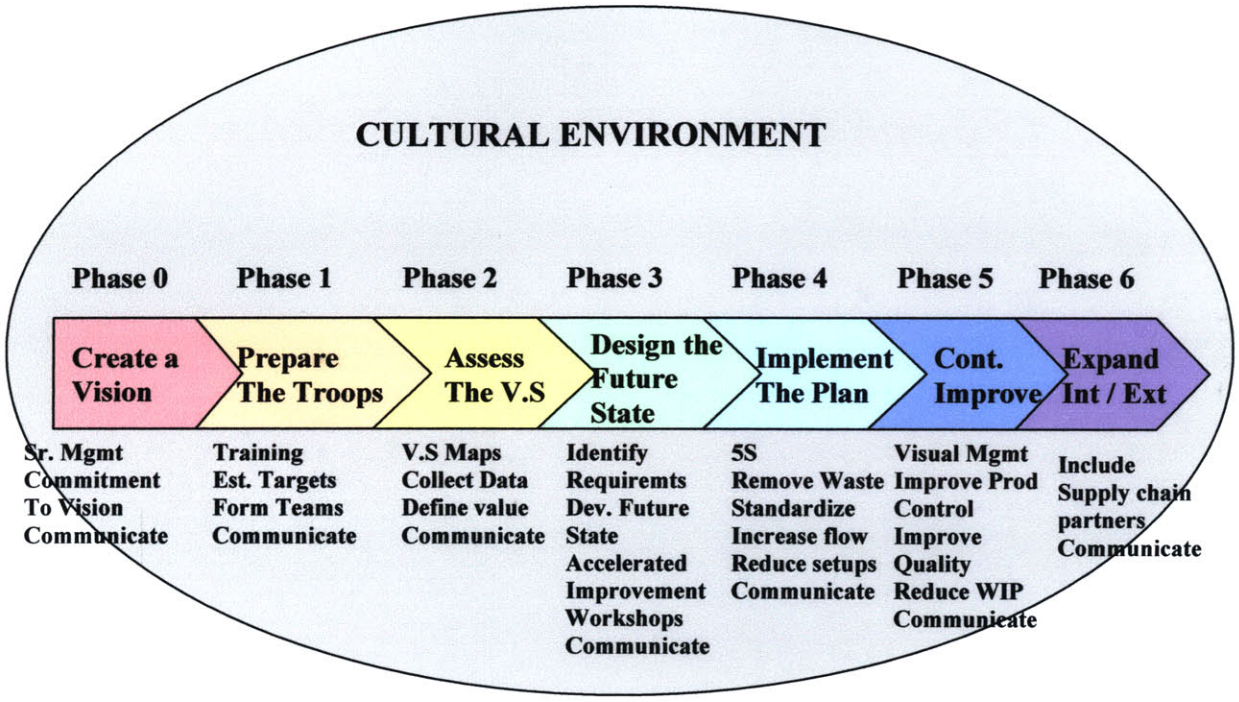


Figure 4-3 Project Transformation Roadmap

As shown above, I have the cultural environment enveloping the Lean transformation process. This is a key success element, because each component of the process can be thought of as the growth and maturing of the seed that was planted back in phase 0. The cultural environment can either nurture it allowing it to grow, or stifle its development and ultimately kill it. Communication is a common theme in this roadmap; all parties simply can not communicate enough during the transformation. Management must be prepared for this, because it is the sharing of ideas and thoughts that strengthens the transformation. I will discuss the element of this cultural environment further in section 6.

SECTION 5: CURRENT STATE ANALYSIS

The objective of this Section is to describe the key aspects of the current operations at the ABB Wessel plant in Longford Ireland. This will be done through qualitative descriptions of the processes and analysis of the current operating methods. This Section will also describe the Value Stream Mapping process that was used to analyze operational efficiency and discuss the Value Stream. It will present the data collected, describe management processes and discuss the key findings.

5.1 Value Stream Mapping

According to Rother and Shook in their pioneering book "Learning to See- Value Stream Mapping to Add Value and Eliminate Muda" there are several objectives of Value Stream Mapping. Most importantly is to give an enterprise view of the manufacturing operation to the managers and/or operators. Everyday, people working in a manufacturing environment, often fall into a fire-fighting mode and lose sight of the overall system and their role in it. Taking the time to prepare and utilize the techniques of Value Stream Mapping allows you to step back and consider the entire operation from your customer back to the suppliers. Additionally, it is an excellent tool to help the senior management and the plant manager to visualize and assess all processes under their control.

5.1.1 Value Stream Mapping Process

The process itself is very simple and straightforward. You usually start with customer delivery and work your way back through the entire process documenting the process graphically and collecting data along the way. This process results in a single page map of the Value Stream and its component processes using simple graphical symbols.

The user collects data such as cycle time, WIP levels, quality levels, and equipment performance data. The actual current inventories that are witnessed and the operating performance at the time of the mapping should be recorded. Depending on the complexity of the process and the number of components involved additional data may need to be collected from other sources. A

very important part of the Value Stream Mapping process is documenting the relationships between the manufacturing processes and the controls used to manage these processes, such as production scheduling and production information. Unlike most process mapping techniques that often only document the basic product flow, Value Stream Mapping also documents the flow of information within the system. Where the materials are stored (raw materials and WIP) and what triggers the movement of material from one process to the next are key pieces of information.

5.1.2 Process Maps for ABB Wessel

The current-state maps that were created for ABB Wessel's Longford plant telecom and LAN (local area network) operations are described here as process maps, because if it were a true Value Stream Map it would include the suppliers, customers and shipping. If a complete Value Stream Map had been performed, these two process maps would be represented graphically as single process boxes with inputs and outputs. The process maps for the cable manufacturing operations represent a mapping of the detail operations of these internal processes. This distinction between process and Value Stream maps is subtle, but important, since it ensures that a greater enterprise, and cable manufacturing's role within it, is not lost.

Figure 5-1 below shows the current-state process map for the telecom and LAN cable lines, which was created by the subject matter experts from the ABB Corporate Research Center in Vassa, Finland. This map appears cluttered at this scale; therefore a larger and easier to read copy is included in Appendix A.

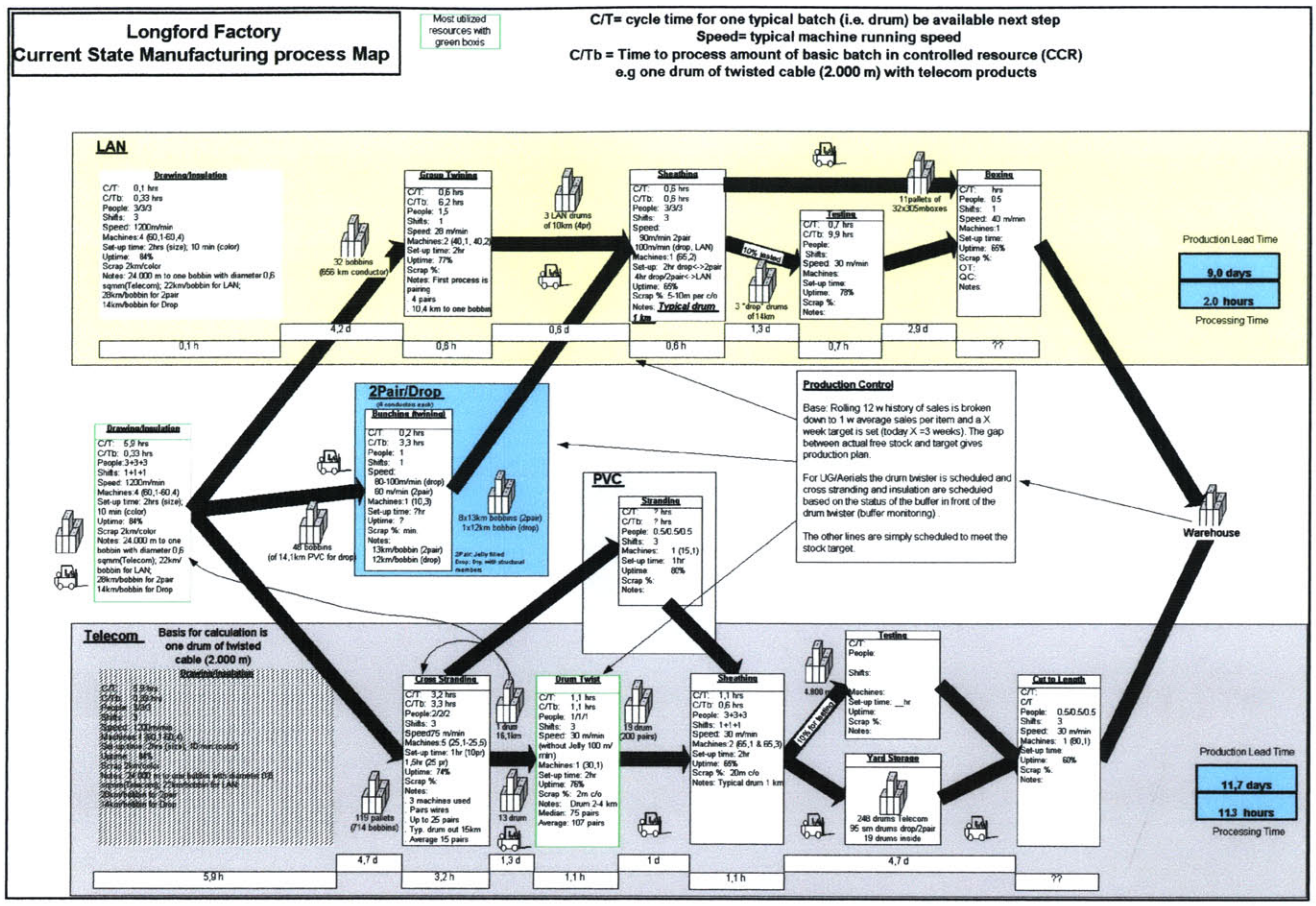


Figure 5-1, Current State Process Map
Telecom and LAN

As seen in the process map above, various symbols are used to identify different processes. The stacked boxes represent WIP, rectangular boxes represent a process or manufacturing operation that must occur, and forklifts represent product movement. Information flows are depicted with line arrows. Non-manufacturing processes such as receiving, production control and shipping are not depicted. Block arrows represent material flows. The manufacturing operations boxes contain data about the operation such as; cycle time, manpower/shifts, equipment up time, machine speed and setup time. Perhaps the most valuable output of process maps such as the one shown in Figure 5-1 is the final totals of lead time and process time. For example, the lead time for the LAN cable was 11.7 days, but during that time only 11.3 hours was process time. This means that almost 11 days of the total 11.7 days to produce the product the product was sitting with no value added activity being done to it. The situation was very similar for the telecom line where the lead time was 9.0 days with only 2.0 hrs of process time. This analysis very clearly shows that there was considerable room for improvement.

5.1.3 Cost and Profitability Analysis

Profitability analysis is another tool that was used and is simple and very illustrative. The concept is to analyze each product to ascertain its profitability. It is important when conducting this analysis, that it is clearly understood how fixed and overhead costs are being allocated. It might be necessary to make changes in the financial accounting numbers in order to get an accurate picture of product profitability. In this particular example, overhead and fixed costs were allocated by machine hours. The goal of this process is to identify which products need help and which product you should potentially retire. This information is also very useful when deciding where and how to utilize production capacity and overtime. (See figure 5-2 for a generic profitability analysis). As you can see, it is very easy to distinguish that product families D and E need the most attention. The next step in this analysis was to conduct activity-based costing (ABC) for each product in the family. When this was done at ABB Wessel, Longford, it was found that for a specific product family, four of the twelve products were actually losing money and 3 of the twelve had a profit of less than 10%. This knowledge led to a rethinking of the basic processes and materials used for this product family, culminating in a major technology development initiative.

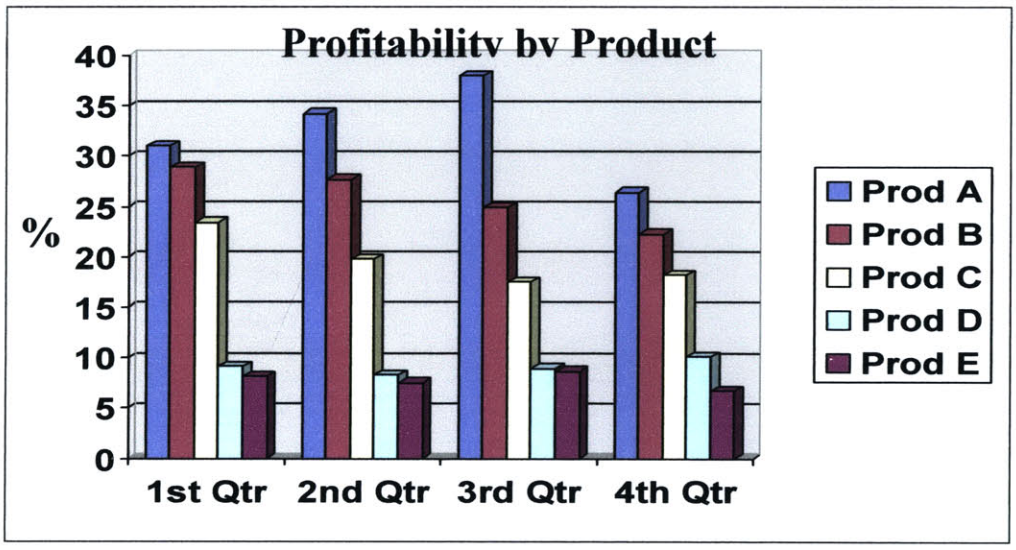


Figure 5-2 Generic Profitability Analysis

Understanding the cost distribution of an operation is also another fundamental, yet essential, piece of knowledge when starting to understand how and where to focus improvement activities.

Figure 5-3 Cost Distribution, below, is a snapshot of the cost landscape at ABB Wessel just prior to the research activity.

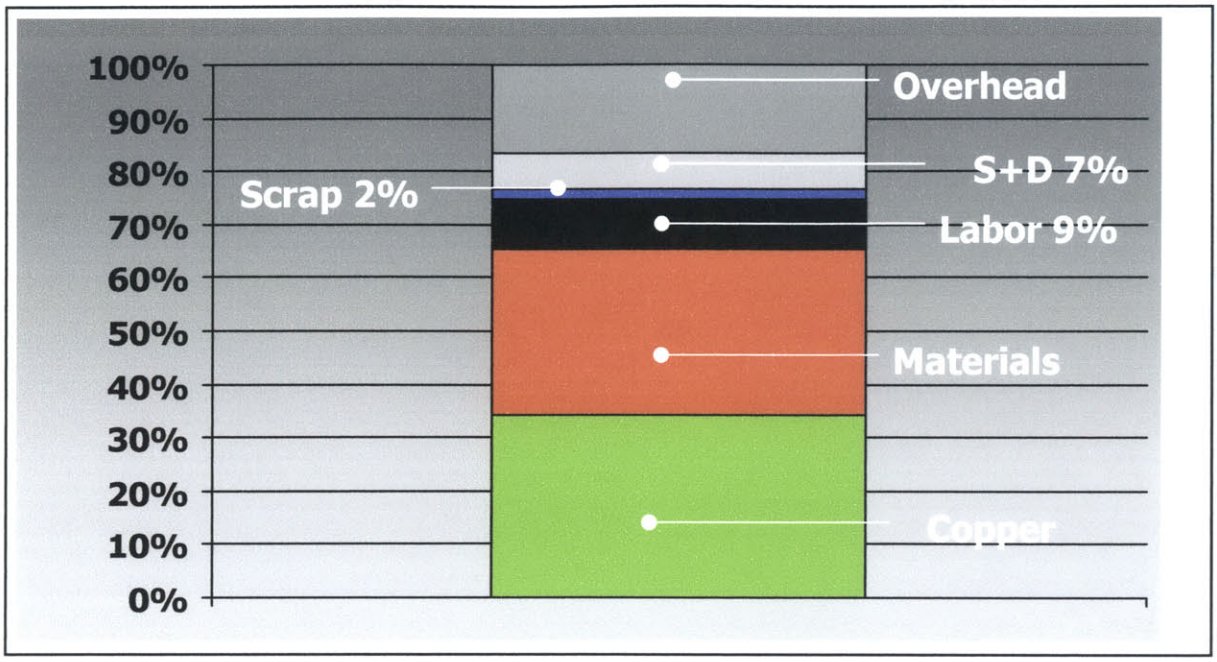


Figure 5-3 Cost Distribution

5.2 Current State of Operations

In this research Value Stream Mapping, cost and profitability analysis were the main tools used to help understand the operations and to identify areas on which to focus the improvement activities. The following section explains the current state of operations and details the process used for making decisions. It also provides metrics or data whenever possible.

5.2.1 Demand Variation

At ABB Wessel, like most manufacturing plants, the production planning was driven by the forecasted demand for the products by the customers. Variation in demand and variation in the lead time to supply the demand created the need to buffer production from the demand by building excess inventory. These variations also had the potential to result in the well known "bull-whip" which refers to the amplification of demand fluctuations from the bottom of the supply chain to the top. This phenomenon was first observed by Forrester (1961) in case studies of industrial dynamics models.

Sources of demand variation usually came from several areas. The first source was the inability of the customers to perform to their own schedules. The reasons for this variability could range from weather, to lack of on time state or city planning approval, or unreliable subcontractors. Additionally, their own basic scheduling/planning systems did not give their buyers sufficient visibility into when the job was to actually be performed and consequently when the telephone cable would be needed at the site. A buyer would simply be notified that a specific job had been authorized and what the intended completion date was. This completion date could be as much as 90 days in the future, leaving it up to the buyers to guess when the work might actually start and when the cable would be needed. (See figure 5-4 Typical Telecom Demand Variation).

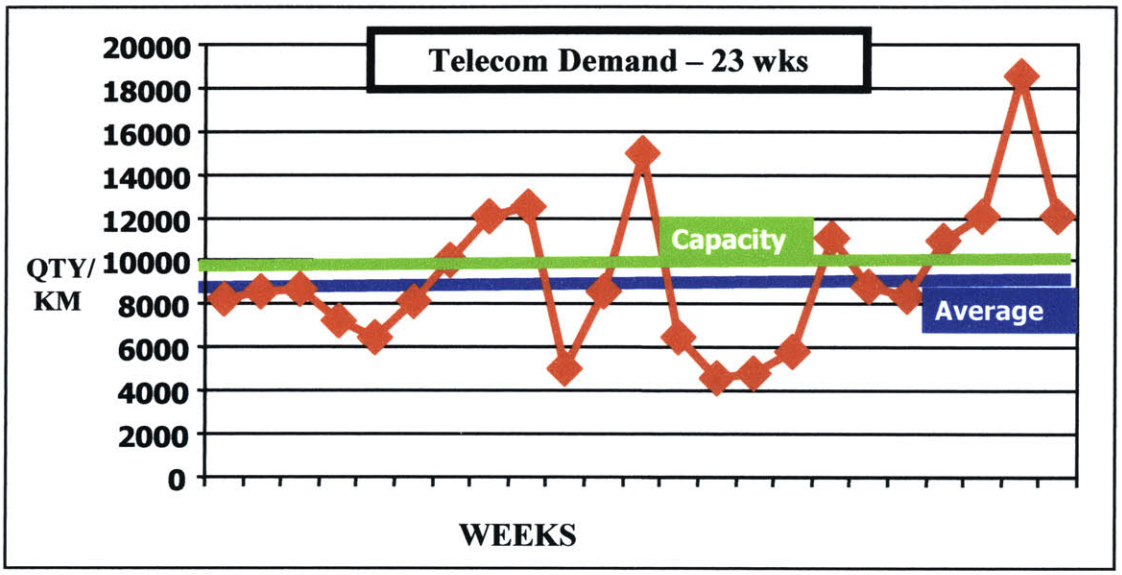


Figure 5-4 Typical Telecom Demand Variation

The second source of variation came from the need to produce product or subcomponents for the sister plant, because they had fallen behind or had a machine malfunction. By its nature, this demand would come on an irregular basis and would vary significantly. This demand would be coordinated with management and generally resulted in overtime to play catch up with regularly scheduled production.

The final source of demand variation was created internally due to inconsistent inventory and production policies and practices. The undisciplined approach to production planning created variations in inventory and increases in WIP, the following sections of inventory and batch size will discuss this further and present data to illustrate this issue.

5.2.2 Scheduling

Production operations were controlled via a production priority list distributed daily to the shop foremen by the production planner. This production priority list was a simple hand written list of the product requirements (type and quantity) for each process in the shop. The production planner would also distribute new production record sheets to each of the operators' stations and collect the previous day's sheets. The production planner was also responsible for checking WIP and finished goods inventories, which he usually did twice a day. These data were manually combined with the customers scheduled usage numbers, sales forecasts, historical production numbers, material availability and operator or machine availability to produce a production schedule. Needless to say, the production schedule was a very fluid document due to frequent production interruptions, material shortages, machine breakdowns, and changes in management decisions.

5.2.3 Changeovers

Changeover data by job was not available for the ABB Wessel operations. However, many changeovers were witnessed during this research and a wide variation in times to accomplish changeover was seen. Typical changeovers were in the range of 45-90 minutes, the reason for this variation is multifaceted, from mechanical problems to operator skill and experience, to the differences in changeover complexity from one product to another. Times were also clearly impacted by the number of personnel involved, availability of forklifts and mechanics, and the urgency of the production need. This was obviously an area that could use more attention.

5.3 Key Operational Issues

Four key operational issues (waste in the basic system, scheduling practices, machine downtime, and changeovers) faced ABB Wessel operation at the Longford plant and presented opportunities

for dramatic improvement. The following sections review these issues and describe the impact of these issues on the ability to create a stable productive operating environment.

5.3.1 Waste in the System

As we can see clearly in the process map figure 5-1 there is a great deal of dead time and high WIP levels in the process flow that represents a considerable amount of dead money and waste in the system. This challenge was addressed by the individual continuous improvement teams (CIT's) which were formed to identify and eliminate waste throughout their processes. They primarily utilized Lean manufacturing principles and Six Sigma tools and concepts to accomplish this task.

5.3.2 Production Scheduling Practices

The current production planning and scheduling process, as described, was very manual and subject to human error and frequent changes in methodology. The need for a more automated system with a set of rules to enforce consistent batch sizing, inventory management, and reduction in changeover costs was needed. In Section 9, I will describe a new system being developed, called the Shop Floor Data Collection System (SFDCS) that is a first step toward this goal, and will make the production planning and scheduling function much easier, consistent, and accurate.

5.3.3 Machine Downtime

Machine downtime is definitely one of the most significant contributors to poor overall operating performance at the Longford facility. The result of this unscheduled downtime is that the 5 day 3 shift operation has been forced to extend operations to nearly 7 days per week to meet demand. As with most problems, the reasons and solutions were quite varied. First and foremost was the need for a proper preventive maintenance program, skilled mechanics and operator involvement in the responsibility for maintaining and ensuring high levels of machine uptime. The current situation has created a self-perpetuating casual loop: unscheduled downtime results in less production capacity, less production capacity leaves less open time to conduct preventative maintenance. The objective here is to break the current cycle at ABB Wessel. The price of not implementing a preventative maintenance program can also be evaluated as the cost of this extra

production capacity and the lack of extra capacity to develop new products. This topic will be addressed in more detail in Section 9.

5.3.4 Changeovers

The distinction between machine downtime and changeovers is quite clear. Changeovers and setups are planned, machine downtime is unplanned. So whenever a changeover is scheduled it is important that it be done as quickly as possible. To accomplish this, the CIT's identified several things such as proper and available tooling, modular and color coded tooling, quick reference product specifications, group work rules, etc., to be reviewed for implementation.

SECTION 6: CULTURAL CHANGE AND LEADERSHIP

This Section investigates the topics of cultural change and leadership, it describes the philosophy and process used and outlines some of the leadership practices and used along the way.

"There is nothing more difficult and dangerous, or more doubtful of success, than an attempt to introduce a new order of things in any state. For the innovator has for enemies all those who derived advantages from the old order of things while those who expect to be benefited by the new institutions will be but lukewarm defenders"

Niccolo Machiavelli

The Prince

6.1 The Importance of Culture

As managers we hear a lot about company cultures; but what are they really, and what determines culture and why is it so important? Corporate culture is often defined as the sum of formal and informal behaviors that a company adopts as their way of doing business. Formal behaviors are such things as written mission statements, vision statements, and organizational charts. The informal side deals with how work gets done, procedures, how employees are treated by management, and how they treat each other.

A company's culture is important because it filters and seeps through to every nook and cranny of the business, including its customers and suppliers. An employee that feels undervalued and frustrated will project that to customers and to their coworkers. Culture can be one of the few things that your competitors cannot duplicate. They can copy your products, services, and marketing, etc., but they cannot copy your people and how they work together. A healthy company culture is also self-perpetuating, because good people will gravitate to it and continue to make it stronger and better. For example, Southwest Airlines is widely recognized as having one of the best company cultures today; consequently every year they have literally thousands of very well qualified applicants to select from.

One of my objectives during this project was to understand the role of culture in implementing Lean and more generally in turning around an organization. I started by forming the foundation of a new culture and new set of behaviors and standards for the people at ABB Wessel. This new culture was to be based on teamwork and cooperation. Of course changing a culture takes time, more time than I had; but as the old saying goes "a house is only as strong as its foundation", so these activities were extremely important to the future success of the company.

6.1.1 Approach to Changing the Culture

The decision to make fundamental changes in company culture is often a response to a need to adapt to powerful external forces. The situation at ABB Wessel was no different, the organization needed to change or it would die. Like organisms in nature, organizations need to adapt to their environment or they will become extinct. Darwin's evolutionary theory applies to the evolution of all species including business organizations. According to Darwin, "It is not necessarily the strongest or the most intelligent who survive, but those that can adapt and change."

"If the rate of change on the outside exceeds the rate of change on the inside, the end is near"

Jack Welch

Retired CEO of GE

The approach I utilized was a four step process that I developed based on my experience, education and intuition.

1) The first step in this process was deciding on the new company culture and business strategy. For ABB Wessel, the senior management wanted to become much more customer focused, cost competitive, team oriented, and Lean in all of it aspects of its day-to-day operations. It was obvious that a transformation such as this would require fundamental changes and re-alignments in order to put the organization and culture in synch with the new realities and strategies.

2) The second step was to try to determine what the core values of the existing culture were. What I found was that there was considerable importance put on authority, past profitability, and tradition; but nothing that I would have called core values, such as integrity, diversity, teamwork, etc. This puzzled me at first, because there was no vision or mission statements, no organization

charts, there were minimal work procedures, and no published code of conduct rules. The company functioned almost like an ancient tribe, with decisions being made by the tribal elders on a case-by-case basis, and proper behavior was learned on the job. I saw this as an advantage for me, since the chief of the tribe, (my supervisor) and the General Manager were the ones who requested the change in culture.

3) The third step was to begin communicating the vision (from step 1), of this new culture: A culture where we solved problems together as a team and understood the needs and desires of our customers better than they did themselves; and all of this was built upon a foundation of Lean and Six Sigma principles and practices. I did this in every meeting and tried to do this as clearly and focused as possible, stressing that this future culture was a culture that we were going to build together and that they shouldn't fear the changes, because it was this transformation that was going to help us survive.

4) The fourth step was to teach and practice this new culture. I did this through training, forming teams and team workshops and meetings. I also would invite and bring the customers into the plant and on the shop floor, and as often as possible, and got the office workers more in tune with the customers through Supply Chain meetings, all of which I will outline in more detail in Section 8. Resistance came in all shapes and forms throughout this process and it was expected; but I found that the best way to deal with it was to be consistent, firm yet understanding, always taking the time to listen to people's fears and frustrations. This experience reinforced my fundamental belief that a leader must have integrity and be trustworthy. People have to know this before they will follow you. If we would have had more time, I would have preferred to go a little slower and make the changes in smaller steps, but that was not possible.

6.2 Leading the Change Process

My role as leader of this early phase of the cultural transformation was clearly one of a coach which sometimes required taking an aggressive role and driving the process more than passively offering suggestions. This was more of a hands-on and in some cases more directive role than a typical consultant would have. Because when people are involved in a dramatic change in their lives they need a continuous resource they can trust to guide them through the change, I provided that. Without this continuous resource of knowledge and encouragement, there is a high

likelihood that the process will be abandoned or modified to the point that it no longer meets the original purpose and we could not allow that to happen.

6.2.1 How Leaders Can Make Change Happen

A common theme in much of the change management literature, such as "Leading Change" by John P. Kotter, is that there almost always needs to be a crisis present to get people motivated. The more an organization is hurting, the more willing it is to try something new and different. While there are exceptions to this rule, typically companies do not start thinking about transforming their culture of strategy until the status quo is totaling dysfunctional. In other words if someone in an organization truly believes he or she will be out of a job in a couple of months unless their group make significant changes, their change responsiveness will be low. But what more commonly happens is that managers shield or protect their employees from the cruel realities of competition because they do not want to cause a panic and create a low morale and turn over problem. While you certainly do not want people to panic, you as a leader or manager need them to understand how serious the situation is and the potential negative effects. Therefore, communication is essential, along with hard facts of the situation you must provide a vision of what could be. If you can help your employees see how both they and the company will be better off if they take on new roles and responsibilities, become receptive to new ideas and processes and implement the specified change strategy successfully, then you have provided for them a clear reason to participate with passion.

Another key ingredient is having strong support at the top and at your peer level, other managers that may have a stake in the same change strategy. Sometimes these people are easily identified, other times not. Sometimes these supporter and sponsors may prefer to operate covertly, especially in cultures of hope and accommodation. In any case the leader will need to build a support base for the change activity, so that they can have access to resources and people. Nobody can transform a culture or implement a Lean environment by themselves, they must have help and the deeper that support structure the better the chances that the change will be successful. As the leader you must build a coalition and make sure everyone is a stakeholder.

SECTION 7: IMPLEMENTING LEAN AND SIX SIGMA

This Section describes the process of teaching and implementing Lean and Six Sigma tools and concepts. It also describes the transition to a lean continuous improvement team environment.

"The final test of a leader is that he leaves behind him in other men the conviction and will to carry on... The genius of a good leader is to leave behind a situation which common sense, without the grace of genius, can deal with successfully"

Walter Lippman

7.1 Teaching Lean and Six Sigma

Since one of the project objectives was to be the catalyst for change and to lay the foundation for a Lean team oriented culture, and considering the relatively short period of time I had to accomplish it, I chose to start the process by teaching everyone, whether they were on the factory floor or in the office, about the fundamental concepts and practices of Lean and Six Sigma. Two questions probably come to mind here - why everyone? and why Lean and Six Sigma together? I chose to teach everyone because it is my experience that everyone can benefit from learning these two concepts, and I did not want any individual group or individual to feel like they were being left behind. In this environment everyone was concerned about keeping their jobs and to teach some and not others, I felt would only strengthen that fear. I chose both Lean and Six Sigma because they complement each other. Lean provides a framework and mindset to address the structural or system deficiencies and Six Sigma brings the discipline and focus of working toward perfection, root cause analysis and the tools and techniques to accomplish it.

After two weeks familiarizing myself with the operation, personnel, doing interviews and working at each of the various processes on the production lines, I began to teach to small groups of six to ten, usually by process work groups. Because this plant had no previous exposure to either of these concepts, I developed training materials that were essentially one hour each, focusing on what are generally thought to be the building blocks of these two concepts.

7.1.1 Key Elements of Lean

For the Lean training sessions I focused on teaching basic concepts such as the five S's, the seven deadly forms of waste and visual management techniques because these were the things I really wanted the teams to be thinking about during their Accelerated Improvement Workshops (AIW's) or Kaizens, which I will discuss in more detail later in this Section. My main sources of reference information on these topics were "The Machine that Changed the World" by Womack, Jones and Roos and "Lean Thinking" by Womack and Jones in the early1990's. After a couple of sessions I soon learned to keep it very simple and to not use technical terms, math or Japanese words. A detailed outline of the training materials is as follows: (The complete presentation is included in Appendix B)

Basics of "Lean" Manufacturing

Toyota Production system (background), Just in Time Production (JIT), Pull Production vs. Push, The Cost reduction Principle and the Lean Production Principles

The Seven Deadly forms of Waste

Overproduction, Waiting, Transportation, Motion, Production defects, Inventory and Over-Processing

The Five S's

Sorting, Straightening, Shining, Standardizing and Sustaining

Visual Management Techniques

Application Stages

7.1.2 Key Elements of Six Sigma

The Six Sigma training materials attempted to demystify the subject and make it more laymen-friendly. A great source of reference on the subject is "Lean Six Sigma" by Michael L. George. I stressed the emphasis on the customer and their definition of value, the importance of understanding process capability and variation and of course the concept of continuously working toward perfection. A detailed outline of the training materials can be found below: (A complete copy of the training materials is included in Appendix C).

What is Six Sigma?

The Elements of Six Sigma

Customer, Process and People

The Key concepts

Critical to quality, what are defects, process capability, variation, stable operations and design of Six Sigma

The Six Sigma process DMAIC

Six Sigma Tools

7.2 The Transition

A key step in the transition to a team-based Lean culture was the Accelerated Improvement Workshop or AIW. Once the training was completed for a specific process, which might take up to three weeks because of the three shifts and the weekly rotation, an all-day AIW would be planned with a cross-functional composition, usually one member from engineering, management, quality and a shop floor supervisor, in addition to 6-10 operators.

7.2.1 Beginning the Continuous Improvement Journey

The AIW was really the stepping off point for the teams as they started the journey toward a culture of teamwork and Lean continuous improvement. The overarching objective of these workshops was to get people working together to solve the problems that they faced. Having said this, the AIW also provided a foundation or a framework for how to work as a team. It introduced them to the roles of facilitator, and scribe which were rotating jobs. During the course of the workshop and consequent team meetings everyone had a turn at doing these jobs.

They learned the proper way to listen to each other, to build on of each other's statements, to debate the issues, to take notes, to feel free to brainstorm, and not to say someone else's idea was stupid. They learned how to use simple tools and techniques such as multi-voting and Pareto charts to reach a consensus. Sometimes tempers would flare and sometimes people got their feelings hurt, but these were all things that each person and team had to go through. There was a lot of emotional baggage from the years of authoritarian management, pent up resentments and

fears that had to be addressed in order for each person to become a healthy contributing member of are team, but we, as a team, got through it. There was still a great deal of distrust between staunch union members (i.e. stewards) and management, but they tried to put this aside and give the teams a chance. These things may all sound so basic and simplistic but for people who had not been involved in teams or being empowered before it is all very real and very important.

7.2.2 Implementation Approach

The implementation approach I chose was very straightforward: conduct the training, form the teams and kick them off with an AIW, then follow with rapid implementation focused on (5S, eliminating all forms of waste paying particular attention to product flow and resolution of safety issues) and conduct weekly team meetings to drive the continuous improvement. In all, twelve teams were trained (162 hours for 81 people), ten all day AIW's were held (656 hrs, 84 people) and one Lean Academy (12 hours 8 people) was conducted. Below is a typical agenda of an AIW.

Typical AIW Agenda

- **Create as-is Process Flow Diagram (PFD)**
- **Identify areas of Waste, 5s and Safety**
- **Break**
- **Prioritize these areas (80/20 rule)**
- **Address any health and safety related issues**
- **Lunch**
- **Create NEW to-be vision and PFD**
- **Identify resources and equipment needed**
- **Break**
- **Negotiate and agree on an implementation schedule and resources required.**
- **Schedule weekly team meetings**
- **Setup rotating team leadership roles**

7.2.3 Team Process

The team process I chose to teach was unsophisticated, but at the same time very important, because I wanted them to learn good habits. So in addition to emphasizing rotating or distributed leadership, where in each meeting there was a new facilitator whose responsibility was to get to the room 5 minutes early and make sure it was set up, have an agenda for the meeting ready and to conduct the meeting (making sure it started and stopped on time), ensuring that everyone got

their chance to talk and participate. There was also the role of the scribe who took the notes, kept attendance, recorded action items and made copies of the meeting notes to be distributed to the other members (I kept a master set of notes just in case). Our rules of conduct were as follows: 1)Be on time and be prepared, 2)There are no dumb ideas, 3)Treat others with respect (listening and not talking while others are speaking), 4)No free riders, we are a team and all must contribute. In general this set of rules served us well. Every once in awhile I would have to impose a fifth situational rule which was "No more whining".

7.2.4 Team Accomplishments

Each of the ten CIT's developed their own plans and implemented hundreds of waste-eliminating, performance-enhancing and safety-related changes. All of these changes fell into the three main categories: 1) 5S 2) Waste Elimination and 3) Safety.

Almost all teams started out by removing unneeded supplies, products and equipment (we called this a scrap round-up), then organizing their tools and supplies that they used on a daily basis (see figures 7-1, 7-2 and 7-3) for examples of group tool boxes and visual management shop aids for consumable supplies and a scrap round-up. See a photo of a typical scrap round-up below in Figure 7-1.

Figure 7-1 Typical Scrap Round-up

Group tool boxes where a big hit in almost all areas. It enabled the operators to self-manage the necessary items such as spanners, open end wrenches, screw drivers, Allen wrenches, flash

lights, gloves, respirators and dust masks, which before would always get locked in someone else's, who was probably on a different shift, tool box. In a later effort by the safety team, group first aid boxes were mounted on these tool cabinets and in every work area, where before the CIT's, the first aid boxes were controlled and kept locked by the shop Foremen and Plant manager.

Figure 7-2 Typical Group Tool Box and Supply Cabinet

Figure 7-3 below shows a typical visual management shop aid. Several of these types of devices were designed by the CIT's and fabricated in house to enable quick and easy inventory and re-supply of consumables, such as colored binders and tapes. In most cases they replaced a dilapidated cardboard box or full pallet of stock which was being used; this method not only reduced floor space but allowed for easy clean up, since all were fitted with wheels. In a parallel effort to these shop aids, the Stores CIT rearranged the stores, putting all daily used consumables at ground level, instead on top of the racks, since they where light. The problem they were addressing was that on night shift, operators had to climb to the top of the rack to get additional tapes and binders if they ran out, since no forklift driver was on the night shift. The combination of these two teams' efforts was a win-win for all parties.

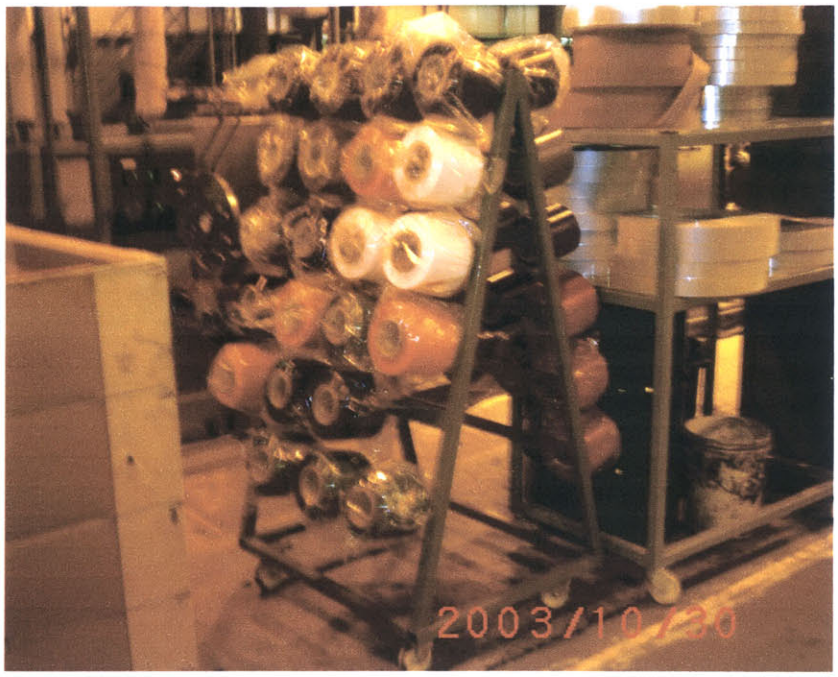


Figure 7-3 Typical Visual Management Shop Aid

Many of the teams made changes to the layout and flow of the product through the area. These changes usually involved creating a specified WIP area and often times the creation of physical barriers or floor rails to keep product from getting damaged and mixed with that of other lines. In several cases the team also addressed personnel and forklift traffic through their areas and created walkways and removed physical bottlenecks allowing for better and safer access of the forklifts (see Figure 6-4 CV Line Personnel Walk-Through). The CV line pass through was a significant accomplishment in that it was also seen a symbolic change by many of the staff and operators. For over 20 years they had needed to duck under CV line #1 to access the rest of the factory floor, often time scraping their backs on the bottom of the trays. This modification was greatly appreciated by employees, visitors and VIP's alike.

Figure 7-4 CV Line Personnel Pass-Through

In addition to these activities, all equipment and support items were cleaned and painted, many of the maintenance issues were repaired and a daily clean up duty roster posted. This has been just a small taste of the many and numerous things that the CIT's accomplished during this research period.

7.2.5 Lessons Learned

These sessions were very instructive to me as well, for as I was teaching and guiding them I was learning too. This was the first time I had tried a distributed leadership approach, outside of LFM. We had used it during our summer team session and it had worked well because we were all equals and there frankly was just too much work not to do otherwise. So, because everyone at ABB Wessel was really starting at the same level of experience with this kind of team process, I felt the distributed model could work and it did. Of course in the beginning I had to provide more leadership with some teams much more than others, but slowly, I assumed the role of guide and advisor.

I also learned a great deal about people and the emotional phases they go through during a major change. They usually started with disbelief and denial, I heard statements like "they will not close the plant", "this will all blow over", "and it will be back to normal soon". I saw lots of

anger and blame, people said things like "management is to blame here, not us" "we worked our butts off and this is how we are treated". Then there were those who reluctantly accepted the fact that we were going to change and many things would be very different. But once they started to accept the change, they would be soon overwhelmed with the magnitude of everything that needed to be done and how quickly we needed it. They would say things like "I'll never be able to learn this new system or how to use computers, I'll need training".

On a lighter note, another thing I found helped people get through this stressful time was having plenty of snacks and refreshments on hand. I would have several pots of tea available with chocolate candies and biscuits (cookies); I tried to make the experience as painless as possible. I also made sure each person had a notebook and a pen or pencil to keep notes and I took lots of photos of the teams and made charts and slides recording their progress and accomplishments. (See Appendix E for a sample team accomplishment presentation).

7.3 Creating a Lean Function

As I had mentioned earlier in the Section, I was not very successful in recruiting internal key individuals with high levels of energy, good attitudes and especially with a background in Lean or change management. So, after several discussions with my project supervisor, Tom Flynn, he authorized me to start a search for a new person with these qualifications. The objective was that this person would work and train with me for the remainder of the internship and then take over for me when I left. I started the recruitment exercise by writing a job description and a description of what I thought the role would and should evolve into over time. In essence what I was doing was creating a new Lean function in the organization, one that would be focused on the value stream and on the ratio of value to non-value. This new position was titled "Value Stream Manager". It is also important to mention here that this person would need additional support personnel, but this was the first step.

7.3.1 Recruitment

We found that because many businesses were closing down their plants in Ireland and moving to China, there was a fairly good pool of talented people available at reasonable salaries. Needless to say this was a very important decision and addition to the company gene pool. What we were trying to do was give it a much needed shot of new DNA and it had to be the right person. After

several interviews we found a well qualified, highly energetic and experienced person who was excellent for the job.

What I learned during this time was that we often restrict ourselves unnecessarily to what we think are the options or resources available to us. I spent a great deal of time trying to make some people something they were not yet capable of being. We as mangers need to think outside of our predisposed boundaries and reach outside of our organizations and affiliations to get the ingredients of success that we need, I will speak more about this topic in the next section.

SECTION 8: IMPROVING THE SUPPLY CHAIN

As suggested at the start of this paper, a value stream manager has two levels of responsibility, the first being the operations within the four walls of the plant and second the value stream at the enterprise level which is commonly referred to as the supply chain. Proper design and management of a business's supply chain can be a key source of value creation and competitive advantage. In today's fierce global markets, with the introduction of products with shorter and shorter life cycles, and heightened expectations of customers, businesses cannot afford not to invest in and focus attention on this extremely important part of their business.

In a typical supply chain raw materials are purchased and items are produced at one or more production sites, shipped to a warehouse or distribution center, and then shipped to retailers or directly to customers. Consequently, to reduce cost and improve service levels, effective supply chain must take into account the various interactions at these various levels. Therefore, we must take into consideration every facility that has impact on cost and plays a role in making the product according to customers' requirements. The goal is to make the system as cost-effective as possible; this can be addresses by reducing lead times, total inventory and work in process in the system, including touch labor and overhead. Some common challenges are:

1) Supply chains can appear to be very complex and cover a wide geographical area, making communication and management difficult, but critical parts can be simple and be hidden by the complexity.
2) The various facilities and businesses in the supply chain frequently have conflicting or non-aligned objectives. For instance, suppliers typically want manufacturers to commit very large quantities in stable volumes, but with flexible delivery dates. The manufactures want small quantities exactly when they need it, not too early and certainly not late. We had a problem with this at ABB Wessel with or supplier of PVC compound. I will describe it in more detail later in the Section.

3) Demand is almost always changing. Most production decisions are made with less than perfect information, using forecasts, and this often results is shortages or worse excess inventory in the system.

8.1 As-Is Supply Chain

The supply chain for the ABB Wessel Longford plant was not all that complex, yet it did not run very smoothly, primarily due to lack of communication and teamwork. A diagram of the system is shown below in figure 8-1. As you can see the majority of transactions take place between four main players; the sister plant in Dublin (Finglas) located 84 miles away, the PVC supplier Associated Plastics Inc. (API) located 34 miles away, The Polyethylene suppliers (Borealis and Dow Chemical) both located in mainland Europe and a handful of small miscellaneous item suppliers also located on the mainland. The majority of Longford customers were located within Ireland and product was shipped directly to them.

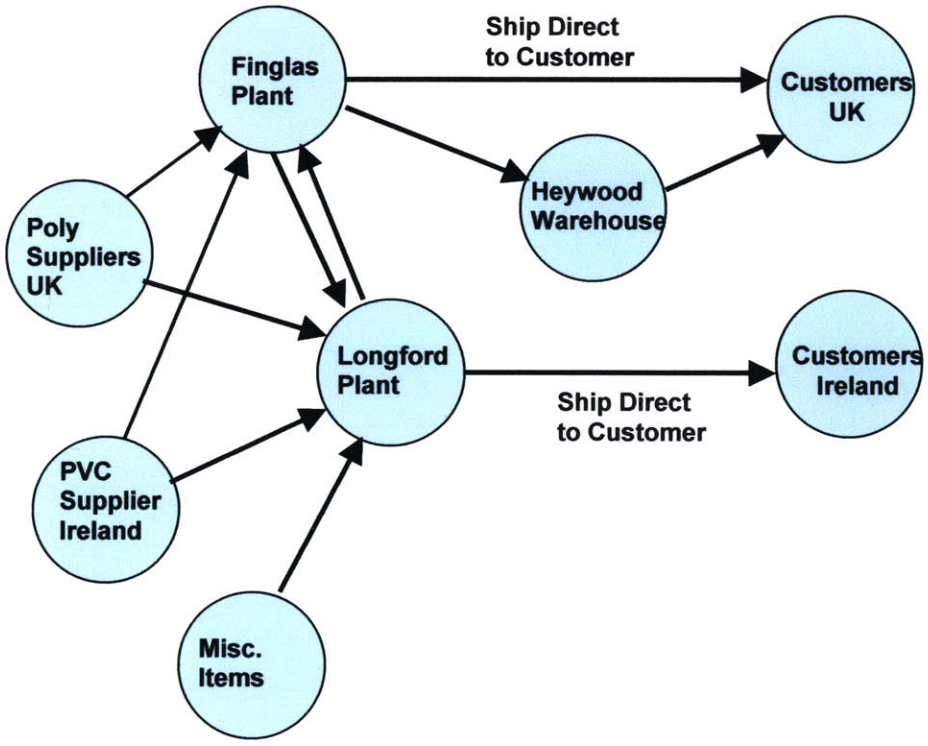


Figure 8-1, ABB Wessel Longford Supply Chain Diagram

Approximately five months into the project it was announced the Heywood warehouse was to be closed and warehouse activities were to be consolidated at the Finglas plant. This was obviously a step in the right direction and was just being implemented as I left. Because this consolidation effort was already in work, I decided to concentrate on improving the coordination of value/supply chain activities in the areas of inter-company logistics and coordination between the Longford plant and the PVC supplier and its main customers Eircom and ESB. Those efforts are described in the following sections.

8.2 Inter-Company logistics

During the period of this research it became obvious that the two plants, Longford and Finglas, were not working together as well as possible. Their interdependencies varied, from sales and production information, copper and finished goods demand levels and storage space availabilities and as the product offerings continued to increase, these were becoming more critical. To investigate these problems I made several trips to the Finglas plant to interview and discuss what problems they were having and to hear their perspective on the situation. I heard comments such as "today the delivery of copper for the core lines in Longford was late, because the production planner did not get the demand forecast until Monday, when he needs it on Friday morning". Not too surprising was the fact that personnel in both plants suffered from lack of correct and timely information to make good production decisions. I also came to find out that many of the people involved in this process had never meet before or had never visited the other plant.

In order to begin rectifying these issues, I initiated a monthly "Inter-site Logistics team" meeting. The first month (October 2003) the Plant manager, production planners, procurement agent and stores manager from Finglas attended a meeting in Longford with their functional counterparts. The goal of the meeting was to "Act as one business" and the focus was to be on the copper and finished goods demand, production, and inter-site shipping process. I facilitated the meeting and wanted this team to think of ways to improve communications and better understand each others needs/requirements. I explained to them how, if we could do these things, we could almost immediately see a drop in stock outs and production interruptions and a decrease in transportation and production costs. The following is a list of issues identified by the team and the agreed on action plan.

- Need better visibility of finished goods and WIP on the factory floor (location, quantity and mix)
  This was critical because both plants were producing several of the same products.
- Need better communication when there is a problem (quick notification)
  This was a key issue, because the other plant would need to adjust production to pick up the slack.
- Need a monthly demand forecast for copper (all sizes)
  This was not being done regularly or on a timely basis, Finglas plant was forced to guess as to what production level to set for Longford.
- Both parties wanted to be treated better (as customers/partners).
- We are often not getting paperwork on a timely basis, can we improve or streamline this system. There was a very paper intensive system of transfers back and forth which was not being maintained.
- We need blank PO's in the system to be set up in order to ship finished goods to you.
- Do we need a buffer stock of 1.74 and 1.36 mm copper in Finglas? This was thought to be an option because these sizes were run as frequently as the 1.9 mm and setups where very costly.
- Use E-mail instead of phone calls to relay important production information (we need to have written record) and do not use the truck driver as a messenger.

For this list of issues and ideas, a going-forward plan was agreed to and implemented. It consisted of agreement between the two plant managers to share finished goods and WIP production data daily. This meant more work for a clerk, but it soon became part of his daily routine and it helped the plant managers' work together on producing the common products. All parties agreed to quickly notify their counterparts of issues or problems that may affect them, as soon as possible. The team agreed that a monthly copper demand forecast for the Longford plant was needed, but with weekly updates to be provided by E-mail and by mid-day on Friday for the upcoming week. In addition, personnel from both sites agreed that they needed to treat each other better and that each location was both customer and supplier to the other and the best way to treat each other was as a partner. This was a key awareness that I was trying to achieve with the group, because for years they had in many ways been competing against each other when in fact they were on the same side just separated by 84 miles of highway N4.

On the topic of paperwork, the team had a revealing discussion about how to make the current system work better, in essence they agreed to just make sure no product leaves a facility without its proper paperwork and to make sure all correspondence has written record (E-mail preferred) and to not use truck drivers to relay messages. More important was the realization that if we were really one company why not just do inventory transfers and cut out the P.O's. We decided this change was worth following up in our next meeting. Another key decision by the team was to create and maintain a small (50 bobbin) buffer of 1.74 and 1.36 mm copper at Finglas to enable non-economical changeovers on the twin rod machine at the Finglas plant.

In the subsequent monthly meeting the team continued to work on issues and to focus on working together and understanding each others needs and requirements better. The idea of doing inventory transfers instead of PO's was an idea ahead of its time. Because of the current legal and tax structures of the two facilities we had to continue the P.O and the accompanying transfer pricing that I will discuss a little later in this Section.

My take-away from this experience was that sometimes you do not need to totally redesign a system to capture the majority of the benefits and value that is locked in it. Yes, it is true that we could have gone down a path of creating a sophisticated MRP / IT system that would have automatically shared the pertinent data, and I'm not saying that that shouldn't be done eventually, but for my money, this was the best approach for the given situation. I believe this to be generally true when just beginning to improve a supply chain, because what people need to see is quick results from their investment in time and effort. This preliminary approach creates an environment of working together and commitment to the team and its goals and objectives. Since one of the primary underpinning's of a good supply chain is communication and sharing of information, it does not matter how pretty or sophisticated it is accomplished.

8.2.1 Transfer Pricing

While working on the supply chain issue at the Longford plant I became interested in the transfer pricing arrangement because it seemed to favor the Finglas plant in almost every way. Sometimes senior executives do not view the transfer pricing problem as important from the overall firms' perspective, because alternative pricing methods merely shift income among the

plants and that except for relative performance metrics, little else is affected. But this is a mistake. The choice of a transfer pricing method does not merely reallocate total company profits among the business units; it also affects the firm's total profits and behaviour. If we think of profit as a pie, the choice of transfer pricing methodology not only affects how big each slice is but how big the pie will be.

An economist's first instinct would be to set transfer prices equal to marginal cost. But it may prove difficult to find out the true marginal cost. As a practical matter, marginal cost information is rarely known to anybody in a firm, because it depends on the opportunity cost which varies with the capacity. Consequently there are basically four methods of transfer prices commonly used:

1) Market based transfer pricing - which says you sell internally for the same price as you can get externally. This method insures that resources are used to optimize overall profitability and usually leads to correct long-run make/buy decisions.

2) Variable cost transfer pricing - this method can approximate the opportunity cost of transferring one more unit of production and it gives the buying business unit the incentive to purchase the correct amount if the selling division has excess capacity. Some draw backs are that it does not allow the selling business unit to recover its fixed costs and will cause the manager to try and hide fixed cost in with variable costs.

3) Full cost transfer pricing - this method usually avoids disputes over which costs are fixed and which are variable. It is simple, but the selling division can export its own inefficiencies to the buying division and can cause the buying division to buy too little.

4) Negotiated transfer pricing - Both selling and buying divisions have incentives to maximize their combined profits, but this can be time consuming and its effectiveness really depends on the negotiation skills of the two parties. If one party is much stronger that the other the relative advantage is stacked in ones favor and overall profits are not maximized.

Based on my investigation, the Finglas and Longford plants have a negotiated transfer pricing arrangement, but due to reasons that I could not uncover, the pricing is very much in favor of the Finglas plant. There are two reasons that this could be intentional. The first is that the senior executives want to transfer a disproportionate amount of profits to the Finglas plant to improve its bottom line, which is entirely their prerogative. The second reason might be to reduce the

overall tax exposure (reduce profits in Longford). This second reason may have been the case during the profitable years, but I find this hard to believe when both plants are losing money. Unfortunately I do not have a solution to this question, I only bring it up to suggest to ABB Wessel, that they review their transfer pricing policy and check to make sure they are not unintentionally shrinking their profit pie

8.3 Raw Material Suppliers

In traditional supply chains each party in the chain focuses on its own profit and hence makes decisions with little regard to their impact on the other supply chain partners. Relationships between suppliers and buyers are established by means of contracts that specify pricing, delivery, quantities, quality, lead times and so forth. This is a traditional at arms length relationship. The key question then is how these supplier/buyer relationships can be transformed into relationships which help to optimize the performance of the entire value/supply chain.

ABB Wessel had been doing business with Associated Plastics Inc (API) for over 20 yrs and the Wessel account was over 50% of their business. The relationship was quite informal and flexible; orders would be received by phone call. Product was delivered several times a week in quantities of ten tons each, in order to minimize transportation costs, and the product was on consignment. API also did business with the Finglas plant and supplied it with several similar PVC granulized products.

I arranged a meeting with the sales manager of API and the procurement manager of ABB Wessel Longford to start a dialog on what we could do together to improve our working relationship and to look for areas or ways to unlock additional value for both of the companies. From my lean factory initiative experience I knew that the deliveries of ten tons of compound (each box weighs one ton) often created storage problems resulting in boxes of compound being stored on the factory floor. This created waste in the flow of the product and waste in multiple moves by the forklift crew. In addition to the storage/economic order quantity question, the empty boxes were meant to be reusable, but because of rough handling where usually too damaged to be returned for a credit of 59 euros each. I also had a question about why we used boxes and Finglas used disposable bags.

Not too surprisingly, during the discussion I found that API thought it could reduce production cost and lead times if it had a good reliable production forecast. So we decided to do something similar to what we had done with the inter-site logistics team and copper. The procurement manager would provide a monthly demand forecast and give weekly updates by Friday mid-day for the upcoming week. We also agreed to work toward a single order point of contact for both plants. This would help API plan its production more efficiently and contribute to reduce lead times. The group agreed this would be a hard sell, because of a turf mentality, but we felt as we got better at working together with Finglas this should be feasible.

On the subject of packaging, it turned out the different types were an artifact of the history of the two plants. The Longford plant did not have much storage space so the packaging needed to be stackable, therefore the boxes. The Finglas plant had plenty of space and they opted for the cheaper disposable nylon bags. This was an interesting problem, the boxes were costing us a considerable amount of money and we needed a better approach. I began to investigate the possibility of purchasing the PVC compounds in bulk, similar to how the Polyethylene was delivered. This solution required capital expenditures in the range of 60-80K euros for the Longford plant to install dedicated silos and a piping system to distribute the bulk material to the extrusion machines. In addition API did not have bulk delivery capability and would need a truck, because after all they had basically built their business around the ABB Wessel business. So the total Cap Ex for the proposal would be somewhere between 130-150K euros. We all agreed that this would be the best long term solution, but in this cash strapped environment it was probably a non starter for now, so we put it on the back burner.

At the end of the meeting we decided to meet again in a month, next time at API. We wanted to see how the new process of sharing forecast data with weekly updates worked and also agreed to go think about how we could reduce the damage to the reusable boxes getting more cycles out of them, and also to not forget about the long term objective of bulk deliveries.

A common theme was starting to emerge from these supply chain meetings. Information and knowledge is a critical enabler of effective supply chain management. Design is also a critical component; in this case it was the design of the packaging. We unfortunately did not have the funds to improve it at the time, but the opportunity was identified.

8.4 Demand Forecasting and Scheduling

In a push based supply chain, such as the one at ABB Wessel, production and distribution decisions are based on long-term forecasts. The manufacturer bases demand forecasts on orders received, historical data, and current inventory levels. Therefore it takes longer for a push-based supply chain to react to the changing marketplace, which can lead to inability to meet changing demand patterns, excessive or obsolete inventory, unacceptable service levels, and large batch sizes. In addition, you must also be aware of the bullwhip effect which can be caused by high variability in customer demand. This often leads to inefficient resource utilization, because planning and managing are much more difficult.

For instance, it is not clear how a manufacturer should determine production capacity. Should it be based on peak demand (like the Dell model), which implies that most of the time expensive resources are sitting idle, or worse, making unneeded inventory. Should you base the plant production on the average demand, which will require extra, expensive, production capacity in the form of overtime or outsourcing during peak demand periods? Similarly it is not clear how to size the transportation capacity; based on peak or average demand. Based on my research, the operations at ABB Wessel Longford plant were sized for average production levels between 10,000 and 15,000 KM a week. Given this knowledge, it is then important that the wide variation in demand be reduced as much as possible. There are several ways to reduce the impact; they include reducing uncertainty, reducing lead times, and engaging in strategic partnerships.

In order to reduce uncertainty, the complete supply chain must have access to the same production forecast schedule. This is in essence what the two teams (Inter-site Logistics and the API team) decided to do. By reducing each others' uncertainty, they could make better overall decisions.

The second approach of reducing lead times is also effective to a point. What this does is let the production process react quicker to changes. This is a good goal in any situation; shorter lead times equate to lower WIP levels, lower inventory levels, and less overall waste in the system. In 2003 ABB Wessel implemented a Theory of Constraints (TOC) initiative focused at the

bottleneck of the Telephone line. This initiative placed a strategic buffer in front of the drum twister so as to insure that this process never starved for WIP. TOC is a very helpful framework for people to use to understand and better manage the WIP and flow on the floor. The problem with this initiative was that it did not get full support from the shop floor supervision and was far from as effective as it should have been. In the following Section I will discuss how in the future state TOC can be integrated into a holistic value stream plan.

The third option available to ABB Wessel is engaging in strategic partnership with their customers. One of these strategic partnerships is Vendor Managed Inventory (VMI). VMI is when a manufacturer is responsible for maintaining the customer's inventory levels. The manufacturer has access to inventory data and it typically is responsible for generating purchase orders. ABB Wessel Longford has been slowly working toward this kind of relationship with its largest customer, Eircom. Over the past 5 years they have reduced the number of shipping points from 81 to 14, customized cut lengths and emergency 6 hour delivery service. In the next section I will describe a Supply Chain Workshop were the executives of ABB Wessel and their major customer Eircom discussed VMI options.

8.5 Supply Chain Workshop

In early November we held a Supply chain workshop with five of ABB Wessel's largest customers at the ABB headquarter in Dublin. The theme of the meeting was "Managing the Supply Chain for Mutual Advantage". This section describes the approach and outcomes of this capstone event.

8.5.1 Approach

The approach of the workshop was to make it a thought provoking all day off-site experience, where the senior executives of ABB Wessel and their major customers learn and reflect on where their supply chains are going, and most importantly, how they could be managed for mutual advantage. The objectives of the workshop were as follows:

- Define a joint set of supply chain objectives
- Improve supply chain alignment
- Identify opportunities to reduce cost across the supply chain
- Improve service levels

- Increase visibility throughout the supply chain
- Improve communication and trust

The format that we chose to use was that of education and learning in the morning and exploration and working together in sub-groups, with a report out and wrap up discussion session in the afternoon. Professor Jonathan Byrnes, supply chain expert and senior lecturer from MIT, was the keynote speaker, his presentation reset the groups basic understanding of supply chain for those in attendance and brought them through a short history of the field and gave them insights into the future of Supply Chain Management and why it can be a key source of competitive advantage and value to their companies. (See appendix E for a copy of his presentation). The second guest speaker was Paul Naughton, VP supply chain from Dell Ireland. His presentation was on the Dell model of supply chain and how it enables Dell to be so dominant and profitable. The objective of this presentation was to show the audience what is achievable with a highly honed supply chain (A copy of this presentation is not available)

As previously stated, the afternoon session was set aside for the working together sub-groups. We provided separate rooms for each team, which was comprised of the executives of a given customer plus one or two ABB Wessel executives. Each team had 2 hours to discuss the following questions and record team notes on flip charts and select a spokesperson to present the work at the report session to follow. The four questions were:

1) What was your supply chain like five years ago? What is it like today? What should it be like five years from now to keep us competitive?
2) What are the gaps (what do we need to do) to get to this future state?
3) What should be the priorities in addressing these gaps?
4) What can we do together in the next three months to begin to close these gaps? (2-3 most important steps).

Figure 8-2 below shows the Eircom/ABB team during the report out session, Tom Flynn at the flip charts

Figure 8-2 Eircom/ABB Team Report Out

8.5.2 Results

Of course specific action plans from each company's gap analysis was slightly different, but some common themes that came through at the report out were: 1) They wanted to move to a pull-based system with web ordering (no phone no fax); 2) Organizational resistance to change at each of the customers was high (unions and management) they wished they would get on board; 3) They needed better information, planning and inventory transparency across the entire supply chain; 4) They wanted partners they could trust; 5) Everyone wanted a roadmap.

In all cases the teams saw some form of integrated information technology and decision-support system across the supply chain as a key enabler. Another key enabler was the simple act of getting together periodically to discuss, plan, and build relationships and trust among the supply chain members. The topic of IT and its future role in the follow-on steps of this supply chain was outside the scope of this project, but it would seem obvious that it will be necessary to move this group into the next stages. In order to continue to foster the trust and working together relationship, the teams committed to staying together and work on their action plans with the intent of getting back together as a large group quarterly.

As observed earlier in this Section, designing and implementing an optimal supply chain is quite difficult because of its dynamics and conflicting objectives. Nevertheless, these five companies came to basically the same conclusions; in order to better align their supply chain and unlock value in the system, they needed more integrated, not less, and they needed to engage in more strategic partnerships, perhaps explore Vendor managed inventory (VMI) relationships, and clearly, information sharing and transparent operational planning are the keys to a better integrated supply chain.

SECTION 9: PROPOSED FUTURE STATE AND IMPLEMENTATION

This Section uses the results of the analysis and the experiences from implementing Lean continuous improvement at ABB Wessel's Longford plant and proposes a potential future state for the organization and will address any issues identified. As presented earlier, manufacturing is a complex system with many elements and often, limited resources. Therefore this section will describe the key elements and implementation approach suggested of a future state (within 1 year). Finally it will describe some of the challenges facing an implementation in this particular environment.

"Destiny is not a matter of chance; it is a matter of choice. It is not a thing to be waited for; it is a thing to be achieved.

William Jennings Bryant

9.1 Proposed Future State

The value stream mapping process, discussed in Section 4, was used as a tool to investigate and document operations, then identify areas for improvement. The future-state map is also a tool, but one that is primarily intended as a tool for change. The future-state map helps clearly communicate a vision of the operational structure that is trying to be achieved and helps the development of concrete implementation plans.

Ideally, the future-state map represents a future that can be achieved in a relatively short period of time and is a component of an overall tactical roadmap. It is important to impose this limitation on the future-state map in order to steer ideas towards a more realistic and more likely to be within the control of the organization. This is important because accomplishing small successes quickly builds confidence in the process and enthusiasm for generating new ideas.

9.1.1 Future-State Map and Elements

The future-state map, shown below in Figure 9-1, is intended to illustrate primarily the material flow and WIP control system, since this was highlighted as a major contributor to cycle time in

the current-state maps. This section will describe this near-term future state and its physical elements. The following section will describe some of the additional key elements or processes that can not be depicted but are essential to creating this future state.

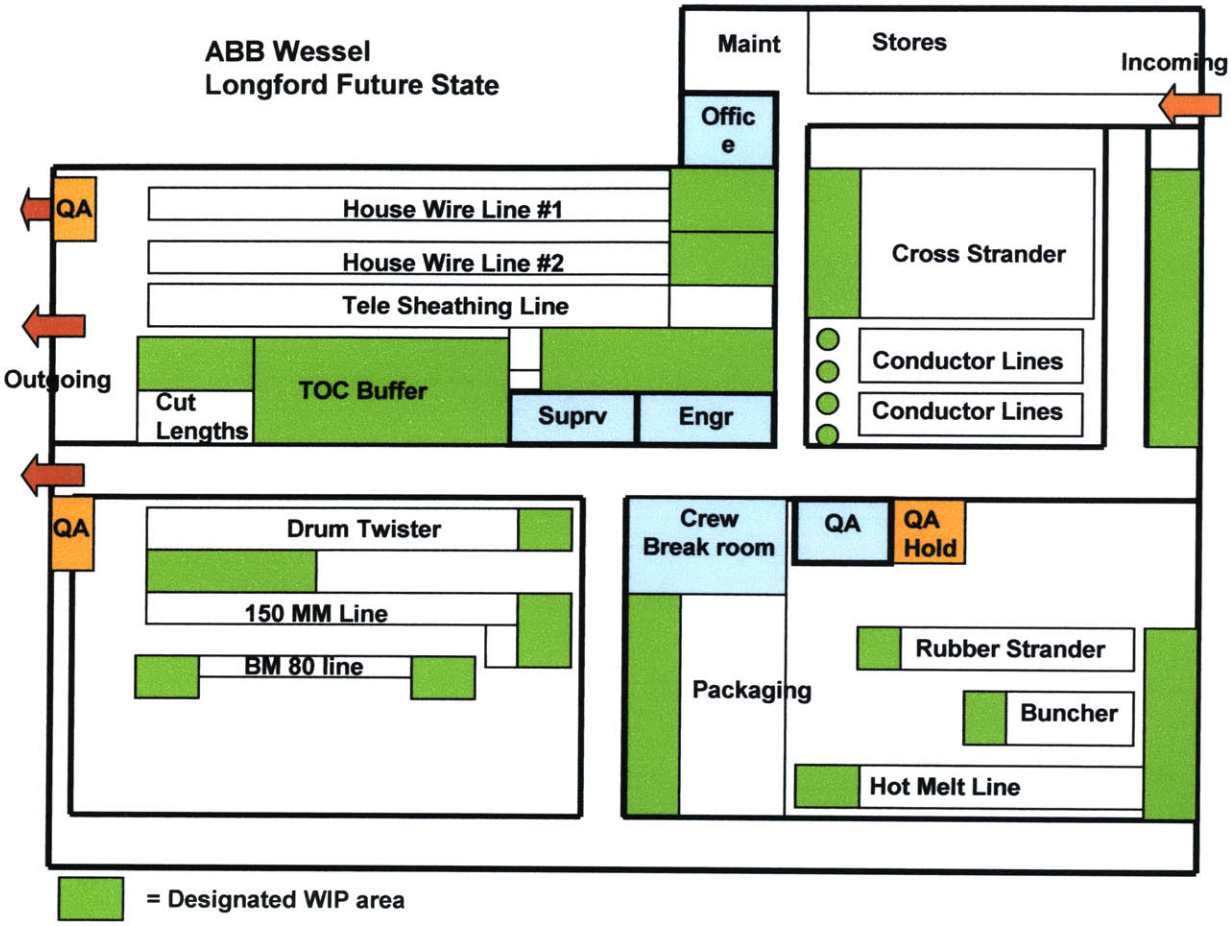


Figure 9-1 Proposed Future-State Map

As seen above, the depicted future state is considerably different in terms of machine mixture, but with minimal equipment movement. First, the most notable change is the elimination of the two constant vulcanization (CV) lines at the front of the plant. This is a decision that was reached approximately two-thirds of the way through the internship and was really bolstered or crystallized by the profitability analysis that was first conducted by product family and then by SKU. The decision to adopt and develop Hot Melt technology to replace the CV lines is a key component to the overall profitability of the plant.

Secondly, the equipment specifically associated with LAN cable production has been removed (group twinners and boxer). This is another product line that was indicated by the profitability analysis to have limited margin and considering the worldwide glut of the product and capacity to manufacture it, I have suggested it be eliminated from the ABB Wessel product offering.

Thirdly, I have shown the conductor lines co-located to enable a reduction of required operators. This change should free up at least one operator per shift. There also is the relocation of the telephone cable cut lengths area to near the main door and near the telephone sheathing line. This change will allow for easier movement of drums in and out of the factory and provide work sharing opportunity with the other operators in that area.

Fourth, is the co-location of the engineering personnel to the shop floor. I've shown this new office space located adjacent to the shop supervisor's office and across from the QA office so that these support functions can better work together. This is a key change, as it symbolizes the integration and team approach which we are building into the culture.

The fifth major change is the addition of another house wire extrusion line. This is a product that had reasonable profit margins and good demand. The manning of an additional extrusion line in that area would be quite easy by instituting work sharing across the original house wire line and the telephone sheathing line. This addition should make both the house wire and telephone sheathing lines much more efficient.

Sixth, is the addition of in-process quality areas behind the Drum Twister and House Wire lines. This was an initiative that was almost completed prior to the end of the research. These stations will be utilized primarily by operators to test their own products. There will be some QA personnel involved but the goal is to make it possible for the operators to conduct the checks. These in-line QA check stations will backlog in inspection and increase product flow through these areas.

Seventh, the coiling area is now a packaging area where heat-shrink wrap, eco-friendly packaging is the norm. This change will require the purchase of two machines but will greatly reduce the environmental impact and disposal cost that ABB Wessel's customers had with the

plywood reels and it is much easier and cheaper to do with less manpower (win-win situation). The other significant change along these lines is that the drum repair area has been eliminated. It is my belief the drum repair should be outsourced and the personnel utilized in a more productive and value-added role, perhaps as an inspector.

Another change is the addition of a crew break area on the shop floor. This is an essential change because it will be instrumental in changing the work practices which are currently the norm. Today break times are loosely controlled resulting in unmanned machines, unplanned down time and internal friction between operators. The addition of an on-shop-floor break area will enable the floor supervision to enforce hard break times and machine coverage schedules. The relocation of the crew break room to the shop floor also will free up much needed office space on the second floor of the office complex. It is envisioned that this break area will be unstaffed and contain a self-serve tea and coffee bar, allowing for the elimination of the canteen personnel currently employed today whose main function is making sandwiches, cleaning the canteen area and delivering tea/coffee, candy bars, and biscuits to the shop floor several times a shift.

A different approach to work practices and staffing of several of the key functions is also needed. I have already indicated several opportunities for group working (conductor lines, house wire/telecom sheathing, Drum Twister etc.), in addition to these changes I recommend that key support functions such as Maintenance, Quality and Transportation (forklifts) be staffed properly for the full three shifts per day. The proper staffing of these roles will enable the product to flow through the factory on a timely basis reducing the overall cycle time and allowing WIP levels and finished goods inventories to be reduced. Much of the dead time identified in the process mapping can be attributed to these evening shifts and the disruption caused by improper staffing.

Integral into these changes is the addition of the Shop Floor Data Collection System (SFDCS), this new system will replace the old manual paper system of planning, production sheets and quality run charts. SFDCS is PC based and will be wireless on the factory floor, providing real-time production performance measurement capability and allowing the shop floor supervisors and plant manager to identify potential problems early. An added advantage of this system is the capability to print product labels at the process lines.

9.2.1 Key Supporting Processes

There are several key supporting processes that will need to be put in place to support the complete turnaround and culture change; I have outlined them in some detail in the following sections.

9.2.1.1 Human Resources

There is a severe need for a HR professional at ABB Wessel and I am pleased to report that, at the time of this paper, the company was very close to employing an individual for this role. As I have stated in this paper several times, an organization can only be as successful as the people that make up the organization. Their skills, attitudes, ideas, sweat and tears are what will propel a company past mediocre to become one of the top performers in its industry. As Jeffrey Pfeffer wrote in his book "The Human Equation- Building Profits by Putting People First" In the end, making the connection between people and profits entails confronting how we think about work, organizations, and the people in them. What matters is a manager's point of view. When you look at your work force, do you see the source of your organization's sustained success and your people as the only thing that differentiates you from the competition? Or do you like so many, see people as labor costs to be reduced or eliminated?

A people-centered strategy enables firms to compete on knowledge, relationships and service, not just price. By the same token, inattention to people as a source of competitive advantage and implementing poor, low commitment management practices can significantly contribute to organizational decline and create a death spiral (See figure 9-2 Death Spiral) that the company may not survive. One such example of this was the Apple Computer company in 1985. Apple was a company largely built on culture, the Macintosh design team worked in a building with a pirate flag flying. People were recruited to Apple with the idea that it was more than a company it was a cause and they were helping to change the world. But, in 1985 when CEO John Sculley laid off 20% of the workforce in a single day, because the sales did not meet expectations, its ability to motivate and attract the best and the brightest was lost. Apple's ability to implement its business strategy and to recapture that original revolutionary spirit was irreparably harmed and has struggled since.

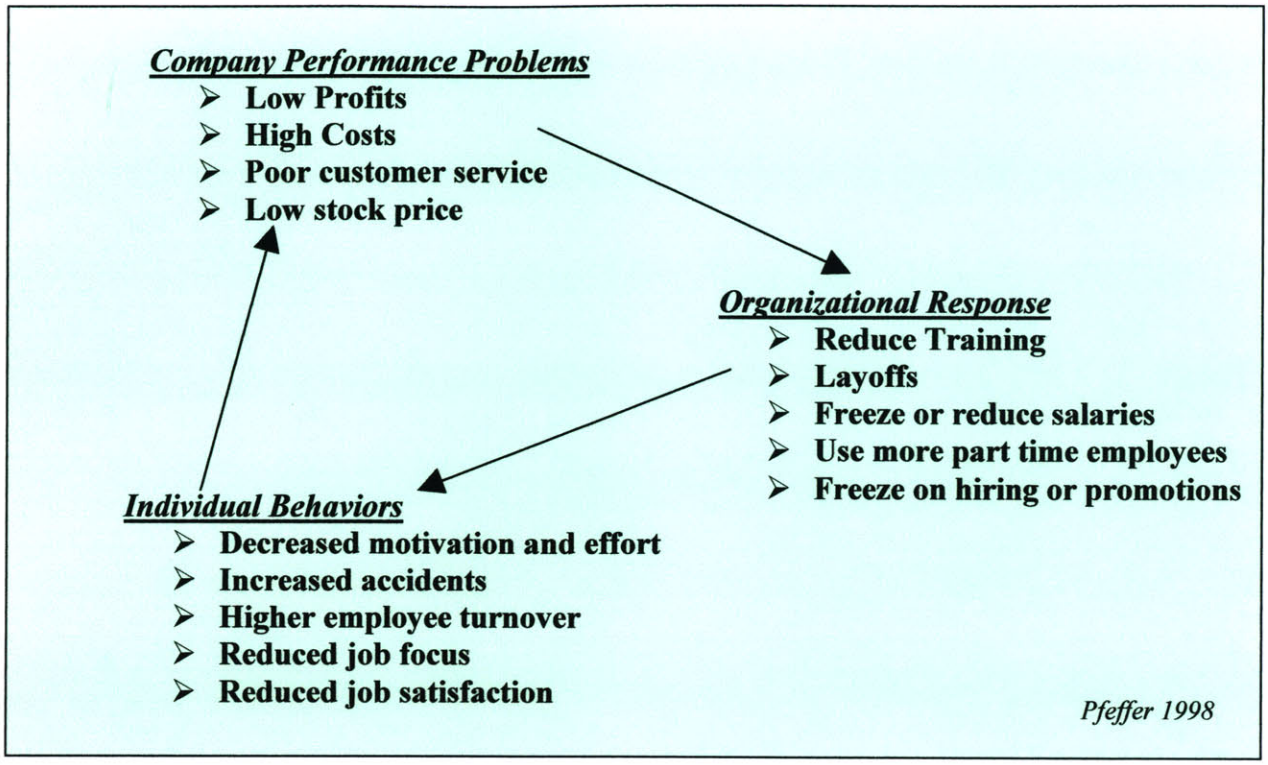


Figure 9-2 The Death Spiral

Having said this, it is of course not easy, or else everyone would be doing it I just want to take this chance to outline what I think are important areas that should be concentrated on and implemented.

1) Employment security – In this era of constant down sizing and so called right sizing it is imperative that people know and trust that if they develop techniques and ways of becoming more productive that they are not working themselves out of a job.
2) Be Selective - The hiring process is a key source of competitive advantage that is to often over looked. My advice here is select new people for their intelligence, attitude and for their growth potential. The leaner a company gets the more important it is that each and every member be a high performer and act as an owner of the company. On the opposite side of the coin, anchor draggers and under performers need to be removed swiftly, nothing will destroy morale faster than free riders and under performers (this applies to all levels within the company). It is my assessment that there are several personnel changes in key positions that need to be accomplished as quickly as possible. They are in the areas of maintenance, shop floor supervision, engineering and plant management. In a later section I will detail a new organization chart describing these changes.

3) Training – There is a desperate need for training at ABB Wessel, everything from safety to SPC. Invest in the people skills then put them in situations where the benefits can be reaped. Personal development plans that are periodically reviewed and supported by management are an excellent way to create a partnership between the employee and the manager.
4) Treat everyone fairly - Remove barriers to knowledge (financial and performance), reduce status distinctions. Implement a recognition system and company newsletter.
5) Pay for Performance – Incentives and rewards for people whose performance is outstanding. There are many forms that this can take. Currently ABB Wessel has a Gain sharing program that shares the savings from reduced scrap and increases in machine utilization with everyone in the plant. This is a great program, and should be continued to motivate the proper behaviors. But pay for performance is more individualized and requires setting goals and objectives and incentives.

This list of focus areas is specific for the situation at ABB Wessel for the next year and is not intended to be an all encompassing view of Human Resources for all companies and all situations.

9.2.1.2 Production Control (SFDCS)

In Section 4, I highlighted the need for an improved production control system, the Shop Floor data Collection System or (SFDCS) was the outcome of one of the CIT's formed during the internship. The SFDCS Application was developed using a rules, data bases and excel spread sheets specified by the team and was programmed in Visual C++ and Visual Basic by an outside vendor. The solution consists of a number of input screens that capture data such as; End of Shift Close (EOSC), Direct Production Time, Drum Information and Lengths. As well as capturing and storing information, the application will also communicate with the BAAN ERP system to get stock and sales information as well as updating stock information on BAAN. The SFDCS will also be responsible for printing WIP and Finished Goods labels so that the tracking of product is possible.

The team, which was comprised of senior management and potential users alike, defined a number of project requirements which were critical in the design and implementation of the Shop Floor Data Collection System they were as follows:

- Home Grown System in 3 Month Period
- Reduction in Labeling Effort
- Real Time Data
- Transparency & Interconnectivity between Functional Areas
- Complete & Accurate Information (Data Integrity)
- WIP and Finished Goods Inventory
- Ability to manage all product types
- Ability to Work with Standard and Non Standard Lengths

Based on these objectives the following functional modules were identified and specifications written: The functional specifications gave an overview of how screens should look in the SFDCS as well as outlining the various functional calls, their input and output parameters as well as return values.

- Planning Module
- Shop Floor Control (Production) Module
- Materials Module
- Quality Module
- Cuts Module
- Finished Goods Module
- Security Module
- System Administration Module

As well as the specific modules included in the SFDCS, a number of other functions need to be defined, including: Standardized reports and ERP (BAAN) Interface.
Each of the ten shop floors PC's running the SFDCS will run on a standard Windows format. The PC's were to be wireless and have an ODBC connection to the Microsoft Access Database server. At the conclusion of the internship, the vendor (KBA systems) was still writing the code and preparing for a go live date of March 2004. Figures 9-3 and 9-4 below show samples of what the user screens were envisioned to look like.

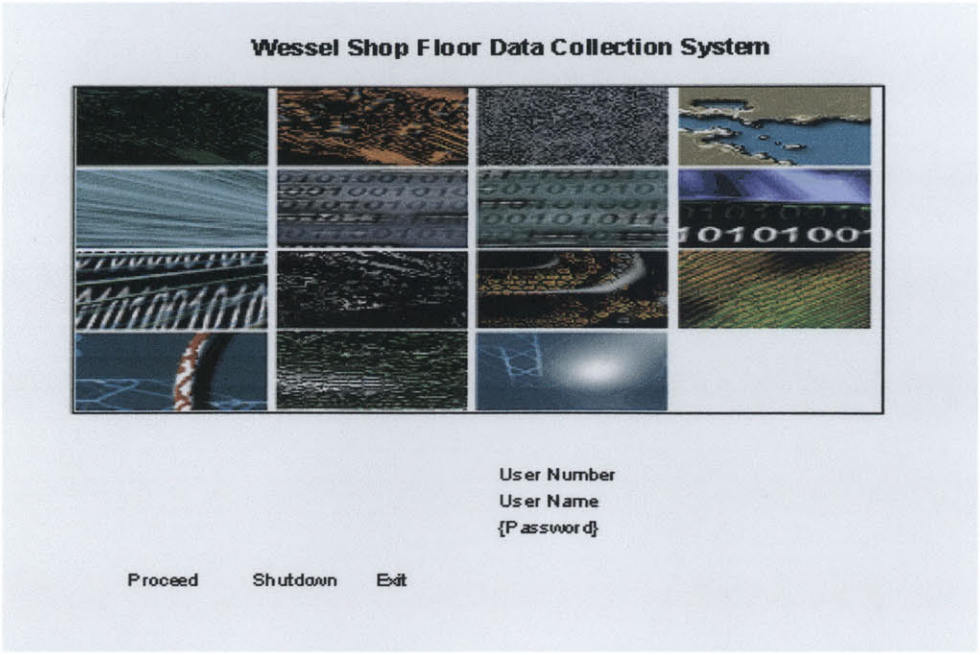


Figure 9-3 SFDCS Logon Screen

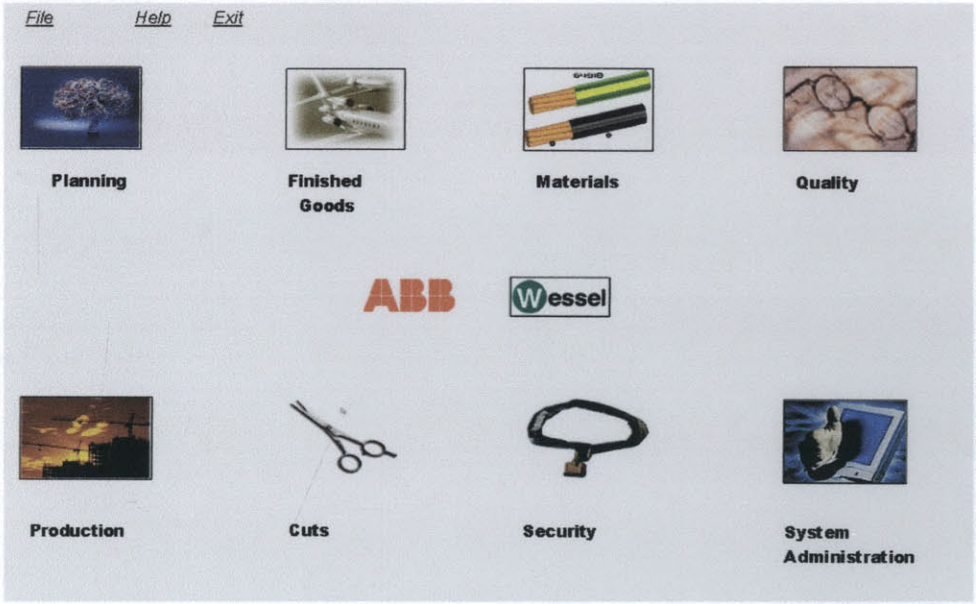


Figure 9-4 SFDCS Main Screen

One of the key modules of the SFDCS is the planning module. The Planning Module reviews data from the BAAN ERP system, as per the present Sales & Stock Report. This report identifies deficit & surplus stock based on Sales and existing stock. The Planning portion of the SFDCS incorporates this data into the various planning screens. There are planning screens for each of the following:

- Insulation
- Cross Stranding
- Offline Jelly Filling
- Drum Twisting
- Sheathing

The Sales & Stock Refresh function allows the Planner to update the WL_SFDCS_ERPSTOCK table with data from the BAAN ERP System. Currently the Planner accesses the Sales and Stock report using the Crystal Web based application. This system works by having a series of predefined reports scheduled to run on the back-end server (i.e. the BAAN server). Once the reports are run, then the data is filtered into an Adobe Acrobat file and presented to the user in Longford.

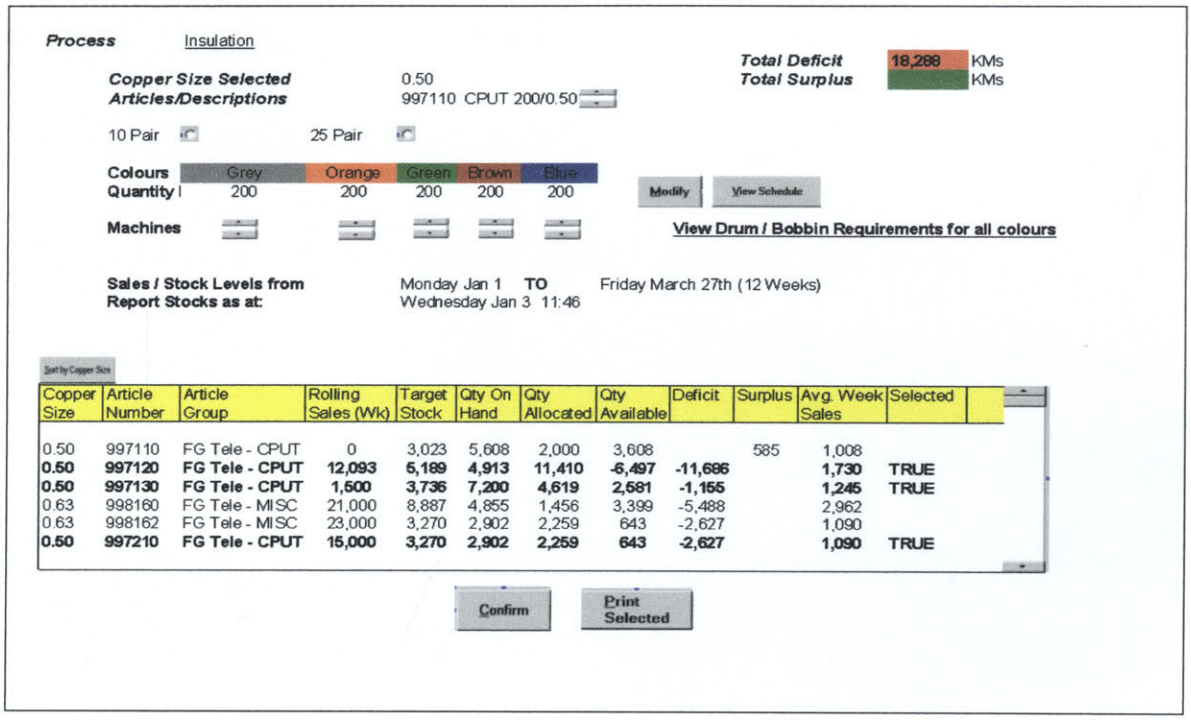


Figure 9-5 Insulation Planning Screen

Above in Figure 9-5 is a representation of the Planning screen for the Insulation Process. The Screen allows the planner to view all of the information that is currently in the Sales/Stock Report, currently downloaded from BAAN. This information is stored in the WL_SFDCS_ERPSTOCK table. The Planner can sort this table on any of the fields in the grid, or on a combination of fields. For example, the Planner may want to view the entire FG TELE (CPUT) group with a copper size of 0.50. In the above example the Planner has selected the

second, third and sixth row of the grid. The total deficit quantities are accumulated in the TOTAL DEFICIT field. This in turn feeds into the COLORS data which can manually or automatically split the quantity.

As well as the quantity per color, the machines required for each color can be assigned. The Planner can overwrite both the quantity and machine fields (MODIFY). The colors are identified on the screen based on whether the 10 Pair or 25 Pair button is selected. If the 10 Pair is selected, the five Base Colors shown above are presented otherwise the 7 Base Colors associated with the 25 Pair are displayed.

The planner may also require an option whereby a machine that is offline, may be turned off in the schedule. All schedules with this machine may be amended so that specific orders can be rescheduled. (VIEW SCHEDULE). The Planner also has the option to view the schedule for the specific articles, they have selected. As well as viewing the schedule, the schedule may also be reprinted and also labels may be printed on specific printers.

The Selection Criteria for the extraction from BAAN as well as the "Report Current As Of" information is also detailed on the screen. This is as it appears on the current Sales & Stock Report. The screen can also have the option to print either the Sales & Stock Report or Preview how the production schedule would look for the current articles. Once the planner has configured the plan, the items are entered in the schedule table and a unique Schedule ID as well as a schedule group is assigned.

A further development planned for Phase 2 for the SFDCS, will be to introduce the idea of a customer forecast into the planning module. As with most MRP systems, the Sales and Stock figures are used in conjunction with the customer forecast, to help calculate the demand. Another possible further development for the SFDCS would be to introduce the idea of a weighting associated with the various weeks associated with the Sales and Stock Report. In this type of system the preceding week, to the one in which the report is run, would be given a greater weighting than five weeks prior to the report run date. A more detailed description of the Shop Floor Data Collection System can be obtained from the author if requested.

9.2.1.3 Total Productive Maintenance

By the end of the internship the maintenance CIT was just getting started, they had their training and had held an AIW, but hadn't made much progress with the five S's, Safety issues and were struggling with transitioning from "repair when broken" philosophy to preventative maintenance. I have many concerns for this group that I will highlight later. They will have to go through these elementary stages before going to TPM, but it is important to keep the goal in sight.

The goal of the TPM program is to markedly increase production while, at the same time, increasing employee morale and job satisfaction. Total Productive Maintenance is a maintenance program concept. Philosophically, TPM resembles Total Quality Management in quite a few aspects, such as 1) total commitment to the program by upper level management is required, 2) employees must be empowered to initiate corrective action, and 3) a long range outlook must be accepted as TPM may take a year or more to implement and is an on-going process. Changes in employee mind-set toward their job responsibilities must take place as well.

TPM brings maintenance into focus as a necessary and critically important part of the business. It is no longer regarded as a non-profit activity. Down time for maintenance is scheduled as part of the manufacturing day and, in some cases, as an integral part of the manufacturing process. It is no longer simply squeezed in whenever there is a break in material flow or when the machine breaks down. The goal is to hold emergency and unscheduled maintenance to a minimum.

To begin applying TPM concepts to plant maintenance activities, the entire work force must first be sure that upper level management is committed to the program. The first step in this effort is to either hire or appoint a TPM manager. It is the responsibility of the manager to sell the TPM concepts to the work force through an educational program. To do a thorough job of educating and convincing the work force that TPM is not just another "program of the month," will take time, perhaps six months or more; but during this time period standard preventative maintenance needs to be implemented to bring the plant up to level capable of accepting TPM.

Once the manager is convinced that the work force is sold on the TPM program and that they understand it and its implications, the first teams are formed. These teams are usually made up of people who directly have an impact on the problem being addressed. Operators, maintenance

personnel, shift supervisors, schedulers, and upper management might all be included on a team. Each person becomes a "stakeholder" in the process and is encouraged to do their best to contribute to the success of the team effort. Usually, the TPM manager heads the teams until others become familiar with the process and natural team leaders emerge.

These teams are charged with the responsibility of pinpointing problem areas, outlining a course of corrective action, and initiating the corrective process. Recognizing problems and initiating solutions may not come easily for some team members. They will not have had experiences in other plants where they had opportunities to see how things could be done differently. In well run TPM programs, team members often visit cooperating plants to observe and compare TPM methods, techniques, and to observe work in progress. Benchmarking is one of the greatest tools of the TPM program.

A typical implementation would be to select a machine in a problem area. The machine is studied and evaluated in extreme detail by the team. Production over an extended period of time is used to establish a record of productive time versus nonproductive time. Some team members would possibly visit a different plant which had a similar machine, but which was operating much more efficiently (this might be logistically impossible for ABB Wessel). This visit would give them ideas on how their situation could be improved. A course of action to bring the machine into a "World class" manufacturing condition is designed and work initiated. The work involved might involve taking the machine out of service for cleaning, painting, adjustment, and replacement of worn parts, belts, hoses, etc. As a part of this process, training in operation and maintenance of the machine would be reviewed. A daily check list of maintenance duties to be performed by the operator was developed. A factory representative would also be called in to assist in some phases of the process.

After success has been demonstrated on one machine and records begin to show how much the process has improved production, another machine is selected, then another, until the entire production area had been brought into a "World class" condition and is producing at a significantly higher rate.

Note that in the example above, the operator was required to take an active part in the maintenance of the machine. This is one of the basic tenants of TPM. The old attitude of "I just

operate it!" is no longer acceptable. Routine daily maintenance checks, minor adjustments, lubrication, and minor part change out become the responsibility of the operator. Extensive overhauls and major breakdowns are handled by plant maintenance personnel with the operator assisting. Even if outside maintenance or factory experts have to be called in, the operator must play a significant part in the repair process. Currently there are significant organizational barriers to this approach. Operators are judged on their output, not including down time. This change in approach will better align the maintenance department and the operators to increase overall uptime and production efficiency. Operators, Shop floor management and the maintenance personnel will have to work together to achieve this, and this will require sharing of knowledge and responsibility.

Training for TPM managers is available from several sources. Most of the major professional organizations associated with manufacturing, as well as private consulting and educational groups, have information available on TPM implementation. I found that the Society of Manufacturing Engineers (SME) and Productivity Press are good resources. Both offer tapes, books, and other educational material that explain TPM.

9.2.1.4 Product and Process Engineering

At the time of this research the product and process engineering department was almost non-existence. This is a critical deficiency which was out of the scope of this project, but is extremely important to bring up at this time. The engineering team must be improved dramatically both is skill and numbers. The future success of this business will be riding on the engineering departments ability to engage in solving material usage problems (which currently accounts for over 60% of the companies cost) and working on new and improved processes that will enable the machines (i.e. conductor, sheathing, drum twister etc) to operate at much faster speeds.

The other key component is the need for new product development. Today, new product development is unstructured, undisciplined and at best ad-hoc in its approach. The future health of this business will rely heavily on the engineering department's ability to quickly and correctly develop new and competitive products; no short cuts should be taken in the restructuring and rebuilding this essential group.

9.2 Implementation Approach

Due to the scope and scale of many of these changes and the seriousness of the situation that ABB Wessel is in, I believe the big bang theory of implementation is the best, primarily because of the severe economic condition of the firm. If they in fact spend the last of the companies' savings in 2003, they will need an infusion of working capital, which means going to the commercial lending institutions or corporate headquarters. Either way there will have to be a dramatic plan associated with the proposal, one that has an accelerated performance turn around timeline.

There are many counter arguments against the big bang approach, the main one being the fear of a union strike. I believe this risk is there no matter what approach is taken and if they are going to have to go to the bank to get operating capital anyways, just get enough to whether the storm if the strike does happen. Communication, before and during the reconstruction, with their suppliers and customers is also key and if not done correctly and often will also put the initiative at risk.

Another counter argument is that cultural change takes time to take root and a big bang approach risks doing irreparable damage to the company culture. I fully understand this concern, especially after all the work that has gone on during this internship, and under more normal circumstances I would elect to take the slow approach, but ABB Wessel really will not have that luxury. During the period of this research we made tremendous progress in building a new foundation of teamwork and Lean thinking from which to build off of. But it is time to tear down the old and non-productive parts of the operation so as to continue the rebuilding process.

The first step is to communicate the plan to everyone involved, not necessarily in detailed specifics, but to let the employees know that significant personnel and organizational changes are coming soon and rapidly. The union will need to be briefed and will probably resist, but faced with making these changes or closing the plant they will reluctantly get on board.

The next thing that needs to be done is to get rid of the foot draggers (people who have demonstrated that they either cannot or will not change fast enough) and non-performers in key positions. This is a difficult and a painful task, but it is needed. There will be some people left behind because they are not capable of making the journey. See Figure 9-6 for a new proposed organization chart.

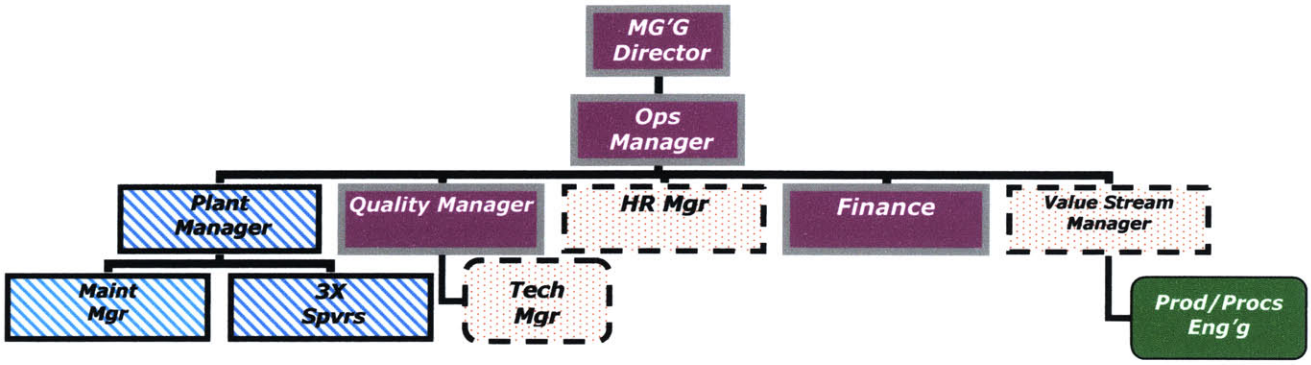


Figure 9-6 Proposed Organization Changes

In the above organization chart the cross-hatched boxes indicate a change in personnel; the dashed boxes are new positions. Another significant revision is the product-process engineering reporting to the Value Stream Manager. This is an attempt to create alignment with the efficient operation of the plant and the need for development of new products and process improvements. Another addition is a Technical Manager reporting to the Quality manager. This position is needed to bring in added skills in SPC, Six Sigma and data and root cause analysis. It is also important to point out that the procurement and order entry functions have been realigned with a separate organization chartered for that purpose only.

Once the leadership team is in place, I suggest shutting down the plant for two to three weeks to make the necessary structural changes, machine removals and relocations. During this period, I would also paint and change the entire appearance of the factory, to give it the feel of being new and starting over. This is a key psychological point. There has to be a definite feeling of leaving the old behind and starting over fresh. I would not underestimate the power of this approach.

The next phase, before beginning operations, would be to fully staff those positions in the factory such as forklifts, mechanics, electricians and inspectors so that the factory can run properly and at full velocity 24 hours a day. Before resuming operations, the crews need to be reshuffled on the shifts and roles and responsibilities. This will involve necessary cross training. As I outlined earlier in this section, the relocation of the conductor lines and addition of a new House Wire line, removal of CV lines and introduction of a new Hot Melt line, shut down of LAN cable production, combined with the new packaging equipment and outsourcing of drum repair should yield at least a 20% reduction in direct touch labor. Those people should not be brought back after the shut down.

Once the factory is back on line it is critical that the new shop floor supervisors begin holding regular crew meetings and the new plant manager and value stream manager have daily production meetings. An electronic time keeping system should be implemented with identification badges, new uniforms should be made available (different color and with ABB on them) and a new set of work rules and expectations should be posted around the factory including the new crew break area on the factory floor.

In parallel to these changes should be the implementation of the SFDCS and TPM. These will take longer to get fully up and running but will result in a much better system of controlling production, which will dramatically reduce WIP and shorten cycle time, enabling the further reductions in raw materials and finished goods inventories.

"To accomplish great things, we must not only act, but also must dream; not only plan, but also believe".

Anatole France

9.3 Issues and Challenges to Implementation

To some this approach might seem ill advised because it is difficult to manage or has high risk, but to those skeptics, I would say the cost to the business of going slow or dragging out the transformation over several years is greater than the big bang approach which implements most components of the change initiative within the first six months and completes within a year. I base this opinion on my experience at ABB Wessel and my assessment of its culture, historical baggage, and working for The Boeing Company for 24 years where I've seen many good ideas run out of steam or fail because resistance was too great. I am concerned that the longer the

initiative takes, the higher the potential that the forces against it will be successful in reducing or eliminating its effectiveness.

The major risk is in keeping production continuity throughout this process. I would recommend that prior to going into the phase of transformation, inventories of fast moving stocks be built up, similar to the preparation for the annual two-week maintenance shut down. Customers and suppliers alike need to be appraised of the plan and of the steps that are being taken to eliminate any delivery interruptions. It needs to be stressed that this realignment of the business is necessary and vital to the companies' long term health. The wild card in this approach is the union reaction; several possible scenarios should be planned for, including a strike. Perhaps it goes without saying here, but a strike should be avoided if possible, without jeopardizing the overall objectives of the transformation. There are a million and one details to be planned for in a transition such as this. This is why I suggest getting the leadership team in place and on board first, because it will take the full contribution of the team to make the transformation successful. The plan needs to be flowed out step by step, possible outcomes and scenarios prepared for, and the critical path identified. In the same way that an architect plans the construction of a building, the team needs to have detail plans and a blueprint from which to work.

9.3 Summary of Recommended Actions

The following table is a summary of the key actions recommended and a brief description of the steps necessary to implement these actions. (See appendix F for Going Forward Schedule)

RECOMMENDED ACTIONS

Build new leadership Team

1) Replace Plant Manager, Shop Floor Supervisors (non union) and Maintenance Mgr.
2) Hire new HR Manager and Quality Technology Manager.
3) Align Product/Process engineering group to report to Value Stream Manager.
4) Develop detailed transformation plans (staffing, equipment, policies, and scenarios)
5) Develop new balanced scorecard (right metrics)
6) Communicate and prepare stakeholders
7) Build needed inventory for shut down

Structural Changes

1) Shut down plant (2-3 wks)
2) Remove and relocate equipment per plan
3) Change factory appearance (paint etc)
4) Out source drum repair
5) Implement self serve break room on shop floor with hard break times.
6) Implement electronic time keeping, Identification badges new uniforms

Operational Changes

1) Communicate policy changes and group work expectations.
2) Make staffing changes with forklifts, maintenance, inspection and reshuffle crews
3) Institute weekly crew meetings and daily production meeting
4) Implement SFDCS
5) Implement PM to transition to TPM
6) Implement employee performance reviews and development plans (training).
7) Continue CIT's in process areas and across product lines.
8) Utilize AIW's and Lean academies to continue Lean culture.
9) Reward top performers, cull out low performers (keep DNA fresh).
10) Benchmark and utilize internal audits to monitor progress

Supply Chain

1) Continue to hold monthly supply chain meetings with all channel partners
2) Continue working toward VMI with Eircom and ESB

SECTION 10: SUMMARY

Leading a cultural transformation and a major performance improvement initiative the size and scope of the ABB Wessel project was an exciting and challenging task. It has in many ways helped to form and shape my views on how to lead and manage. The objective of this Section is to summarize the objectives, accomplishments, conclusions and lessons learned during the 6.5 month internship. To re-cap, the project objectives were clear. The senior management of ABB Wessel, namely the General Manager, Tom Flynn, wanted me to accomplish the following objectives:

- Start the cultural transformation from Hierarchal to Team-based
- Create a customer-focused organization
- Lower the operating costs by eliminating waste within the entire Value Stream
- Create the capacity for new business growth
- Attract Corporate investment
- Help ABB Wessel prove to themselves and others that they could change, improve and become competitive again.

This was a tall order considering the relatively short timeframe of the internship, 6.5 months, but the company was in a desperate position and was going to go out of business if a substantial intervention was not done quickly.

10.1 Accomplishments

During the 6.5 month internship we accomplished literally thousands of tasks that required the combined efforts of all the employees and management at ABB Wessel. A key enabler was the forming and support of the ten CIT's who were trained in Lean and Six Sigma principles, tools and concepts. Through their AIW's and weekly meeting they focused on their individual process areas, organizing, cleaning and removing all forms of waste and worked with other process area CIT's either up stream of down stream to increase efficiency and productivity overall.
The management team began to communicate better through daily production meetings and weekly senior staff meeting, flowing down information to their subordinate managers and direct reports. We also initiated a monthly management benchmarking trips to local companies to help us see other areas and things we could do to improve. A new Value Stream manager position was

created and filled. Began a new collaborative relationship with a local university, to help accelerate the R&D process and create new and improved products to help grow the business.

We developed a new home-grown production control system that we called SFDCS, that will be utilized throughout the factory with wireless PC's. It will have the capabilities to assist in all aspects of production planning, forecasting, production and quality instructions and records and raw material and finished goods inventory control. We introduced a new Overall Equipment Effectiveness metric called OEE, to measure in a holistic way equipment performance.

In addition to cleaning and organizing the factory floor, office and storage yard environment, we made it healthier and safer, by implementing a "No Smoking" policy within the plant; we also established a 100% Ear, Eye and Foot protection requirement within the factory. Many other safety related task were accomplished varying from insulating hot steam pipes to repairing leaks and moving the shop public phone away from a forklift blind spot.

During the course of this project we were also successful in attracting corporate investment. A pilot program to reduce footprint size and introduce automated controls was approved to the tune of 90K Euros on the BM80 line. In addition funding for the SFDCS for 30K Euros was authorized by headquarters.

The efforts in the supply chain were also very fruitful culminating in the all day Supply Chain Workshop with five of ABB Wessel's key customers, some of the highlights of the workshop was the distinguished speakers such as Professor Jonathan Byrnes from MIT and the discussions between Eircom and ABB Wessel about VMI and a renewed future mode of operation between them.

By involving all the employees at ABB Wessel in Lean continuous improvement teams we were able to reduce WIP and Finished good levels down to historic lows, see figure 10-1 for finished inventory levels for 2003. The data clearly shows a dramatic decrease in inventory levels from August to December, which is the period that the continuous improvement teams were up and running and many of the changes described in section 7 were implemented.

Figure 10-1 Inventory Data

At ABB Wessel prior to this research, equipment performance data was not taken in a structured or disciplined fashion. Overall equipment effectiveness (OEE) was introduced by ABB corporate mid way through the internship, as a holistic way to view equipment performance. This metric was already being utilized in some of their European plants with some success, because it was easy to use and understand and it encompasses most of the important performance measure into one single value. The following is an explanation of how OEE is calculated.

OEE = Availability x Performance x Quality
O = Availability = operating time /planned production time
E = Performance = Qty produced / (Ideal rate x operating time)
E = Quality = Qty good products / Total products made

Figure 10-2 below, shows data that was re-created from old production reports that may not be entirely accurate but can serve as an initial indicator of how poorly the plant was performing at the beginning of the project. As you can see, these numbers range from 38%-62%, for the third quarter, World class OEE is 85% - clearly there was room for improvement. The overall equipment effectiveness across all machines on the telecom product line saw substantial

increases in OEE during the active implementation phase of this project, which was Q4 2003. Each of the process Continuous Improvement Team (CIT's) was focused on Lean principles such as 5S, reducing waste in the setup and changeover problems, and implementing new ways to increase product flow with less WIP. This leaves is a huge potential to increase OEE further by implementing a preventative maintenance program and group work and setup processing. The Drum Twister especially will benefit from group setups, which can reduce changeovers from an average of 60 minutes to 15 minutes.

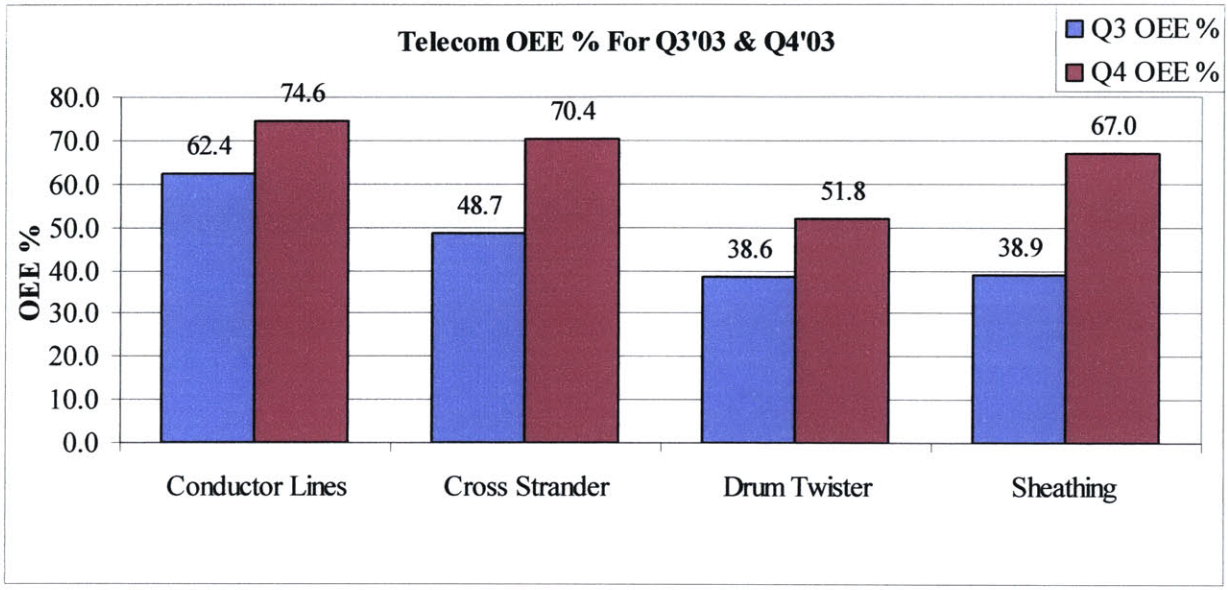


Figure 10-2 OEE Data Q3/Q4 2003

10.2 Lessons Learned and Personal Reflections

The key learning was that all change roads lead back to people. I found that we can not make an effective transition of any magnitude unless the key people involved in the project embrace the new processes, as well as have the skills to capitalize on them and the leadership ability to motivate others to use the new ways to the best of their abilities. No matter how process-oriented a change might be people always have to implement it. To help our people increase their change capacity and develop the skills, behaviors and attitudes we need to demonstrate that senior management is serious. While you can and should communicate the seriousness by words, you also must demonstrate it by your actions. Most people will not make a commitment

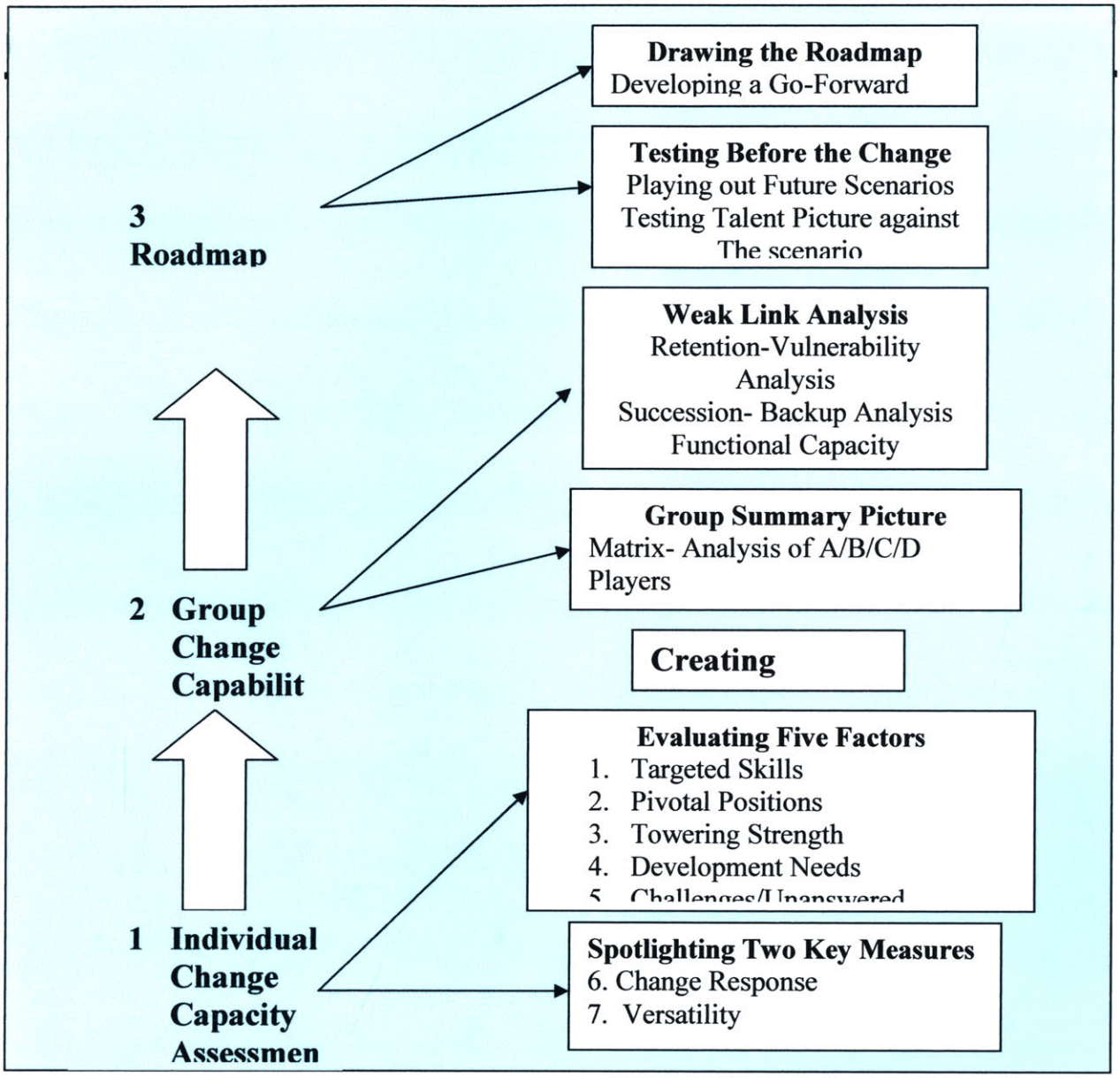
to changes that you require unless they are convinced that there's a compelling reason to make the commitment. In your organization you must create the energy and the sense that old rules no longer apply.

At the beginning of the project I made the very naïve assumption that all of the management team would get on board and be supportive and become leaders of the change process. This did not happen, there were several key members of the management team who just could not cope with the speed or the scope of the changes needed. Hind-sight being 20/20, I should have expected some problems with some of this group after realizing the depth of the problems and the apparent lack of trying to keep up with modern practices in several of the company's departments. Several times in my research this problem of not adequately engaging middle managers and first line managers has come up. It seems to stem from the fact that a lot of attention is given to upper management and the workforce and the line managers feel squeezed, because they still need to reach the same production quotas, even when their people are in training or on a team trying to resolve problems. Middle managers often times feel that they have very little to gain because the safety stock is reduced and parts shortages occur and everyone promises that later they will see the benefits.

A lesson learned from this experience with was that if you are going to lead a change, in a team, an organization or in a whole company you really need to conduct an assessment of their capacity or fitness for change before hand. Most organizations and companies usually have a mixture of people, some that embrace change and doing things in a new and better way, some that are just good utility players and will go whichever way the wind blows - to them it is just a job anyways and it does not really matter what they are doing as long as they get a paycheck. There are foot draggers who resist just enough to slow the whole process down to their liking. Then there are the people who just will not change period. The change capacity of the people who are going to be involved is critical, and is of course a very subjective analysis. But I believe it should be done and if there are foot draggers or people who resist change in key positions that are critical to the change initiative they should be replaced before the initiative is started. Unfortunately I did not conduct a change capacity assessment prior to beginning my project and I wish I had.

This idea of conducting a change capacity assessment, reminded me of when I was a Scout Master for my son's Boy Scout troop back in Wichita Kansas. Every month during the year we would go camping, 40-50 boys ages 11-18 and a handful of adults, usually at local campgrounds or on farms or ranches near by. It was basically car camping and everyone could come regardless of age and experience level. In addition to this activity, every summer we would go on a real adventure (50 mile hike or 100 mile canoe trip with 10-12 individuals) into the wilderness for two weeks. The preparation for a trek such as this was much more serious and it was my duty to assess each boy's physical and mental stamina, skills and abilities, maturity and attitude before he could go, because once we were on our way and in the wilderness, there was no turning back and we all had to rely on each other. Consequently during the months leading up to the adventure, we would have training exercises and develop our skills, endurance and mental toughness, so as to make the challenge a rewarding and successful experience for all. Embarking on a large change initiative such as the one at ABB Wessel without conducting a change capacity assessment and providing change exercises to build up the people change muscles prior to the big event is no different than taking a bunch of green, out-of-shape scouts into the wilderness without adequately assessing their capabilities first. I have come to the conclusion that in this day and age a person's change capacity needs to be high no matter what the occupation and it is the responsibility of the senior management to ensure that they and their staff are up to the challenges of the modern business world. If they cannot keep up and do not have the change capacity needed, they should be replaced for the good of the company. This is especially critical the leaner an organization is, because there just aren't extra people to pick up the slack and the organization as a whole can only progress as fast as its slowest member. Managers need to make sure that their people do not fall into these modes of incapacity and give them frequent change experiences, whether it is something as simple as moving people around the office or having a rotation system where the staff changes roles routinely. A change capacity assessment is probably always going to be a subjective analysis, but fortunately there has been some work in this area by Charles H. Bishop in his book "Making Change Happen One Person at a Time" He has useful profiling techniques and formats to help do this critical job, fairly and consistently. His six step process is simple but thorough. (See figure 10-3) I would note that my

experience suggests that this process does not adequately consider external factors such as culture and the business environment.



10-3 Bishop's Overall Change Assessment Process

10.2.1 Leadership Practices and Principles

There are literally hundreds of excellent leadership techniques and models that people might choose to follow. But because each person has different strengths and weaknesses and leadership style, the approach really needs to vary with the situation you are faced with. The

trick is to know which one to use and when. The experience of leading a change initiative of this size and scope at ABB Wessel was challenging at times and helped me consolidate a set of leadership principles and practices that I will continue to build upon in future endeavors. I have outlined these personal leadership practices and principles below:

1) **Establish credibility and trust quickly:** This can be done through clear concise statements of your experience, your skills, knowledge, and, most importantly, your demeanor. Confidence in yourself and maintaining absolute integrity and loyalty are essential. Complete a quick win early, preferably move a monument or change something symbolic to the culture. Always be yourself and practice what you preach, even when no one is looking. People must believe and trust you, and the only way that will happen is if you prove to them you're trustworthy.

2) **Jump in and take charge:** Nature hates a vacuum and so should a leader, if there is a need, fill it, you cannot lead from the outside or by never getting your hands dirty. I am frequently reminded of Prof Shoji Shiba's Fish Bowl leadership principle, do not be afraid to jump into the fish bowl and see things from the fish's perspective, then be capable of unlearning your past experience, preconceptions, assumptions and cultural constraints before analyzing the situation. In addition to this skill you must be aware that your authority will be challenged or tested, this usually will happen very soon after you take charge. You must deal with it swiftly, thoughtfully and publicly if the challenge was made publicly. When this happens you will not usually have time to go to your office and think about how to respond, so you need to be prepared beforehand. My test came the first day of Lean training, about 15 minutes into the class I had an individual who wouldn't participate in our first team exercise because he thought it was childish. I could not let this behavior be seen by the rest of the group as acceptable, so I threw him out of the meeting and told him he could come back next week if he had his attitude right. It turns out this individual was something of a ring leader and by me not backing down, the rest of the group fell in line and participated in the training exercises without incident. As a side note this particular individual came to the next meeting one week later and we all had a big laugh about it.

3) Communicate the mission clearly: The mantra of "keep it simple stupid" (KISS) is still the best, whether you're the president of the United States or an LFM intern. At ABB Wessel the mission was "We're going to save the company, period!" Communicating a mission clearly is just the first step in painting a picture in each person's mind of what you see the vision of the future is, and you, as the leader, are the artist. So, even though the communication is keep at a simple level, you must have thought through the plan and stay a step or two ahead to lead the way. In addition, you can not just dogmatically espouse god and motherhood mission statements without putting some teeth and passion behind them.

4) Build a team: The bigger the better, but you must recruit key individuals to be change leaders with you, people with high energy levels and great attitudes, they do not have to be the smartest, just well respected. Think of yourself as the coach of a baseball team and you need players for each position. What you are trying to do is to create a critical mass of people who will embrace the change, push for the change and work well together. This is an area that I had a limited amount of success in at ABB Wessel, because most of the people there were just not capable of taking on new and expanded roles and responsibilities, so I needed to find help outside the company. I will discuss this issue more in depth in Section 6.

5) Watch out for quicksand: Do not get caught up in the reporting and statusing merry-go-round. Yes, you should, from time to time, make presentations, PowerPoint is still useful, but more important is daily (face to face) reporting directly to the change champion. This of course can be difficult with senior executives who travel a great deal. But fortunately with E-mail and cell phones it is doable. My supervisor at ABB Wessel was excellent about providing me access to him; we would sometimes meet and discuss the progress of the initiative two or three times a day. A side benefit was that we became good friends and learned a great deal from each other along the way, these kinds of relationships can be very useful many years later as roles and assignments change.

6) Change the Rules: If you do not change the rules you'll just keep getting what you always got and that was what led to the problem in the first place. The key to changing

the rules is often "just do it and ask for forgiveness later". Of course you have to be selective with this course of action, because you do not want to be branded a renegade, and have the less bold managers that have been in your camp jump ship, but when you can not seem to get help removing a roadblock, sometimes it requires changing the rules.

7) Action-Action-Action: Do not get caught up in the let's study the problem until its dead mode or analysis paralysis. I'm a firm believer in the 80/20 rule, you'll never have all the data or questions answered, use your judgment and trust your instincts to keep the initiative rolling. As Colin Powell once said "Procrastination in the name of reducing risk actually increases risk". I would add to that, procrastination or prolonged indecision on your part will cause you to lose the respect of your team and your superiors'. During the ABB Wessel project, action was a key strategy as it was essential to keep the ball rolling before the opposition could build roadblocks and slow it down.

8) Keep your eyes on the goal: When you have your eyes on the goal, you can be more flexible and consistent in the implementation phase. You can not predict all the possible scenarios or outcomes, but you can keep the ship headed on the right course. I have found this especially useful when leading engineers. Engineers for the most part are really more excited about solving a particular problem than they are about what the overall goal of the project is. So you must be careful in how you frame the problem and put boundaries on the solution, if all you want is a quick ballpark solution make sure that is what they are working on. At ABB Wessel, I also found this simple rule useful while leading the manufacturing folks. Often they would become so focused on their process and optimizing it that they couldn't see its potentially negative effect on downstream users. The leader must keep his or her eyes on the goal.

9) Take care of the troops: Never ask them to make sacrifices or to do something that you yourself are not prepared to do. If you ask someone to come in early or stay late or work the weekend, you need to be there too. If you ask your people to take a cut in pay or benefits you need to be willing to do the same. As Don Davis, retired CEO of Stanley Tools, once told our LFM class "Selfship is the enemy of Leadership" you must think of your people first and yourself last. Always be fair, respectful and empathize with them

as they are going through the change process. Try to lessen the shock of change by giving them plenty of information. Let them know what the changes will be and who will be affected and how. Give them your best estimate of the timeframe, remembering that these things always take a little longer than originally planned. You must give them some time to prepare and let the changes sink in. Many leaders try to distance themselves from this aspect of leadership, because it is difficult and the better you know your people the harder it is to remain objective when making tough decisions. One of the clear lessons that I learned from this experience is that "every problem is ultimately a people problem".

10) Be Optimistic: Optimism and attitude are contagious. It is the leader that sets the tone and he or she must be sure that optimism not pessimism permeates the fabric and the soul of the organization. Whether you realize it or not your subordinates take their cues from you. There are times when the group will need to feed off of your energy and positive attitude; I found this very much to be true while at ABB Wessel. It was sometimes an emotional drain, but it is the job of a leader, you must prepare yourself. Sometimes you have to put aside your own doubts, disappointments and concerns and remain steadfast, optimistic and strong.

11) Reflect: Take the time each day to reflect on what you have and have not accomplished, the challenges you may have encountered, and reflect on how you personally could have been a better leader. I am a list person, and I usually do this reflection with my list of things to do in hand. I practiced it daily while on this assignment at ABB Wessel. Sometimes I would find myself making a note to go talk to someone about a misunderstanding, or upon reflection, I felt I needed to apologize for something I did or said. This technique has a very powerful humbling ability, if you're like me, you usually feel like you could have done something better than you did.

As I said at the beginning these are some of the significant leadership principles and practices that I had gleaned from LFM and this internship experience. It is a snapshot in time because leadership is not a philosophy or science; it is a way of life and by its own nature changes and evolves daily. It is my hope that by writing down these lessons, that it will in some small way

contribute to the body of knowledge on this subject and be helpful to others who might find a similar circumstance in the future.

10.3 Conclusions

Many managers have utilized Value Stream techniques (Lean, Six Sigma) they are very powerful. However, I found during this project that there is an equally important component in change management involving the people and culture that in fact really determines whether those Value Stream techniques yield great results or merely interesting information and mediocre improvements. The literature on Value Stream Management is rich with material on the techniques, tools and processes, but it has been my experience on this project that it is the people /change management perspective that is critical. The key success factors are: 1) How well a change agent prepares and motivates the people involved. He/she must get them on board and contributing early to the transformation. 2) The roles in the change process are very important, and do you, the change agent, have the right kind of people to fill them as the organization changes. 3) The environment for change must exist or be created; it must be conducive to the implementation of Lean processes and teamwork. My contribution is in helping to better understand these factors with a set of findings rooted in my practical field research and management experience. Managing the Value Stream can undoubtedly be a primary source of competitive advantage in today's ever changing global environment. A Value Stream manager must know as much about leadership, process mapping and Lean philosophy as they do about people and relationships. It is all about people and organizing them to create value, unlocking dormant value and delivering it to your customer.

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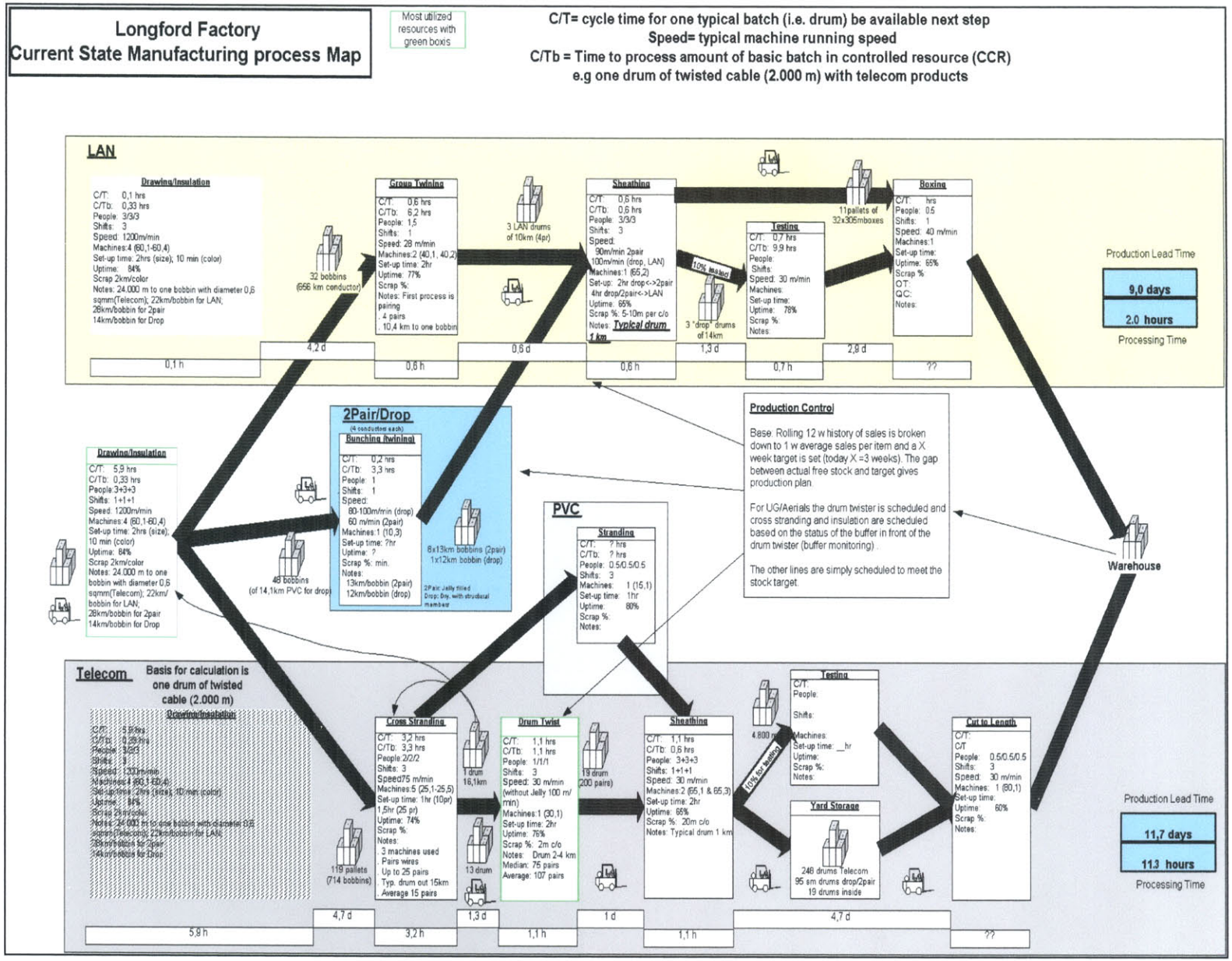

Longford Factory
Current State Manufacturing process Map
Most utilized resources with green boxis
C/T= cycle time for one typical batch (i.e. drum) be available next step
Speed= typical machine running speed
C/Tb = Time to process amount of basic batch in controlled resource (CCR)
e.g one drum of twisted cable (2.000 m) with telecom products
LAN
Drawing/Insulation
C/T: 0,1 hrs
C/Tb: 0,33 hrs
People: 3/3/3
Shifts: 3
Speed: 1200m/min
Machines:4 (60,1-60,4)
Set-up time: 2hrs (size); 10 min (color)
Uptime: 84%
Scrap 2km/color
Notes: 24.000 m to one bobbin with diameter 0,6 sqmm(Telecom); 22km/bobbin for LAN;
28km/bobbin for 2pair
14km/bobbin for Drop
32 bobbins (656 km conductor)
4,2 d
0,1 h
Group Twining
C/T: 0,6 hrs
C/Tb: 6,2 hrs
People: 1,5
Shifts: 1
Speed: 28 m/min
Machines:2 (40,1, 40,2)
Set-up time: 2hr
Uptime: 77%
Scrap %:
Notes: First process is pairing
. 4 pairs
. 10,4 km to one bobbin
0,6 h
3 LAN drums of 10km (4pr)
0,6 d
Sheathing
C/T: 0,6 hrs
C/Tb: 0,6 hrs
People: 3/3/3
Shifts: 3
Speed:
90m/min 2pair
100m/min (drop, LAN)
Machines:1 (65,2)
Set-up: 2hr drop<->2pair
4hr drop/2pair<->LAN
Uptime: 65%
Scrap %: 5-10m per c/o
Notes: Typical drum 1 km
0,6 h
10% wasted
3 "drop" drums of 14km
1,3 d
Testing
C/T: 0,7 hrs
C/Tb: 9,9 hrs
People:
Shifts:
Speed: 30 m/min
Machines:
Set-up time:
Uptime: 78%
Scrap %:
Notes:
0,7 h
11 pallets of 32x30Sinboxes
2,9 d
Boxing
C/T: hrs
People: 0,5
Shifts: 1
Speed: 40 m/min
Machines:1
Set-up time:
Uptime: 65%
Scrap %
OT:
QC:
Notes:
??
Production Lead Time
9,0 days
2.0 hours
Processing Time
2Pair/Drop
(4 conductors each)
Bunching /twining
C/T: 0,2 hrs
C/Tb: 3,3 hrs
People: 1
Shifts: 1
Speed:
80-100m/min (drop)
60 m/min (2pair)
Machines:1 (10,3)
Set-up time: ?hr
Uptime: ?
Scrap %: min.
Notes:
13km/bobbin (2pair)
12km/bobbin (drop)
8x13km bobbins (2pair)
1x12km bobbin (drop)
2Pair: Jelly filled
Drop: Dry, with structural member
Drawing/Insulation
C/T: 5,9 hrs
C/Tb: 0,33 hrs
People:3+3+3
Shifts: 1+1+1
Speed: 1200m/min
Machines:4 (60,1-60,4)
Set-up time: 2hrs (size); 10 min (color)
Uptime: 84%
Scrap 2km/color
Notes: 24.000 m to one bobbin with diameter 0,6 sqmm(Telecom); 22km/bobbin for LAN;
28km/bobbin for 2pair
14km/bobbin for Drop
46 bobbins (of 14,1km PVC for drop)
PVC
Stranding
C/T: ? hrs
C/Tb: ? hrs
People: 0.5/0.5/0.5
Shifts: 3
Machines: 1 (15,1)
Set-up time: 1hr
Uptime: 80%
Scrap %:
Notes:
Production Control
Base: Rolling 12 w history of sales is broken down to 1 w average sales per item and a X week target is set (today X =3 weeks). The gap between actual free stock and target gives production plan.
For UG/Aerials the drum twister is scheduled and cross stranding and insulation are scheduled based on the status of the buffer in front of the drum twister (buffer monitoring).
The other lines are simply scheduled to meet the stock target.
Warehouse
Telecom
Basis for calculation is one drum of twisted cable (2.000 m)
Drawing/Insulation
C/T: 5,9 hrs
C/Tb: 0,29 hrs
People: 3/3/3
Shifts: 3
Speed: 1200m/min
Machines:4 (60,1-60,4)
Set-up time: 2hrs (size); 10 min (color)
Uptime: 84%
Scrap 2km/color
Notes: 24.000 m to one bobbin with diameter 0,6 sqmm(Telecom); 22km/bobbin for LAN;
28km/bobbin for 2pair
14km/bobbin for Drop
119 pallets (714 bobbins)
4,7 d
5,9 h
Cross Stranding
C/T: 3,2 hrs
C/Tb: 3,3 hrs
People:2/2/2
Shifts: 3
Speed75 m/min
Machines:5 (25,1-25,5)
Set-up time: 1hr (10pr)
1,5hr (25 pr)
Uptime: 74%
Scrap %:
Notes:
. 3 machines used
. Pairs wires
. Up to 25 pairs
. Typ. drum out 15km
. Average 15 pairs
1 drum 16,1km
13 drum
1,3 d
3,2 h
Drum Twist
C/T: 1,1 hrs
C/Tb: 1,1 hrs
People: 1/1/1
Shifts: 3
Speed: 30 m/min (without Jelly 100 m/min)
Machines:1 (30,1)
Set-up time: 2hr
Uptime: 76%
Scrap %: 2m c/o
Notes: Drum 2-4 km
Median: 75 pairs
Average: 107 pairs
19 drum (200 pairs)
1 d
1,1 h
Sheathing
C/T: 1,1 hrs
C/Tb: 0,6 hrs
People: 3+3+3
Shifts: 1+1+1
Speed: 30 m/min
Machines:2 (65,1 & 65,3)
Set-up time: 2hr
Uptime: 65%
Scrap %: 20m c/o
Notes: Typical drum 1 km
1,1 h
4.800 m
10% for testing
Testing
C/T:
People:
Shifts:
Machines:
Set-up time: __hr
Uptime:
Scrap %:
Notes:
Yard Storage
248 drums Telecom
95 sm drums drop/2pair
19 drums inside
4,7 d
Cut to Length
C/T:
C/T
People: 0.5/0.5/0.5
Shifts: 3
Speed: 30 m/min
Machines: 1 (60,1)
Set-up time:
Uptime: 60%
Scrap %:
Notes:
??
Production Lead Time
11,7 days
11.3 hours
Processing Time

APPENDIX B: THE BASICS OF LEAN

The following presentation is a combination of concepts and materials taken from Lean materials at MIT, Boeing and ABB CRC.

Basics of Lean Manufacturing

Lean Production Principles

- Agenda
  - Basics of "Lean" manufacturing
  - Seven forms of Waste
  - 5S
  - Visual Management Techniques
  - Application Stages
  - Q & A

1

Basics of Lean Manufacturing

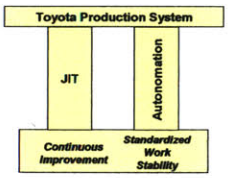
Basics of Lean

2

Basics of Lean Manufacturing

TPS and Lean Manufacturing

- The Toyota Production System (TPS) is the basis for what is called "Lean Manufacturing"



3

Basics of Lean Manufacturing

Just in Time (JIT)

- Just-In-Time Production (Continuous Flow Production)
  - Provide every customer with the highest quality product while meeting highly specific order and delivery requirements
    - *Only* units ordered
    - *Just when* they are needed
    - *Exact amount* needed
  - Applicable to Finished Goods, internal customer, and next user
  - Ideal state is ***one-piece flow*** - the ability to replenish a single part that has been pulled by the customer
  - Tools such as Value Stream Mapping, Takt Time, Standardize Work, and pull systems must be present

4

Basics of Lean Manufacturing

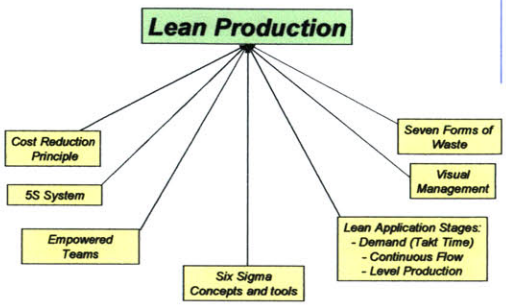
Autonomation

- Autonomation
  - Automation with a "human touch"
  - Practical use of automation to mistake-proof detection of defects
  - Goal is zero defects and flow promotion

5

Basics of Lean Manufacturing

Lean Production Principles

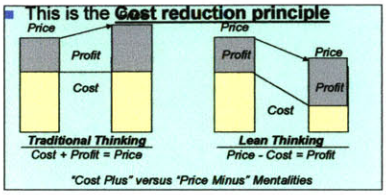


6

Basics of Lean Manufacturing

The Cost reduction principle

- Today's market is global and very competitive
  - Especially in the mature Cable industry!
- Customers increasingly ask for reduced prices!
- The only way to profit is to continuously eliminate waste in value stream
- This is the Cost reduction principle



7

Basics of Lean Manufacturing

The Seven Forms of Waste

8

Basics of Lean Manufacturing

Elimination of Waste

- Types of Waste - Waste can be grouped into seven major categories described below:
  1. Overproduction
  2. Waiting
  3. Transportation
  4. Motion
  5. Production Defects
  6. Inventory
  7. Over-Processing

9

Basics of Lean Manufacturing

Overproduction

- Considered the most significant source of waste
- It means producing more, sooner or faster than required
- Source of the following cost items:
  - Excess inventory
  - Money tied up in inventory
  - Effort to store batches
  - Storage space
  - Equipment & people to handle, sort
  - Material shortages
  - Capacity limitation (labour & equipment)
  - Increases lead-time

10

Basics of Lean Manufacturing

Waiting

- Idle time between operations or during and operation
- Typical root causes are:
  - Missing material
  - Unbalanced line
  - Scheduling mistake

11

Basics of Lean Manufacturing

Transportation

- Transportation waste is moving material more than necessary
- Typical root cause is:
  - Poor lay-out
  - Poor Sequencing of tasks

12

Basics of Lean Manufacturing

Motion

- Motion waste is any motion not necessary to the successful completion of an operation
- Some common forms of this waste are:
  - Back-and-forth movement in a workstation
  - Searching for parts
  - Searching for tools
  - Changes in the position of worker

13

Basics of Lean Manufacturing

Production of Defects

- This entails producing defective goods or mishandling material
- Some common forms of this waste are:
  - Rework of parts not made correctly in the first place
  - Productivity loss due to need of capacity to manage re-flow

14

Basics of Lean Manufacturing

Inventory

- Inventory waste is excess stock in the form of:
  - Raw materials
    - Examples: Extra length of Aluminium foil on roll
  - Work-in-process (WIP)
    - Examples: Bobbins at Conductor line, Buffer stock at Drum Twister
  - Finished goods
    - Examples: 4 weeks of stock for Eircom

15

Basics of Lean Manufacturing

Over-Processing

- Over-processing means doing more than necessary as defined by the customer or specification.
- Most difficult to identify and eliminate
  - Examples: In process testing, thicker than needed insulation on cables.

16

Basics of Lean Manufacturing

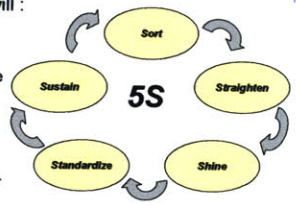
The Five S's

17

Basics of Lean Manufacturing

What is 5S?

- Designed for organization and standardization of any workplace, including offices
- **It is a pre-requisite to any improvement method**
- Implementation of 5S will :
  - Teach everyone the basics of improvement
  - Provides a starting place for eliminating waste
  - Remove obstacles to improvement with little cost
  - Give people control over their workplace



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Basics of Lean Manufacturing

5S Activities

- ***Sort*** - sorting through the contents of an area and removing unnecessary items
- ***Straighten*** (Set in order) - straighten necessary items for easy and efficient access - and keep them that way!
- ***Shine*** (Sweep) - cleaning everything, keeping it clean, and maintain area and equipment as it should be
- ***Standardize*** - create guidelines for keeping the area organized, orderly, and clean; making the stds obvious
- ***Sustain*** - educate and communicate to make sure everyone follows and maintains 5S standards

19

Basics of Lean Manufacturing

Clutter and extra equipment removed

- Before

- After

20

Basics of Lean Manufacturing

Not used machine removed from workarea

- Before

- After

21

Basics of Lean Manufacturing

5S Additional benefits

- 5S will have positive impact on performance
- Reflected in metrics such as:
  - Reduced Lead times and cycle time
  - Quicker "Change-Overs"
  - Reduced accidents
  - Reduced absenteeism
  - More involvement by workforce

22

Basics of Lean Manufacturing

Visual Management Techniques

23

Basics of Lean Manufacturing

Visual Management:

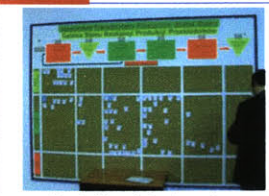
- The goal of visual factory is to give people control over their workplace
- Visual factory supports team empowerment
  - promotes self-management
  - Reduces dependability on supervisor's orders
  - Reduces feeling of subordination to supervisors
- A visual factory positively impacts **all** visitors
  - Customers understand the work the supplier does
  - Division Managers enjoy visiting and talking about VFs

"A Picture is worth a 1000 words"

24

Basics of Lean Manufacturing

Visual boards simplify the understanding of situation



- Production status board visualizes the actual situation

- Production schedules give visability

25

Basics of Lean Manufacturing

Floor markings can be used in Visual Factories

Yellow is the colour that defines Production Line 2 at ABB SACE - Cabinet Manufacturing in Lodi, IT

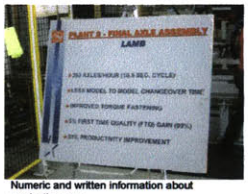
Yellow Kanban cards and a yellow solid line defines inventory areas

Yellow lines define WIP cart area and working area

26

Basics of Lean Manufacturing

Sample "Info Boards" in Visual Factories



Numeric and written information about production area

Graphic information about production area

- **Information boards help in presenting the factory to customers and visiting management.**
- **Info boards provide clear explanation of production area. They serves as evidence of understanding and care about the production processes in the factory.**

27

Basics of Lean Manufacturing

Lean Manufacturing Tools

Application stages

28

Basics of Lean Manufacturing

Demand, Flow and Level to a Lean System

- It's helpful to group lean concepts into three stages
  - ***Customer Demand Stage*** - understanding the customer demand for your products, including quality characteristics, lead time and price
  - ***Flow/Pull Stage*** - implementing continuous flow manufacturing throughout your plant so internal & external customers receive the right product, at the right time and in the right quantity
  - ***Leveling*** - distributing work evenly, by volume and variety, to reduce inventory and WIP and to allow small orders by customer

Demand → *Flow/Pull* → *Leveling* → Lean System

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Basics of Lean Manufacturing

Understanding customer ordering patterns

- First and primary concept in lean is to determine what must be produced every day
- Should be based it on previous actual production, long term agreements, sales forecasts, interviews with customers
  - At Wessel-Longford we use an average of the previous 24 months orders (will be trying out other methods in the future)
- Takt Time= $\frac{\textit{Available Production Time}}{\textit{Total Quantity Required}}$
- Production is to be driven accordingly
  - Every X seconds/minutes/days, a product must be delivered!

30

Basics of Lean Manufacturing

Establishing work flow

- An upstream operation should never makes more than it is required by the downstream operation
- Tools and concepts necessary are:
  - Accurate production scheduling
  - Continuous flow
  - Standardized work
  - Line balancing
  - Quick changeovers
  - Autonomous maintenance

31

Basics of Lean Manufacturing

Activities to Develop a Lean Production area

- Continuous Flow / Lay-out → **Process Speed**
- Order-visualisation → **Order Speed**
- 5S Organisation → **Productivity**
- Visual Factory → **Control**

32

Basics of Lean Manufacturing

Discussion

Q & A

33

APPENDIX C: THE BASICS OF SIX SIGMA

Basics of Six Sigma

Six Sigma Concepts and Tools Training

- Agenda
  - What is Six Sigma?
  - Elements of Six Sigma
  - Key Concepts
  - The Six Sigma Process DMAIC
  - Six Sigma Tools
  - Q & A

1

Basics of Six Sigma

Basics of Six Sigma

2

Basics of Six Sigma

What is Six Sigma?

- Six Sigma is a highly disciplined process that helps us focus on developing and delivering near-perfect products and services.
- Why is it called Six Sigma?

  It is a reference to a statistical term that measures how far a given process deviates from perfection.
- The Central concept is that you can measure how many "defects" you have in a process and systematically figure out how to eliminate them.

3

Basics of Six Sigma

Think of it this way!

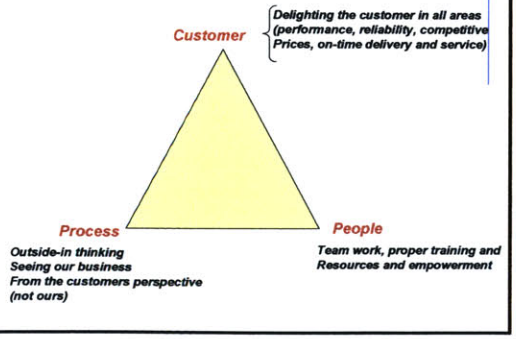
The Classical view of quality 99% good (3.8 σ)	The Six Sigma view of quality 99.99966% good (6 σ)
• 20,000 lost articles of mail per hour	• 7 articles of lost mail per hour
• Unsafe drinking water 15 min of every day	• 1 minute of unsafe drinking water every 7 months
• 5,000 incorrect surgical operations per week	• 1.7 incorrect surgical operations per week
• 2 short or long landings at most major airports every day	• 1 short or long landings at most major airports every 5 years

Six Sigma equates to 3.4 defects per million opportunities

4

Basics of Six Sigma

The three main elements of 6σ



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Basics of Six Sigma

Key Concepts of Six Sigma

- Critical to Quality (CTQ): Attributes most important to the customer.
- Defect: Failing to deliver what the customer wants
- Process capability: Understanding what your process can deliver
- Variation: What the customer sees and feels
- Stable Operations: Ensuring consistent, predictable processes to improve what the customer sees and feels
- Design for Six Sigma: Designing to meet customer needs and process capabilities.

6

Basics of Six Sigma

The Six Sigma Process DMAIC

- **Define**
  - Establish team and what process we are going to work on
  - Identify Sponsor and team resources
- **Measure**
  - Gather data to establish the "current state" what is actually going on in the workplace with the process as it works today
- **Analyze**
  - Determine process capability and speed
  - Determine the sources of variation and time bottlenecks (cause and effect relationships)
- **Improve**
  - Generate ideas for improvement
  - Conduct experiments
  - Develop action plans and implement
- **Control**
  - Develop a control plan and monitor performance
  - Mistake proof the process

7

Basics of Six Sigma

The Six Sigma Process DMAIC cont.

- Tollgate Reviews between each major phase of the process. This is where we will check to make sure the project is linked back to the original corporate / BU goals.
- The appropriate managers, project champions and other stakeholders will have a chance to listen to the team present its work and ask questions to make sure they are staying focused on the company's priorities.

8

Basics of Six Sigma

The Six Sigma Tools

- **Define Stage**
  - Project definition Form PDF (problem statement, scope, assumptions, resources and schedules)
  - SIPOC process diagram (Suppliers, Inputs, Process, Outputs and Customers)
    - Also helps identify the CTQ attributes
- **Measure Stage**
  - Describing a process and its characteristics
    - Process mapping (flow charts)
    - Lead time /cycle efficiency
  - Focusing and Prioritizing
    - Pareto charts
    - Cause-and-effect matrix
    - Failure modes and effects analysis (FMEA)

9

Basics of Six Sigma

The Six Sigma Tools

- **Measure Stage cont.**
  - Generating and organizing ideas
    - Brainstorming / Multivoting
    - Cause and effect diagrams (fishbones)
  - Collecting data and ensuring accuracy
    - Checksheets
    - Gage R&R (how reliable is the measurement system)
  - Understanding and elimination variation
    - Run charts
    - Process capability
    - Design of Experiments (DOE)
    - Histogram

10

Basics of Six Sigma

The Six Sigma Tools

- **Analyze Stage**
  - Causal Analysis
    - Scatter plots (relationships between two sets of data)
    - ANOVA (analysis of variance) and helps us see which factors or input variables affect our output
    - Regression analysis (mathematical model that quantifies the relationships)
- **Control Stage**
  - Control charts (UCL, LCL mean)
  - Instituting procedures for immediate detection and correction of future problems
    - Prevention measures
    - Remedial action (training, clearer instructions)
  - Continuous improvement team meetings

11

Basics of Six Sigma

Discussion

Q & A

12

APPENDIX D: SAMPLE CIT ACCOMPLISHMENT PRESENTATION

ABB

Telephone and LAN Cable Production

Wessel

Step #2: Cross-Strander Line

- Production of twisted pair sub-assemblies for the telephone cables.
- Operations Include
  - Twisting pairs
  - Stranding
  - Binding (tapes)
  - Jelly Filling
  - Winding
- Work team has 2 people per shift
- Throughput time ranges from x-xx min per drum (x-xx Km)
- Average Processing xx-xx drums per day per machine

1

ABB

Cross-Strander Line Floor Plan

Wessel

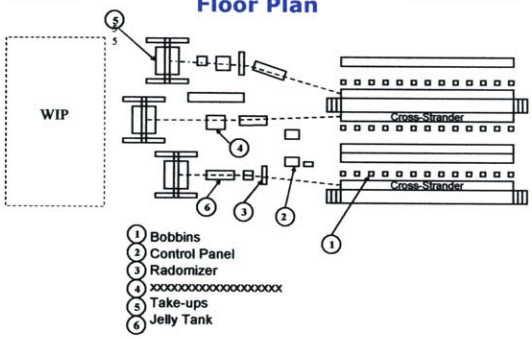

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ABB

Cross-Strander Line Team

Wessel

- Team Objective:
  - Improve efficiency, have less down time and be more productive
  - Have a cleaner, safer,and more organized work area
  - Improve quality and record keeping
- Team Members:

Mickey Duffy	Robin Lane	John Masterson
Charlie Twaddle	Christy Devlin	Pauric McGeeney
Sean Kenny	Bernard Bird	Brian Rawlings

3

ABB

Cross-Strander Line Team AIW

Wessel

4

ABB

Cross-Strander Line Team

Wessel

Improvement Activities

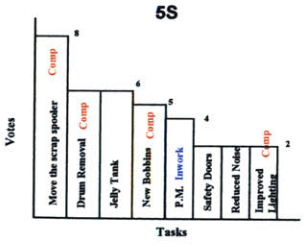

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ABB

Cross-Strander Line Team

Wessel

Improvement Activities

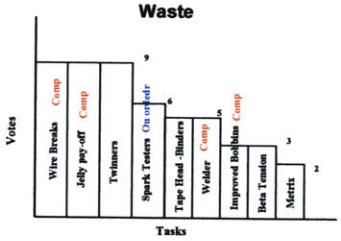

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ABB

Cross-Strander Line Team Metrics

Wessel

- Cost: Targets
  - WIP xx Drums/day
  - Scrap xx lbs/wk
  - Dwn Time: xx hrs/wk
- Quality: Target- Zero Defects passed on to Drum Twister
- Delivery: Target- 100% on time delivery of needed drums to Drum Twister buffer stock
- Safety: Target- 100% Eye and Ear protection
  Zero Accidents

7

ABB

Cross-Strander Line Before Photos

Wessel

8

ABB

Cross-Strander Line After Photos

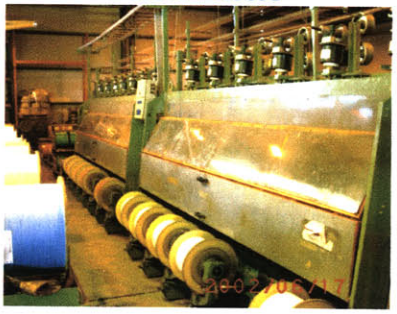
Wessel

9

ABB

Cross-Strander Line Before Photos

Wessel



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APPENDIX E: PROF. BYRNES SUPPLY CHAIN WORKSHOP PRESENTATION

What's Next:

Supply Chain Management in an Era of Precision Markets

Jonathan L.S. Byrnes
MIT
jlbyrnes@mit.edu

November 11, 2003

WESSEL ABB

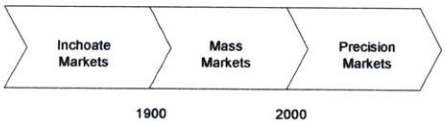
1

Today's Menu

- The Third Era
- Supply Chain Structure
- Service Differentiation
- Product Flow Management
- Third-Era Supply Chain Management

2

Three Eras of Markets



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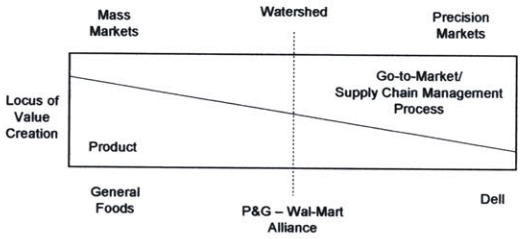
Shifting Locus of Value Creation



4

New Era, New Imperatives

Mass Markets	Precision Markets
Stable, Homogeneous Markets	Dynamic, Heterogeneous Markets
Product Driven	Account Driven
Product Innovation Crucial	Supply Chain Innovation Crucial
Production Power	Distribution Power
Functional Separateness (annual alignment)	Functional Integration (frequent alignment)
Broad-Market Targeting	Precision Targeting
"Average" Approach	"Differentiated" Approach
Standardized, Powerful, Broad	Focused, Aligned, Flexible

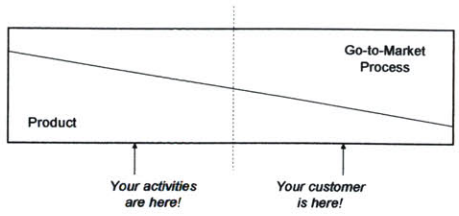
5

Drivers of Change

- Mature, Sophisticated Buyers Exerting Pressure to Increase their Profitability
- Increased Competition Filling the Ecological Niches
- Sophisticated IT Both Inside and Between Channel Partners
- Sophisticated Supply Chain Management Capabilities Throughout the Channel
- Strong Offshore Competitors

6

Where Are Companies?



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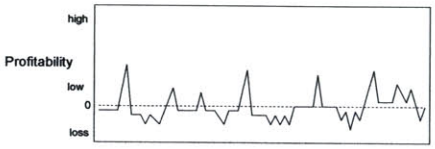
Problematic Consequences

Scattered Islands of Profitability in a Sea of Marginal Business



Accounts/Products/Orders

8

New Domain of Value Creation

	Mass Markets	Precision Markets
Product Attributes	crucial	important
Internal Efficiency	adequate	important
Supply Chain Management	adequate	decisive
Customer Internal Profitability	–	crucial

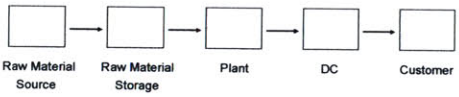
9

Much to Gain – Or to Lose

- Profitability
  - 30-40% Accounts, Products, Orders Unprofitable
  - Opportunity to Increase the Best Business
  - Danger of Losing the Best Accounts
- Market Share
  - Best Customers Reducing Their Supplier Bases by 30-60%
  - Huge Share Gains from Account Focus, Service Differentiation, and Process Innovation
  - Major Competitive Gains – Or Losses

10

Who Owns What?



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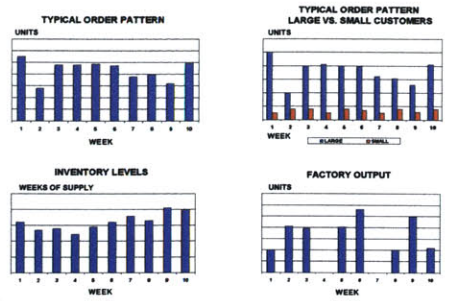
Service Differentiation Matrix

Account Size	Low	High
Large	**Integrated Accounts** • Aligned business strategy and scorecard - Collaborative, trustworthy actions • Process-driven alignment - Coordinated supply and demand chain - Dedicated resources when the business case warrants	**Strategic Accounts** • Aligned, long-term business strategy - 3-5 year joint long-range planning - Innovative - Shared risk • Fully integrated - Integrated supply and demand chain (process and systems) - Dedicated cross-functional teams - Approach opportunities through the eyes of the customer
Small	**Stable Accounts** • Reliable service - Consistent - Cost-efficient • "Menu" approach to product and service offerings	**Emerging Accounts** • Functionally excellent service - Flexible - Innovative • Some unique needs met • Pioneer scalable innovations

Account Willingness to Innovate

12

Product Flow Management - Before



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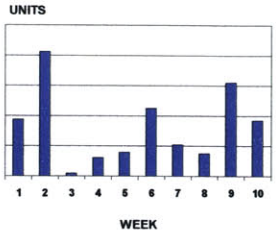
Product Flow Management - National Purchase Pattern



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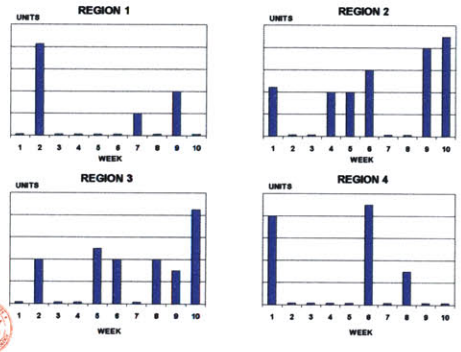
Product Flow Management - Regional Purchase Pattern



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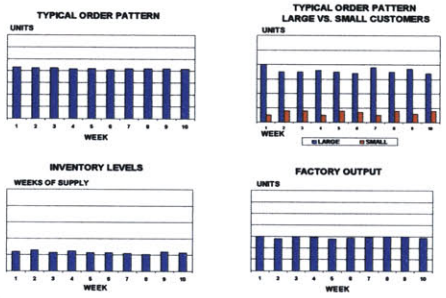
Product Flow Management - After



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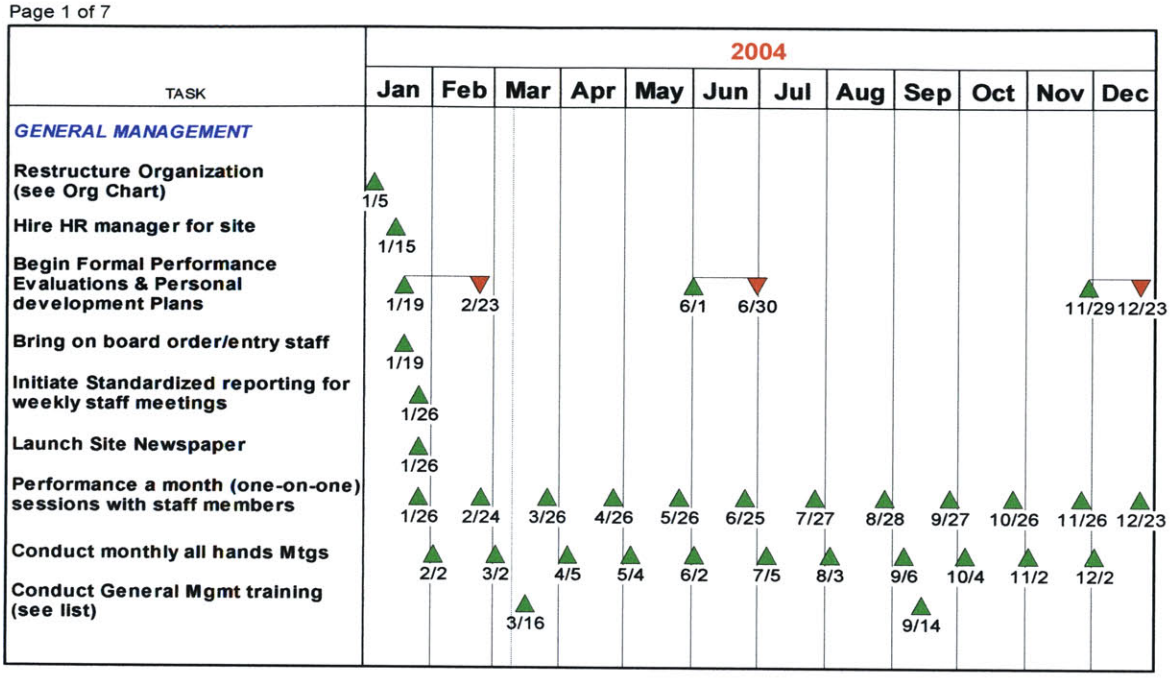
Third-Era Supply Chain Management

- Decisive Factor for Market Share and Profitability
- Focus on Service Differentiation and Customer Profit Enhancement
- Critical Factor in Most Companies Today...and Tomorrow
- Very Hard to Manage - Huge Competitive Advantage!

17

APPENDIX F: GOING FORWARD SCHEDULE

Page 1 of 7



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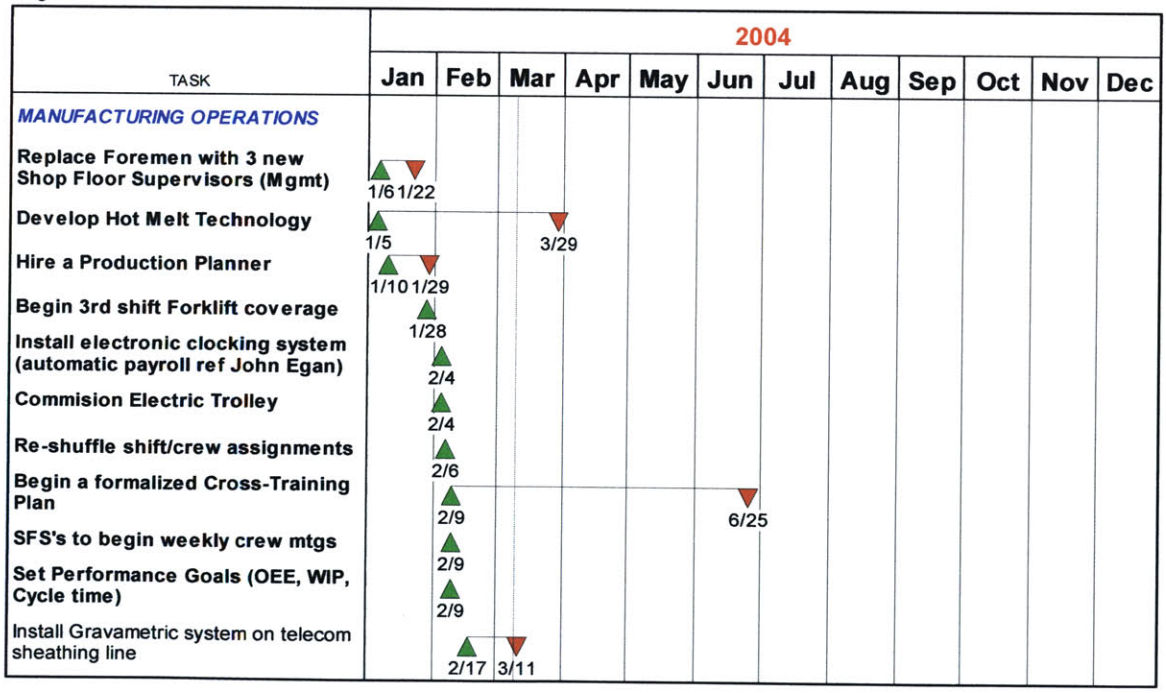

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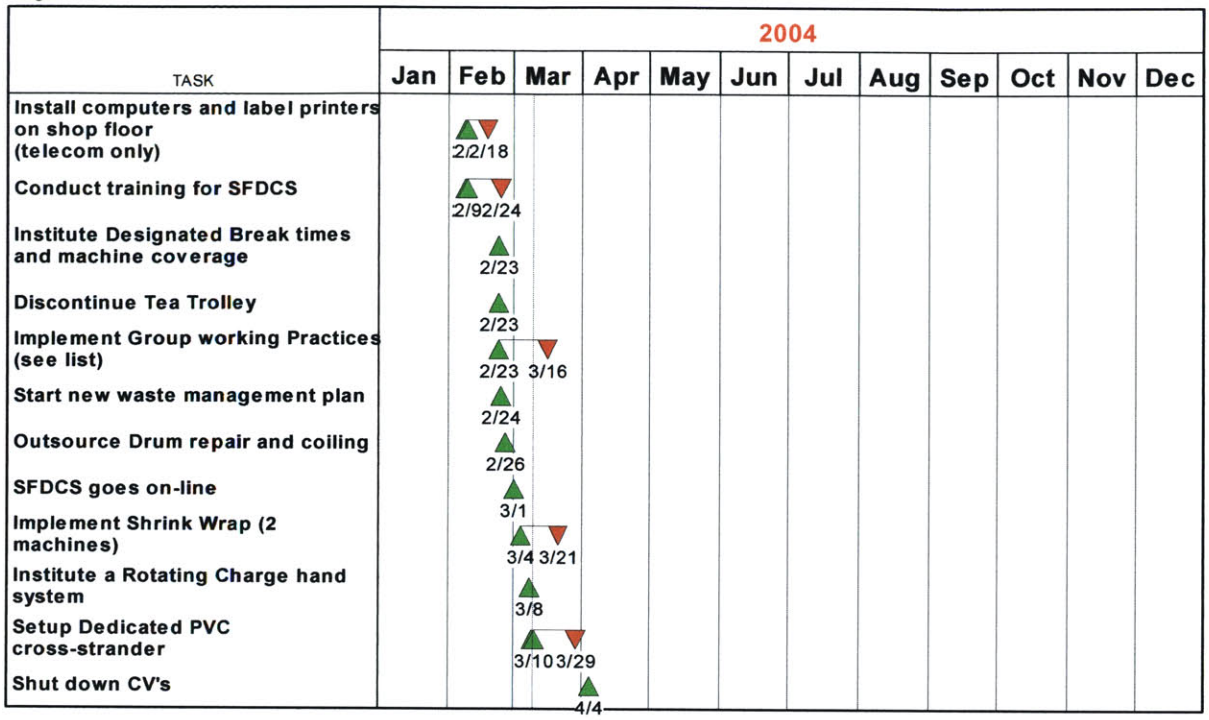

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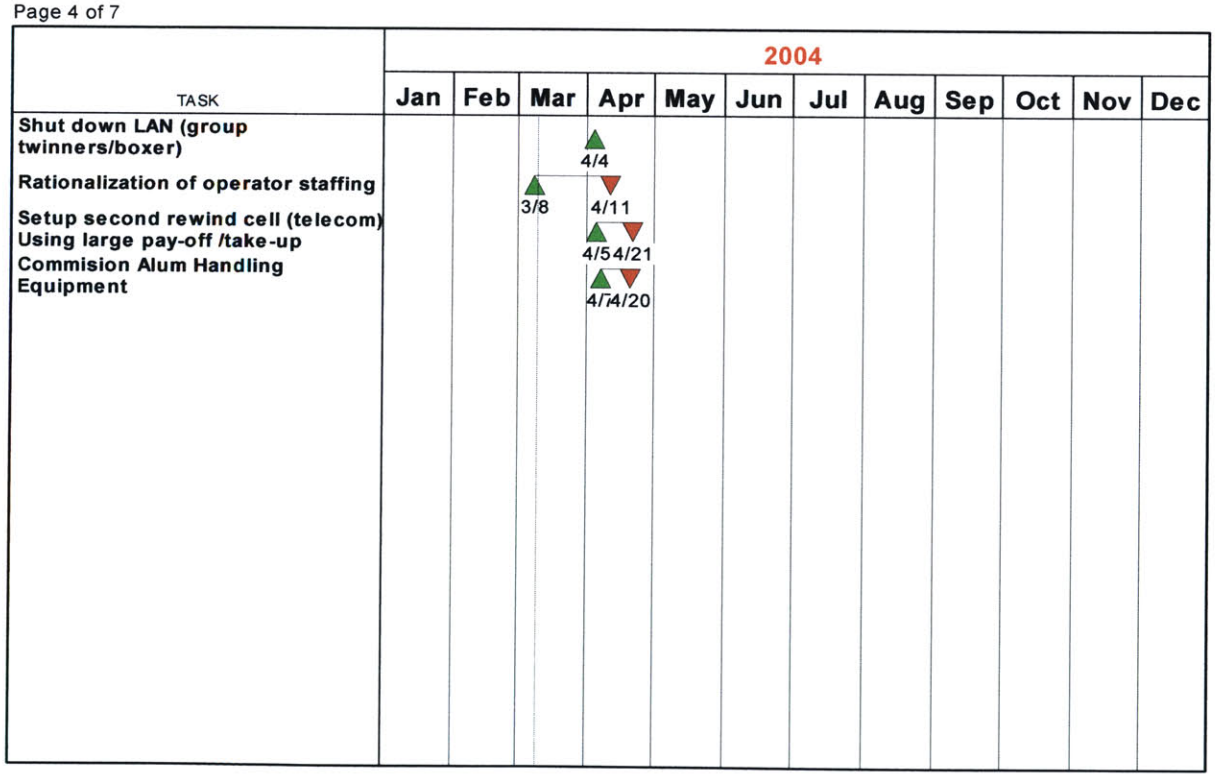
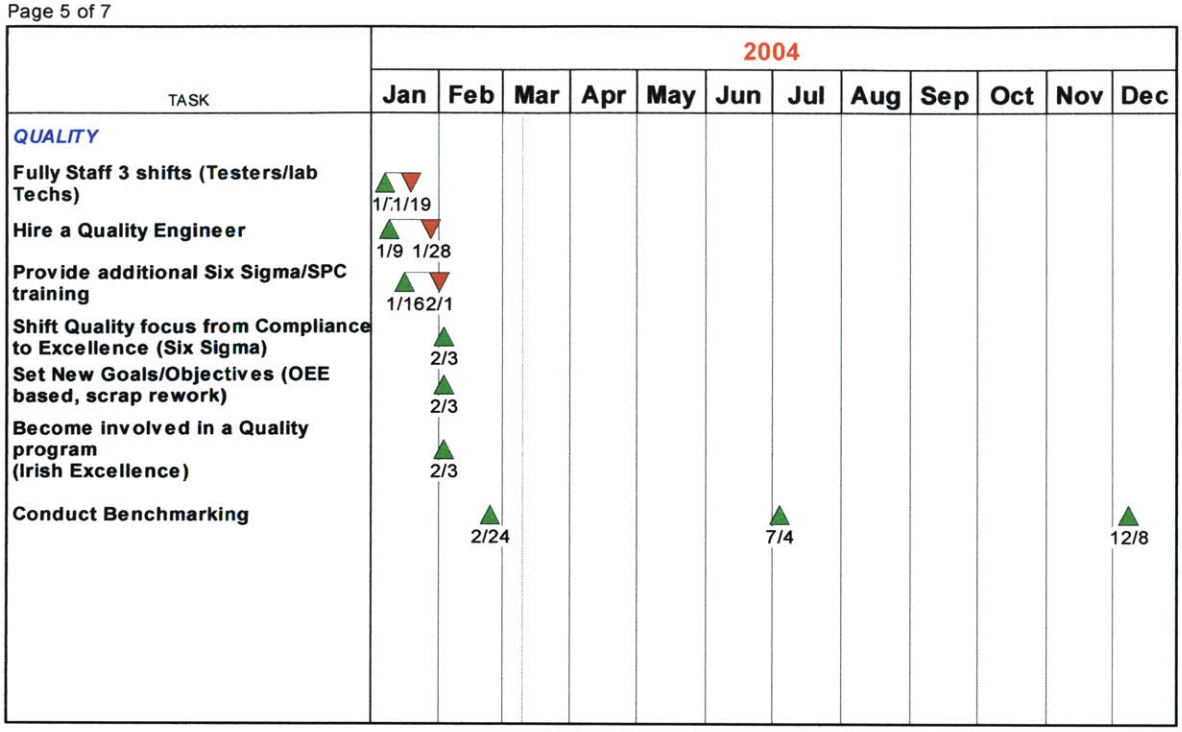
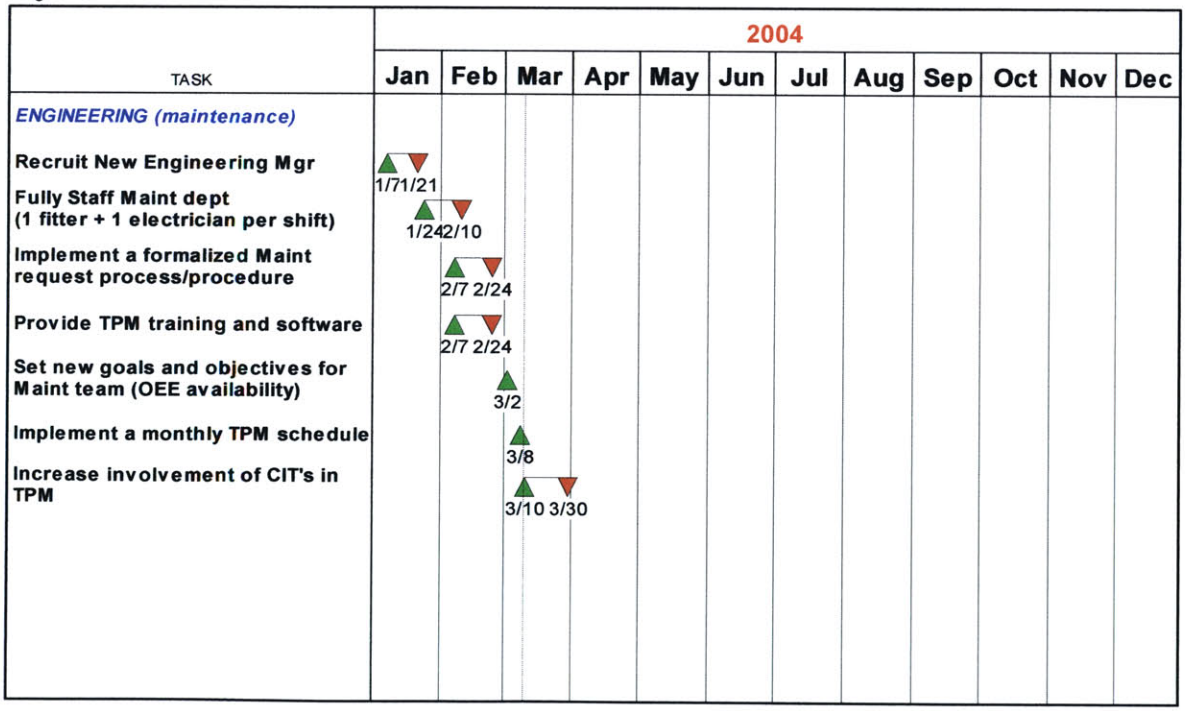



2004
TASK
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
QUALITY
Fully Staff 3 shifts (Testers/lab Techs)
1/1 1/19
Hire a Quality Engineer
1/9 1/28
Provide additional Six Sigma/SPC training
1/16 2/1
Shift Quality focus from Compliance to Excellence (Six Sigma)
2/3
Set New Goals/Objectives (OEE based, scrap rework)
2/3
Become involved in a Quality program (Irish Excellence)
2/3
Conduct Benchmarking
2/24
7/4
12/8


2004
TASK
Jan
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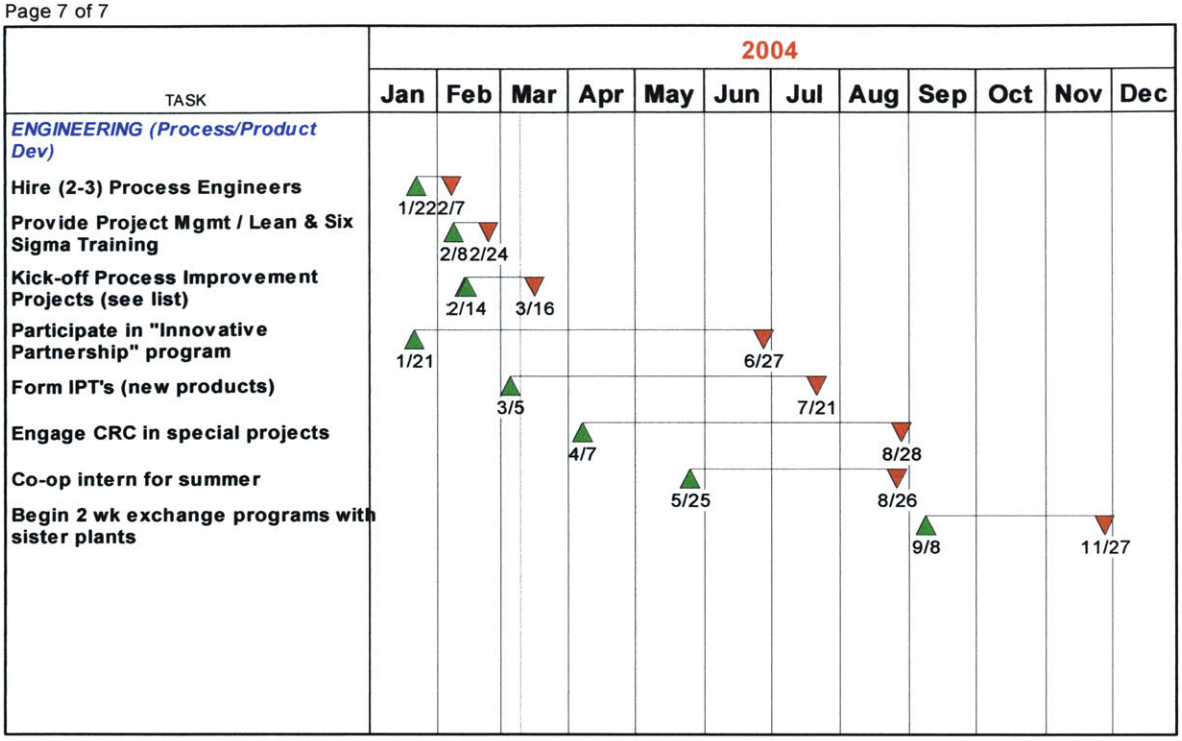
Nov
Dec
ENGINEERING (maintenance)
Recruit New Engineering Mgr
1/7 1/21
Fully Staff Maint dept (1 fitter + 1 electrician per shift)
1/24 2/10
Implement a formalized Maint request process/procedure
2/7 2/24
Provide TPM training and software
2/7 2/24
Set new goals and objectives for Maint team (OEE availability)
3/2
Implement a monthly TPM schedule
3/8
Increase involvement of CIT's in TPM
3/10 3/30


TASK
2004
Jan
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Jul
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Sep
Oct
Nov
Dec
ENGINEERING (Process/Product Dev)
Hire (2-3) Process Engineers
Provide Project Mgmt / Lean & Six Sigma Training
Kick-off Process Improvement Projects (see list)
Participate in "Innovative Partnership" program
Form IPT's (new products)
Engage CRC in special projects
Co-op intern for summer
Begin 2 wk exchange programs with sister plants
1/22
2/7
2/8
2/24
2/14
3/16
1/21
6/27
3/5
7/21
4/7
8/28
5/25
8/26
9/8
11/27