ABSTRACT

KARPE, YATIN SURENDRA. Weave-Room Performance Decision-Making Process In Textiles: Mapping An Information Engineering Methodology. (Under the direction of Dr. George Hodge and Dr. William Oxenham).

The purpose of this research is to understand, define and map the weave-room performance decision-making process, and to develop an Information Engineering methodology for studying and analyzing decision-making processes in textile manufacturing departments. A preliminary Decision Cycle Model was developed using knowledge management principles, resulting in a definition of Information Engineering, which was "a technique for extracting the meaning contained in the information so as to allow the understanding needed by the user to make an informed decision". A case study approach, in conjunction with a process-modeling tool called IDEF0, belonging to the IDEF (Integrated Definition language) family of modeling techniques, has been used. Case studies were conducted at three weaving plants, resulting in the development of the three AS-IS models. These case studies provided the framework to compare with, and become the underlying basis for, the proposed Best Practices TO-BE model of the weave-room performance decision-making process. Additionally, both the AS-IS and TO-BE models lead to the development of ten key performance-improving tasks that could potentially assist in enhancing the decision process as well as providing the background for analyzing the usability of IDEF0 as an effective process-mapping tool, by means of a SWOT analysis. Finally, a generic Information Engineering methodology was developed that could be used for mapping manufacturing-related decisions. The research deliverables resulting from the Information Engineering methodology would eventually lead to the development and creation of a kind of Digital Decision Dashboard (D^3), which could potentially prove to be a valuable tool for decision-making in textiles, thus addressing a critical need presently facing the textile industry.

Weave-Room Performance
Decision-Making Process in Textiles:
Mapping An Information Engineering Methodology

by
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TEXTILE TECHNOLOGY MANAGEMENT

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DEDICATION

To my wife, Neeraja and my family…thanks for being there!

BIOGRAPHY

Yatin S. Karpe is a native of Bombay (Mumbai), India. He completed his schooling from St. Xavier's High School, Bombay, and his undergraduate degree in textile engineering (Summa cum Laude) from the University of Bombay, Department of Textile Engineering (Victoria Jubilee Technical Institute, Mumbai, India).

After working for a couple of years, in two internationally renowned textile companies in India (Raymond Woolen Mills Ltd. And Reliance Industries Ltd.), he decided to complement his technical expertise with some international management background. He came to the U.S., pursued and completed a M.S. degree in textile management& sciences from the University of Georgia in Athens, Georgia. His thesis dealt with the competitiveness of the Indian cotton textile industry. During that time, his interest in pursuing academic research grew and hence he decided to further his career with a Ph.D. degree.

He came to North Carolina State University at the College of Textiles, Dept. of Textile and Apparel, Technology and Management, to pursue a Ph.D. degree. While pursuing his degree, he also worked as Project & Technology Manager with the Office of Technology Transfer (OTT) at North Carolina State University. A career in technology transfer allowed him to get the best of both the worlds; university as well as the industry. He realized that it is the right bridge between the two, eventually leading to economic development and resulting in improving and enhancing the quality of life for the common man. In January 2006, after having worked at OTT for 4 years, he decided to come back to his roots of being an academic researcher and complete his Ph.D. at NC State as a full-time graduate student.

Upon successful completion of his dissertation, he plans to move to Pennsylvania, where he will be taking a position with the Lehigh University Office of Technology Transfer, Entrepreneurial Research and Education and continue to pursue his dreams and ambitions.

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There are many individuals and organizations that have contributed and helped me complete this work. I would like to express my utmost gratitude to all of them.

First, I would like to thank my advisor, Dr. George Hodge for all the hours he so patiently invested in giving me guidance, encouragement and support, and for the intellectual stimulation which helped shape this research. He is the reason behind why I chose this topic for my research and he has been a very inspiring influence in my life. At the same time, I would also like to thank my co-advisor, Dr. William Oxenham, who has been, and will continue to be, an inspiration, guide and mentor; one who has always shown me the right path to success. I sincerely thank both of them. I would like to extend my sincere thanks to the other members of my committee, Dr. Thomas Honeycutt & Dr. Michelle Jones, as well as Mr. Neil Cahill (ITT), for their suggestions and valuable recommendations throughout this process.

I would also like to thank the three companies and all their management staff that participated in this research - without whom this research would be impossible. Unfortunately I cannot recognize these people and companies by name to maintain a non-disclosure promise made to them.

On a more personal level, there are several motivators who need to be mentioned. My wife, Neeraja, who spent several hours discussing the research topic with me. She guided me when I needed her, encouraged me when I needed a push, picked me up when I felt low and most importantly I need to thank her for always being there, and being herself throughout this long journey to get my Ph.D. I cannot forget to mention my parents Surendra and Sulbha (baba & aai) - in India who have been a constant source of love, encouragement and support. Thank you for always being right beside me and sorry for not being there with you in India when you needed me most. I have to thank my brother Sachin (dada) and his family in London for being an inspiration and a role model for me.

Finally, my sincere thanks to all the folks with whom I have interacted at North Carolina State University and who have continuously showered me with lots of love, support and encouragement. My special thanks to Muditha Senanayake, my fellow graduate student friend with whom I have had several long discussions about my classes, courses, research and career. He continues to be a true friend. Thanks to Kavita Kinra for being a wonderful friend, and last, but not the least, many thanks to Art and Mary for giving me their never ending support during my stay here in Raleigh.

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1 INTRODUCTION

Information technology is justifiably considered to offer far-reaching solutions to a wide range of manufacturing and management problems encountered in almost every industry. However, research in the field of technology management indicates that, in many organizations, information technology is not being used effectively, efficiently or economically. This observation seems to hold true even for the textile industry, where the competition is fierce and is becoming more global in nature. Textile companies are competing in an increasingly turbulent environment that is requiring improved information management capabilities to support effective decision-making.

In recent years, the arrival of knowledge-based economy structure has dominated our society. Knowledge assets have replaced the traditional production elements such as labor force, as being the more critical factors for an organizations' success (Corbitt, 2005). This seems to be the case even in the textile industry. As a result, generation and continuous accumulation of knowledge assets in firms has become the primary focus of technology management in the 21st century. Without a basic understanding of what constitutes knowledge, it is hard to know how to manage it (Wraige, 2004). Individuals face knowledge coordination problems when the knowledge needed to diagnose and solve a problem or make an appropriate decision exists, but knowledge about its existence or location is not available to the individual (Sambamurthy, 2005). Valuable experience gained by plant personnel can be lost if not recorded or shared properly using knowledge management tools (Kazi, 2005). It is the optimal generation and application of knowledge that is the key to a firm's success, and it is information technology that brings scalability to knowledge management and highlights its importance in today's competitive manufacturing industry, especially in textiles. The effectiveness of building knowledge for decision-making within a company depends upon its ability to absorb and understand the newly acquired knowledge from many different sources and integrate that new found knowledge into the existing knowledge base (Mageshkumar, 2005).

Remarkable growth in productivity of various manufacturing machineries has stimulated increasing applications of diverse information technologies (Daspal, 2005). Information technology is the key to improving competitiveness through improved decision-making. The information technologies developed over the last 30 years have been primarily technology based, while decision-making remained a human thinking process. As particular users desired/ needed information to make decisions, they "tapped" the pipeline through which information flowed past the various users in the organization. Unfortunately, as businesses became more complex, and information generation increased, the users' capacity to select and digest the right information was limited and led to a communications barrier (gap) in the interface between the human and the information system. Information has no use, and therefore no value, until a decision-maker utilizes it. The ability of the users to make "right" decisions does not depend on information itself, but on the meaning and understanding derived from that information, wherein lies the concept of Information Engineering (which will be defined later in this research). The design of an interface (point of integration) whereby the human decision-maker "taps" into the information system could influence the proficiency of converting information into decisions and it is here that Information Engineering could play a vital role, thus improving decision effectiveness and creating a new opportunity for enhanced decision making in the textile industry (Hodge, 2001).

The main purpose of this research is to understand and define the weave-room performance decision-making process by mapping AS-IS and TO-BE models and developing an Information Engineering Methodology that could result in more efficient and effective decision-making by the textile plant personnel. This section introduces the background and need for conducting research in this relevant subject area for the textile industry. Chapter 2 presents a review of the literature regarding the relevant subject matter, such as information technology, knowledge management, decision-making and information quality. Chapter 3 introduces the concept of Information Engineering and proposes a basic decision model that will be used as a basic underlying foundation for the research process. Chapter 4 addresses the methodological process, which includes the use of Integrated DEFinition (IDEF) process modeling techniques, the specific research goals of the research and the particular approach used to conduct this research. Data Collection & Analysis form chapter 5, which includes the three case studies and their relevant AS-IS model diagrams, along with their detailed explanations. The sample reports and documents that are related to these three case studies are a part of the Appendix, while the definition of all the terms that are used in these diagrams are part of the IDEF Glossary. Chapter 5 is followed by the Results, chapter 6, which includes the Best Practices TO-BE model diagram, which is based on the inferences from the case studies (that have been analyzed in chapter 5), along with key performance improving tasks that would enhance the decision-making process. This section includes a SWOT (Strength, Weakness, Opportunity, Threat) analysis of IDEF0, while discussing its usability and functionality as a tool for mapping and analyzing the manufacturing and decision-making processes. Also, the last part of chapter 6 proposes a generic Information Engineering Methodology that could potentially be used for studying and analyzing decision-making processes for different manufacturing related decisions across the textile plants. The Conclusions section is chapter 7, which provides the concluding remarks, along with research contributions and proposes the potential future direction for this particular research.

This entire research process and approach will assist in achieving the following research deliverables:

1. Structured, well-defined "AS-IS" weave-room performance decision-making process map for each plant studies for this research.
2. Proposed "TO-BE" Best Practices map that could be used by any weave-room plant.
3. Recommended key performance improving tasks for enhancing the weave-room performance decision-making process.
4. Usability/functionality of IDEF as a tool for analyzing plant-specific manufacturing decisions by means of a SWOT analysis.
5. A generic Information Engineering methodology for mapping manufacturing decisions.

The goal of the current research is to fundamentally enhance the decision-effectiveness of the textile personnel on the plant floor, using the data-to-decision cycle model as the basis. The Information Engineering approach could prove to be a valuable asset in improving data and information quality with the use of knowledge management and modeling tools. Thereby reducing the overload (information overload) that tends to occur in the current highly automated machinery and making it simpler for the personnel on the plant floor to make the right decision. The research deliverables resulting from the Information Engineering methodology can eventually lead to the development and creation of a kind of Digital Decision Dashboard (D^3), which would be the decision-making tool of the next generation for the textile industry. D^3 would bring an integrated view of a company's diverse sources of knowledge to an individual's desktop, enabling better decision-making by providing immediate access to key business information. By tracking key performance data, a dashboard would keep a business running smoothly by informing business managers and leaders of changes in any critical business metrics so that timely and informed decisions would be made in real-time. Benefits of dashboards include features such as “up-to-date or instant information”, “on-screen information”, and “increased productivity” (Swoyer, 2005). The D^3 would be a similar tool for decision-making in textiles, capturing and disseminating vital management information for effective and efficient decision-making, thus addressing a critical need presently facing the textile industry.

2 LITERATURE REVIEW

2.1 Information Technology (IT) -

"Twenty years from now, the typical large businesses will have half the levels of management and one-third the managers of its counterpart today. Work will be done by specialists brought together in task forces that cut across traditional departments. Coordination and control will depend largely on employees willingness to discipline themselves." *-Peter Drucker (Drucker, 1998)*

Behind all these changes lies Information Technology. Computers communicate faster and better than layers of middle management. They also demand knowledgeable users who can transform their data into information (Drucker, 1998). Knowledge Management theory that can utilize Information Technologies to collect, process, integrate, model, store and use information in the right context needs to be studied and applied for best use of information management (Liao, 2004).

2.1.1 IT: Introduction

The information revolution is sweeping through the global economy. No industry can escape its effects. Dramatic changes in the cost of obtaining, processing and transmitting information are changing the way we do business. Through a combination of economic progress, trade liberalization and changing technology, markets, industries and distribution channels are becoming more global and the nature of both supply and demand are changing. Overall, the environment in which firms are operating is becoming increasingly dynamic, diverse, complex and hostile. In this environment, the need for relevant, timely, accurate and cost-effective information is paramount.

Much of the Information Technologies of the past were designed to get data to the user, but very little attempts were made to convert it to meaningful information (Anon3, 2004). The present generation business managers must capture data from various internal and external production systems, databases and resources. To be competitive, they must analyze, divide, correlate and compare the raw data; transform it to meaningful business information; and convert the meaningful business information into useful knowledge; all of which points at designing a new approach. The ideal method is to distribute and share the information and, in doing so, trigger a process that increases the organization's knowledge assets. Finally, they must convert the organizations' knowledge into business success, using it to achieve competitive advantage, sustain growth and increase profits.

The United States Integrated Textile Complex is facing stiff competitive pressures in the global marketplace and is constantly being forced to explore innovative ways to compete. Changing economic and political conditions and the increasing globalization of the market, mean that the textile sector faces ever-new challenges. Along the textile supply chain, companies need to continuously invest in new and innovative solutions and technologies to optimize the production processes (Esswein, 2004). The U.S. textile firms continue to recognize that information-related technologies are vital to the strength and competitiveness of their businesses. These textile companies are spending increasingly more money on information systems. A survey conducted by Kurt Salmon Associates indicates that IT spending, as a percent of sales in the US textile & apparel industry, is gradually increasing (KSA, 1997). Another survey by IBM and the Textile Institute (UK) indicated that IT is the key to improving competitiveness through improved decision-making, production quality, speed, flexibility and customer service (Anon1, 1994). All these parameters are influenced by the speed with which the system (including personnel) can respond to necessary changes. Maximum benefits will only be achieved from the large investments made in sophisticated monitoring and testing equipment, by manipulating the data to provide the necessary, correctly packaged information.

In order to create a successful, high performance textile company of the future, certain transformations need to be undertaken. The two key enablers facilitating the transformation are IT and management practices. These optimize use of the two key assets of an enterprise - information and people (Jayaraman, 1996). All around the world, textile companies are competing in an increasingly turbulent environment that is requiring improved information management capabilities to support effective decision-making. In the textile and clothing industry, one of the main problems of a manager is intelligent decision-making (Liu, 2006). However, despite the information revolution of the last two decades, utilization of information by firms has not kept pace with the technological ability to capture and process data. The full benefits of IT will only be realized by a system that can manipulate captured data to ensure that only appropriate information is directed in a timely fashion to decision-makers.

Previous research related to IT in the textile industry has focused mainly on the identification of data requirements and analyzing data to find the usefulness of the various data elements for process monitoring and control (Schertel, 2000; Schertel, 2002). Attempts to apply Data Mining (which is the automatic extraction of patterns of information from historical data, enabling companies to focus on the most important aspects of their business) and Data Warehousing (which is a repository of data) concepts to the textile industry have also been partially successful. But all these methodologies have only concentrated on filtering and coordinating the data to make decisions, while not addressing the concept of understanding the "meaning content" of the information obtained. There is a need to design a new process that can assist in the process of enhancing the "information quality”, which could be a step beyond just data mining, and channelize the right information to the right user. But first, lets understand the evolution of IT in the appropriate context.

2.1.2 IT: Evolutionary Phases

IT is justifiably considered to offer far-reaching solutions to a wide range of manufacturing and management problems encountered in almost every industry. Yet, although many significant efforts have been made in the field of technology management, it is evident that in many organizations information technology is not being used effectively, efficiently or economically. This observation seems to hold true for the textile industry. Introducing information technologies and computer based information systems into textile production processes can achieve a substantial increase in productivity and quality of work.

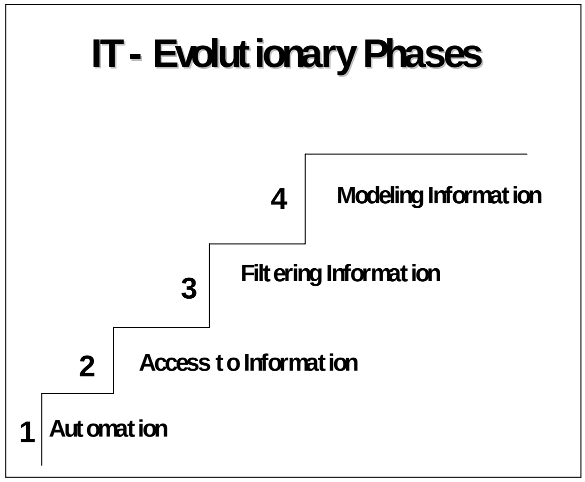

Figure 2.1: IT Revolutionary Phases (Benjamin, 1992)

Currently we are in the third stage of a four-stage evolution of conceptual thinking in the IT function (Benjamin, 1992). These stages bear a close resemblance to the manner in which IT applications evolved and exist in today's textile and apparel supply chain. Each stage is defined by what the IT function has to deliver in order to support the organization effectively (Benjamin, 1992).

1. <u>Automation:</u> Initially, application design was directed at automating existing manual systems. Progress could easily be measured by monitoring the systems portfolio. Masses of information were made available, but access was, and largely still is, exceedingly difficult. Much of the data was locked up in files accessed only by particular programs. Information could not be shared across applications or platforms. The dominant method of giving out information to its users was as line printer reports that found their most productive use as children's drawing paper.
2. <u>Access to Information:</u> Before automation could be completed, it became clear that we were better at collecting information than disseminating it. Since about 1970, the primary concern of IT groups has been to reverse this trend. On-line systems replaced batch systems. PC's and workstations are no longer stand-alone devices. Data

modeling and database management systems are enabling the integration of information at appropriate levels in order to support the organizations information needs. The problem of providing secure information access is a dominant driver of IT investment today and will continue to be a major consideration.

3. Filtering Information: Today, instead of being starved for information, managers and workers are in danger of dying from a surfeit of communication. Data overload and effective data utilization are key issues facing almost every industry, including the textile industry. The average information content of "information" is rapidly falling. To stay productive, organizations are going to have to invest in the development of unique forms of active information filtering. If information access is a key driver of current investment, providing the right information filtering capabilities emerges as a major challenge. Researchers at the College of Textiles, North Carolina State University have conducted research in conjunction with the American Textile Manufacturers Institute (ATMI) in identifying data requirements (for spinning) and analyzing data to find the usefulness of the various data elements for process monitoring and control (Oxenham, 1999).
4. Modeling Information: When information is accessible and filtered, then the question must be asked, "What do I do with it?" Expert systems, modeling systems and executive and managerial support systems such as MRP, MRPII, ERP, APS, MES and others have a role to play in modeling information to make it more useful. In this stage too, researchers at the College of Textiles have conducted research in information modeling, data analysis and decision-making with regards to the different textile manufacturing processes (Hodge, 1999; Karpe, 2000) viz., Design of Supply Chain Systems for the Textile Manufacturing Complex (Winchester, 1998), Knitting Data Model (Campos, 1993), Enterprise Modeling (Hodge, 1997) and so on. The application of information models will require a proactive effort far beyond that required to order and filter data, but it will be necessary to ensure a good fit with business processes. Information modeling cannot be managed without bringing together all three application segments – business operations, information repositories and personal support systems (Veryard, 1992). In addition, information modeling will

require development of new models that integrate business processes and system designs.

In the present era of automation, the US textile industry can move forward as a leader in the 21st Century by adopting a unique and distinct approach of Information Engineering and thus gain a global competitive edge. This approach, which is a technique for identifying appropriate information for specific sets of decisions, and then tailoring and relaying this information to support effective management, will assist in the decision-making process and respond quickly to the ever-changing needs of the US F-T-A-R (Fiber, Textile, Apparel, Retail) supply chain. It could prove to be a tool in knowledge mobilization, one of the twenty-four "Critical Business Practices" identified for the creation of an agile enterprise (Dove, 1996). Computers currently are used in the industry to automate information-processing tasks; however, in the future, their use will be geared towards knowledge management or processing with the aid of intelligent agents. But before we discuss any new intelligent agent, it is important for us to understand the various components that are a part of the whole Knowledge Management (KM) paradigm, as is currently being known. Understanding and studying the growth of KM would assist in better comprehending a new approach.

2.2 Knowledge Management -

"In an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge." *-Ikujiro Nonaka (Nonaka, 1998)*

2.2.1 Introduction

Knowledge Management (KM) can be compared to the Industrial Revolution, where the work shifted from hand-centric labor to machine-centric processes leading to an explosive rise in production and new technologies. In the same way, KM drives the shift from the manual generation of information (paperwork, which is still common today) to complete electronic processing (with the ability to effectively use and apply information). This Knowledge management revolution leads to faster rates of producing knowledge assets, and new technologies for adapting knowledge faster (Leibmann, 2000). A study by the Cambridge Information Network found that 85% of chief information officers surveyed believe that managing knowledge creates a competitive advantage by fostering better decision-making (Taft, 2000). Infact, a recent Bain & Company trends survey shows that technology-influenced tools such as Knowledge Management have made substantial gains in use since the last decade (Anon4, 2005) (Anon5, 2005).

Knowledge management is first and foremost a management discipline that treats intellectual capital as a management asset. For thousands of years, humans have been discussing the meaning of knowledge, what it is to know something, and how people can generate and share new knowledge. Individual and organizational knowledge has been invisible on balance sheets, overlooked in reward and incentive systems and allowed to flow out of companies en masse, unrecognized and uncaptured. The "knowledge workers", as they are called, are unequivocally the most vital resource in the 21st century company. The primary goal of knowledge management is to deliver the intellectual capital of the firm to the knowledge workers who make day-to-day decisions that in aggregate determine the success or failure of a business (Microsoft, 2000b).

Knowledge management is a nascent, but rapidly growing practice that seeks to maximize the value of an organization by helping its people to innovate and adapt in the face of change. With the ubiquitous nature of the web, most managers now understand the power of information and knowledge. Data warehousing, data mining, groupware and other new technologies now offer managers a host of powerful ways to capture, organize, filter and disseminate information in the process of creating business intelligence and corporate knowledge. These Knowledge Management attributes greatly influence Information Technology strategies in today’s fast-paced organization (Mullin, 1998). What Information Technology brings to Knowledge Management is the ability to carry out knowledge management processes quickly, efficiently and cost effectively, making it an enabling technology (Hanchate, 2000). Enterprise Information/Knowledge Management, which encompasses artificial intelligence, electronic data interchange and knowledge-based systems or expert systems is gaining momentum in the textile industry (Jayaraman, 1992). Some significant forces are pushing organizations to use knowledge management practices to manage their experiential and intellectual capabilities more systematically (Microsoft, 2000b). Developing such capabilities is what this research is all about. Very limited research seems to have been conducted in knowledge management application to the textile industry (Lin, 2003) (Jayaraman, 1984). But before we try to develop a tool to implement KM practices, it will be useful for us to lay some groundwork on the fundamentals of knowledge management. And before we do that, we have to clear an important misconception.

2.2.2 Knowledge Misconception

"More information does not necessarily translate into more knowledge."

-Anon

In fact, the opposite may be true - at least to the manager on the receiving end of the massive amounts of information. More information leads not necessarily to more knowledge, but to chaos (Radding, 1998). A cartoon once appeared in an online journal, showing a man standing by the seashore with an enormous wave about to engulf him. He looked up resignedly and said, "Oh good, more information!" (Fuld, 1998). Finding data and information is not a problem, finding the right and relevant information is surely a significant problem. Textile companies must distinguish between data, information and knowledge. Increasing amounts of data do not yield more information and knowledge, but in fact, result in rapidly decreasing yield ratio (Fly, 2000). The misconception that more information means more knowledge, suggests exactly where KM can make a difference: for humans to translate information into knowledge, a mechanism must be established for interpretation and context in addition to communication.

2.2.3 Knowledge Management: A Historical Perspective

A chronology of important KM events is presented in the following table (Beckman, 1999)

Table 2.1: Historical Perspective of Knowledge Management Growth (Beckman, 1999)

Year	Entity	Event
1986	Dr. Karl Wiig	Coined KM concept at United Nation's ILO
1989	Large Management Consulting Firms	Start internal efforts to formally manage knowledge
1989	Price Waterhouse	One of the first to integrate KM into its business strategy
1991	Harvard Business Review (Nonaka & Takeuchi)	One of the first journal articles of KM published
1993	Dr. Karl Wiig	One of the first books dedicated to KM published (Knowledge Management Foundation)
1994	Knowledge Management Network	First KM Conference held
1994	Large consulting Firms	First to offer KM services to clients
1996+	Various firms and practitioners	Explosion of interest and activities

2.2.4 Definition of Knowledge

"Knowledge is applying data and information to make valid inferences"

-T. Beckman(Beckman, 1999)

For thousands of years, humans have been discussing the meaning of knowledge, what it is to know something, and how people can generate and share new knowledge. Defining Knowledge is an essential first step when investigating knowledge management. There are several definitions of knowledge that exist, but only a few that are relevant to the research will be discussed.

- One definition states that *Knowledge is information that has been organized and analyzed to make it understandable and applicable to problem-solving or decision-making - (Turban, 1992)*
- Another states that *Knowledge is the whole set of insights, experiences and procedures that are considered correct and true and that therefore guide the thoughts, behaviors and communications of people - (Van der spek, 1997)*

- One specific definition that relates to the ongoing research states that *Knowledge is reasoning about information and data to actively enable performance, problem-solving, decision-making, learning and teaching -(Beckman, 1997)*

Thus several definitions of KM exist and are interpreted according to the needs of the user.

2.2.4.1 Types of Knowledge

According to Karl Sveiby, a leading knowledge management consultant, the concepts of focal knowledge and tacit knowledge are central to any discussions related to KM (Radding, 1998). In fact, implicit and tacit knowledge in Knowledge Management are important, often synonymous, terms (Day, 2005).

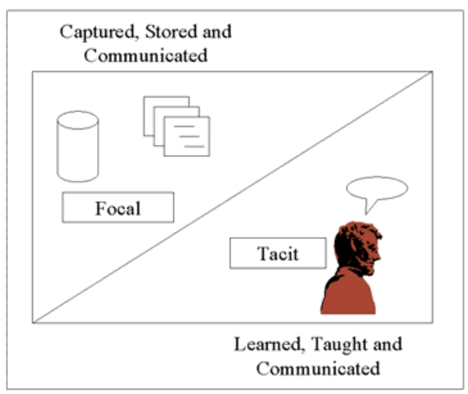

Figure 2.2: Knowledge Types (Radding, 1998)

Sveiby defines focal knowledge as knowledge about the object or phenomenon that is in focus (or of explicit interest). Tacit knowledge is knowledge that is used as a tool to manage or improve what is in focus. Tacit knowledge is highly personal, hard to formalize and therefore difficult to communicate to others. Or in the words of the philosopher Michael Polanyi, "We can know more than we can tell". Tacit knowledge is also deeply rooted in action and in an individuals' commitment to a specific context. Tacit knowledge consists partly of technical skills (the kind of informal, hard-to-pin down skills captured in the term "know-how"), and partly has an important cognitive dimension to it. It consists of mental models, beliefs and perspectives so ingrained that we take them for granted, and therefore cannot articulate them. Of the two types of knowledge, tacit is more fundamental. For example, if a certain piece of information represents focal knowledge (say end-breaks in ring spinning), how a person perceives that information and operates on it is driven by his tacit knowledge (decision to continue or stop that machine, examine the physical attributes of the spindle or yarn, and so on).

According to Sveiby, although focal and tacit knowledge are complimentary, all knowledge is tacit or rooted in tacit knowledge. Tacit knowledge functions as a background knowledge, which assists in accomplishing a task that is in focus. That which is tacit varies from one situation to another. The human being is a knowledge machine, continuously switching between tacit and focal knowledge to blend the old and well known with the new and the unforeseen. To further strengthen Sveiby's knowledge concepts, Nonaka and Takeuchi (Beckman, 1999) have determined the dimension of knowledge accessibility, dividing it into the similar two categories, tacit and explicit and stating that knowledge gains in value as it becomes more accessible and formal. According to them, tacit knowledge deals with the human mind (knowledge of experience), while explicit deals with things such as documents, text and so on, that which is readily accessible and in focus. Further, another KM specialist, Collins (Beckman, 1999), relates knowledge types to their accessibility, stating that tacit knowledge is more embrained/encultured knowledge, while the explicit knowledge is more symbol-type. Thus, knowledge seems to exist in several different types of dimensions and structures. The next logical step is to define Knowledge Management.

2.2.5 Knowledge Management: Definitions

Knowledge Management has been around for approximately a decade. Karl Wiig, management consultant and Artificial Intelligence practitioner, is one of the field's most prominent advocates and its likely founder. His definition of KM is as follows:

- *"KM is the systematic, explicit and deliberate building, renewal and application of knowledge to maximize an enterprise's knowledge-related effectiveness and returns from its knowledge assets" (Wiig, 1997)*

Other definitions of KM are -

- *"KM is getting the right knowledge to the right people at the right time so they can make the best decision" - (Petrash, 1996)*
- *"KM applies systematic approaches to find, understand and use knowledge to create value" - (O'Dell, 1996)*
- *"KM is the practice of identifying, capturing, organizing and processing information to create knowledge, which is then distributed and otherwise made available for others to use and to create more knowledge" - Hubbard (Radding, 1998)*

Leading knowledge theorists believe that knowledge is embedded in people and that effective management of knowledge requires hybrid solutions that involve both, people and technology. In order to transform knowledge into a valuable organizational asset, knowledge, experience and expertise must be formalized, distributed, shared and adapted. KM is considered a key part of the strategy to use expertise to create a sustainable competitive advantage in today's business environment.

2.2.6 Knowledge vis-à-vis Information

"Knowledge and Information are not interchangeable"

-Anon

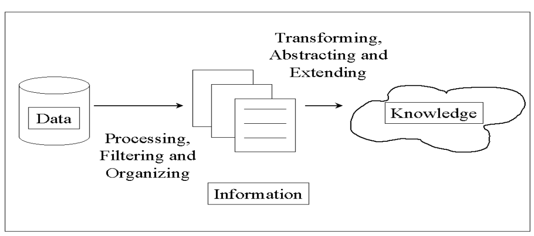

Figure 2.3: Data-To-Knowledge

In the knowledge management context, any form of knowledge discussion invariably leads to the question of the relationship of knowledge and information. If information has meaning, then is it not the same as knowledge? No. Because, the understanding is that information does not become knowledge unless its value is somehow enhanced through interpretation, organization, filtration, selection or engineering.

Historically, information had been a scarce factor in the decision-making process. Decisions had to be made without the knowledge of some critical conditions that could determine the outcomes. But as we entered the information era, information was thrust upon us in a steadily increasing flow (Simon, 1998). But the relevant information that could assist in the decision-making process was missing. We were provided with large quantities of information that we could sift and filter through to find the relevant nuggets, some of which we surely could not absorb in their totality. But if one factor (information) has become abundant in the system, what has become scarce? It is the time that we have to process this wealth of information (Simon, 1998). In the widely published world represented by works of John Naisbitt's ‘Megatrends’ and Alvin Toffler's ‘The Third Wave’, information and knowledge become increasingly blurred as modern systems disperse information in volumes greater than what can be absorbed. Both of these books were written before the advent of the Internet, which has increased the information overload and availability far beyond what either of these writers could have imagined. As Sveiby notes, the latest technological developments have further challenged conventional notions of information. Information, once deemed as fixed or static, is now dynamic. Information has, essentially, become a continuous process. But how is this information then related to knowledge? This can be better understood by studying and examining a few knowledge hierarchies.

2.2.6.1 Knowledge Hierarchy

A certain dimension of knowledge considers the premise that knowledge can be organized into a hierarchy. One school of thought draws distinction between data, information and knowledge (Van der spek, 1997) (Davenport, 2000) –

Data:	Facts, images or sounds
Information:	Formatted, filtered and summarized data
Knowledge:	Instincts, ideas, rules and procedures that guide actions and decisions

Another KM specialist, Tobin (Tobin, 1996) adds an additional higher level of "wisdom":

Data:	Relevance
Information:	Application
Knowledge:	Intuition, Experience
Wisdom:	

"But one needs to remember that a collection of data is not information, nor is collection of information - knowledge, nor is wisdom a collection of knowledge. Rather, the whole represents more than the sum of its parts and has a synergy of its own" (Bellinger, 2000). Both the above hierarchies jump from information to knowledge, assuming that knowledge can be gained by merely obtaining information. There is no way in which it can be determined whether or not the right interpretation of that information has been done. This "information-gap" will be discussed in detail in the latter part of this research. But before that, we need to understand the fundamentally basic knowledge process.

2.2.7 Knowledge Process

The basic knowledge process consists of four steps: capture, storage, processing and communication (Radding, 1998).

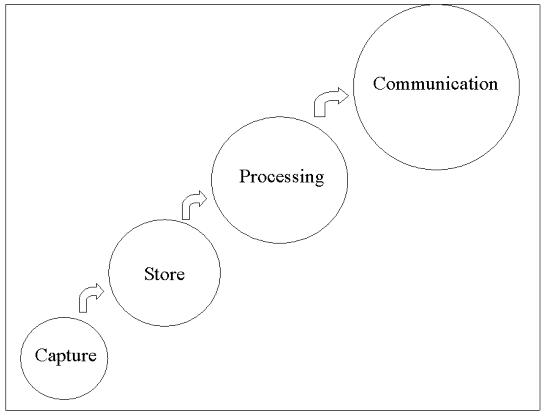

Figure 2.4: Knowledge Process (Radding, 1998)

1. “Capture: The organization/individual captures the focal and tacit knowledge in the form of data or higher-level information.
2. Storage: The captured raw knowledge (data and information) must be stored in a place where it can be managed, secured and made accessible to others, such as a data warehouse.
3. Processing: Raw knowledge is transformed into valuable business knowledge during the processing step. Processing may involve sorting, filtering, organizing, analyzing, comparing, correlating, mining or a number of different techniques. It involves a little more than just labeling the knowledge so others can easily find it when they need it, or it may entail sophisticated, complex, statistical analysis to uncover hidden relationships and insights. It is here that the human intuitiveness and experience comes into play in making decisions and it is here that the "meaning" contained in that knowledge is determined.
4. Communications: To be truly valuable, knowledge must be shared with others. Communications can be active or passive. Knowledge can be transmitted via information systems or passed through personal interaction. It may simply be placed in an accessible storage receptacle, ready when users need it.”

2.2.7.1 Knowledge Functions

Closely related to this knowledge process are the four basic knowledge functions: externalization, internalization, intermediation and cognition (Frappaolo, 1998)

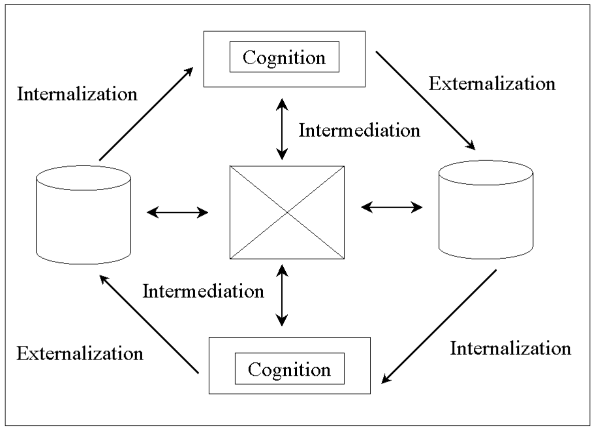

Figure 2.5: Knowledge Functions (Frappaolo, 1998)

1. “Externalization: This encompasses the capture and storage of raw knowledge. The goal is to collect similar knowledge and combine it. Carl Frappaolo, VP of Delphi Consulting, includes search and information management and various analysis and processing capabilities at this stage.
2. Internalization: The process of filtering the collected knowledge to extract and transfer the information to the particular knowledge seeker. This process may involve sophisticated querying and presentation. For example, complex knowledge may be visualized and presented not as an overwhelming list of data points, but as a rich graphic that reveals relationships and insights at a glance.
3. Intermediation: Similar to internalization, but addresses the need to transfer tacit knowledge using intermediaries. Intermediaries are not typically people, but systems and automated agents that provide additional filtering and information based on profiles of the knowledge seeker or the knowledge source.
4. Cognition: The application of knowledge. While automated systems such as Expert systems and systems based on Artificial intelligence (AI) can be used in this area, cognition remains a manual process. In the end, for example, someone must review the list of relationships identified through the data mining and determine- probably by using tacit knowledge- which system will be the most promising to pursue. And it is this process of extracting the meaning content and

enhancing the quality of the information obtained which is missing in any of the present generation information systems."

Justin Hubbard, in an article in Information Week (Hubbard, 1998), pointed out that employees learn skills and processes on the job, through interaction with customers and coworkers and through their involvement in various business processes, but no formal mechanism captures what they learn, organizes it and makes it available to others. Similarly, organizations capture volumes of information and have the ability to capture additional massive amounts of information; yet the facility for organizing that information, processing that into knowledge and disseminating it to others for use and possibly for further processing into yet more knowledge are rudimentary at best.

2.2.8 Knowledge Conversion Cycle

"Knowledge Begets Knowledge" *-Alan Radding (Radding, 1998)*

The very process that is used to create, communicate and apply knowledge results in new knowledge. New knowledge almost always begins with an individual. A brilliant researcher has an insight that leads into a new patent. A shop-floor worker draws on years of experience to come up with a new process innovation. In each case, an individuals' personal knowledge is transformed into organizational knowledge, valuable to the company as a whole. The result is a knowledge cycle in which data is transformed into information. The information is then culled and enhanced and transformed into knowledge. The knowledge is then applied and the results are documented, creating new data and information and hence recommencing the process all over again (figure 2.6).

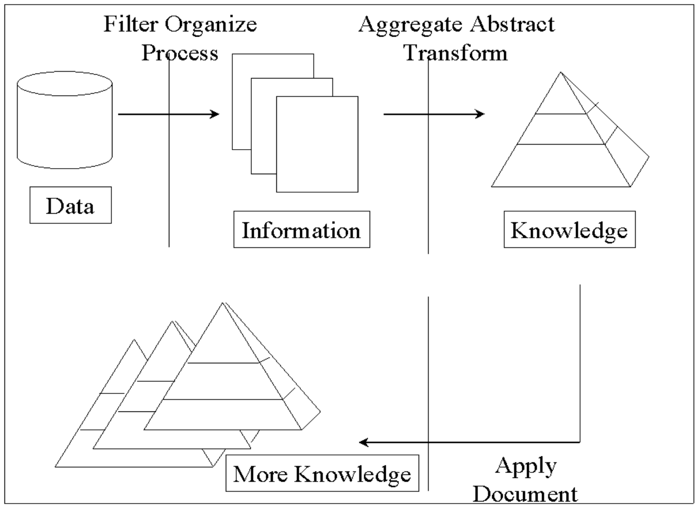

Figure 2.6: Knowledge begets knowledge (Radding, 1998)

Knowledge conversion addresses the problem of pulling tacit knowledge into the organization's knowledge base, where it can be managed and shared. Otherwise, this knowledge remains highly personal and difficult to communicate. Without a mechanism to capture and convert this tacit knowledge into explicit or focal knowledge, a large piece of the organization's knowledge asset is unused each day. For this purpose, Nonaka and Takeuchi define four phases of the knowledge conversion cycle.

2.2.9 Knowledge Phases

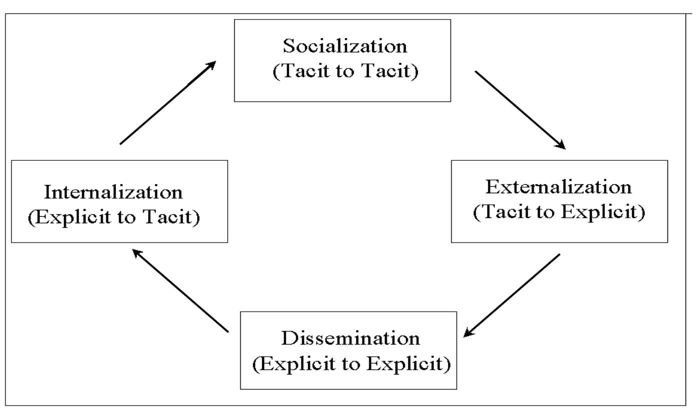

Figure 2.7: Knowledge Phases (Nonaka, 1995)

1. Socialization - The conversion from basic tacit knowledge to advanced tacit knowledge through sharing of experiences, imitation and practices. This type of activity occurs during coaching, in apprenticeships, at conferences and seminars or simply during employee interaction during recesses.
2. Externalization - Also referred to as capture. The conversion from tacit knowledge to explicit knowledge, usually by articulating the tacit knowledge and turning it into explicit form, such as a report or document.
3. Dissemination - The conversion from basic explicit knowledge to advanced explicit knowledge by the owner's sharing it with one another. Dissemination is the primary way knowledge is leveraged throughout the organization.
4. Internalization - The conversion from explicit knowledge back to tacit knowledge, enabling workers to incorporate the knowledge into the way they respond and behave when faced with a situation or problem, to which the knowledge applies.

A thorough understanding of the knowledge conversion process is essential to implement an effective knowledge management program. According to Dr. Yogesh Malhotra (founder, principal and knowledge architect of @Brint.com, a knowledge portal), knowledge management systems are effective when handling externalization and dissemination (e.g. ISO programs) while being less effective in nurturing and supporting socialization and internalization phases of the knowledge cycle (Malhotra, 2000). The following example elicits the various phases of the knowledge cycle (Nonaka, 1998).

"In 1985, product developers at the Osaka-based Matsushita Electric Company were hard at work on a new home bread-making machine. But they were having trouble getting the machine to knead the dough correctly. Despite their efforts, the crust of the bread was overcooked, while the inside was hardly done at all. Employees exhaustively analyzed the problem. Comparing x-rays of machine-kneaded dough and professionally kneaded dough's did not provide any meaningful data. Finally one of them, Ikuko Tanaka, proposed a creative solution. The Osaka International Hotel had a reputation of making the best bread in town. They decided that she would train with the hotel's head baker to study the kneading technique. After a detailed studying procedure, she realized that the baker distinctive style of stretching the dough. After several trial and error methods, she and her coworkers designed special ribs inside the machine that replicated the bakers' stretching technique, thus successfully reproducing the bread. The result, an exclusive "twist dough" machine, was an instant hit and hit records sales in its first year. Using this example to understand and correlate to the four phases of the knowledge cycle, one can draw the following inferences:

1. From tacit to tacit: Sometimes one individual shares tacit knowledge directly with another. Ikuko learned the tacit skills of observation, imitation and practice while interning at the hotel, thus "socializing" her way into the craft. But on its own, socialization is a limited form of knowledge creation and since it never becomes explicit, it cannot be easily leveraged by the organization as a whole.
2. From tacit to explicit: When Ikuko was able to articulate the foundations of her tacit knowledge of bread making, she converted it into explicit knowledge, thus allowing it to be shared with her project-development team. Another example might be when a company financial controller who, instead of merely compiling a conventional financial plan of the company, develops an innovative new approach to budgetary control based on his own tacit knowledge developed over the years in the job.
3. From explicit to explicit: An individual can also combine discrete pieces of explicit knowledge into a new whole. For the same example, when the financial controller of that company collects information from the whole organization and puts it together into a financial report, that report is new knowledge in the sense that it synthesizes information from many different sources. But this combination does not really extend the company's knowledge base either. But when tacit and explicit knowledge interact, as in the Matsushita example, something powerful happens, and it is precisely this exchange between tacit and explicit knowledge that Japanese companies are especially good at developing. And it is this overlap that could be the basis of a new approach.
4. From explicit to tacit: As explicit knowledge is shared throughout the organization, other employees begin to internalize it - that is, they use it to

broaden, extend, and reframe their own tacit knowledge. Other employees use the innovation and eventually come to take it for granted as part of the background of tools and resources necessary to do their jobs."

In a knowledge creating company, all of these four patterns exist in dynamic interaction, a kind of a spiral of knowledge. Summarizing the Matsushita example, we have the four steps –

1. First Ikuko learnt the tacit secrets of the baker (Socialization)
2. Then she translated the secrets into explicit knowledge that she could communicate to her members and others at Matsushita (Externalization/ Articulation)
3. The team then standardized this knowledge, putting it together into a manual or workbook, and embodying it in a product (Dissemination/ Combination)
4. Finally, through the experience of creating a new product, Ikuko and her team enriched their own tacit knowledge (Internalization).

This starts the spiral of knowledge all over again, but this time at a much higher level. The new tacit insight about genuine quality developed in designing the home bread-making machine is informally conveyed to other Matsushita employees. They now use it to formulate equivalent quality standards for other new Matsushita products. According to Nonaka and Takeuchi (Nonaka, 1995), articulation and internalization are the two critical steps in this spiral of knowledge.

This spiral of knowledge elicits one fact; knowledge creation results form efficient and effective use of the existing information. And in order for the user or decision-maker to utilize this information effectively, the quality of that information is of prime importance. It must be understood that Information Quality and Knowledge Management have been identified as the tools of future information society (Raether-

Lordieck, 2003). Enhancing the quality of information results in better understanding of the situation, resulting in effective decision-making.

2.3 Information Quality -

"The issue of information quality is a sleeping giant, and its effects could dwarf those of product quality and service quality combined" *-Karl Albrecht (Albrecht, 1999)*

2.3.1 Information: The Next Quality Revolution?

There seems to be need for a quality revolution, and the sooner we get it started, the better. We've experienced the product quality revolution and the service quality revolution. Both are still underway and bringing us valuable lessons. Next comes the information revolution.

With all the talk about the shift towards an information-based economy, its surprising how little is being said about the staggering costs of defective or mishandled information. One of the biggest problems of the information revolution will be how to get rid of information and not how to create more of it. One needs to learn to dispose of information, not cherish and hoard it. One has to adopt the precept that less is more, i.e. we need to cut down on the undisciplined production, duplication and distribution of information. Is a 10 page illustrated report really better than a one-page report if the one-page represents the very essence of the information needed? The recent successes of "capsule" books, (such as Books for "Dummies" and "idiots"), testifies the fact that the people are well aware of information overload. They want distilled knowledge on specific topics, not a drink from a fire hose.

2.3.2 Information Quality

Information quality problems hamper virtually every area of a business, from the mailroom to the executive office. Every hour the business spends hunting for missing data, correcting inaccurate data, working around data problems, scrambling to assemble information across disintegrated databases, resolving data-related customer complaints, and so on, is an hour of cost only, passed on in higher prices to the customer. That hour is not available for doing value-added work. Research has shown that senior executives at one large mail order company personally spend the equivalent of one full-time employee (senior executive) in reconciling conflicting departmental reports before submitting them to the Chief Executive Officer. This means that the equivalent of one senior executive's time is spent or wasted because of redundant and inconsistent (non-quality) data. According to Bill Inmon, 80 to 90 percent of the human efforts in building a data warehouse are expanded in handling the interface between operational and data warehouse environments (Inmon, 1992).

The resulting effect is that information quality problems hurt the bottom line. The social and economic impact of poor-quality data costs billions of dollars (Wang, 1995) (Strong, 1997). Quality experts agree that the costs of nonquality are significant. Quality consultant Phil Crosby, author of Quality is Free, identifies the cost of non-quality to manufacturing as 15-20 percent of revenue (Crosby, 1979). J.M. Juran pegs the cost of poor information quality at 20 to 40 percent of sales (Juran, 1988), Kearny puts this cost at 25 to 30 percent of sales dollars, while in service companies, poor quality can amount to an increase of 40 percent in operating costs (Boyle, 1992). Furthermore, as much as 40 to 50 percent or more of the typical IT budget may actually be spent in "information scrap and rework", a concept well known in manufacturing. Following the analogy between manufacturing and information systems, we can clearly see that there is a significant economic benefit to be gained if data or information quality can be managed effectively (Wang, 1992). Information quality is a business issue and information quality improvement is a business necessity. For organizations in a competitive environment, information quality is a matter of survival, and then of competitive advantage. For organizations in a public and not-for-profit sectors, information quality is a matter of survival, and then of stewardship, of stakeholder resources.

Before defining Information or Data Quality, it is imperative to understand what data and information is and why information quality is required. And because the ultimate objective of business is to achieve profit or to accomplish its mission, one must then define what is meant by knowledge and wisdom in the context of information quality and how it differs from information (Degler, 2000). It is in wisdom or applied knowledge that information is exploited, and its value realized.

2.3.2.1 Data

Data is the plural form of the Latin word datum, which means "something given". In the context of classical computer science, the term data has come to mean numeric or other information represented in ways that computers can process. Simply stated, data is the representation of facts about things (where facts means something that is known to have happened or to be true or to exist). Data is the raw material from which information is derived and is the basis for intelligent actions and decisions. As an example, ‘19195551212’, represents a fact that is true. While it represents something real in the world, this data without a descriptive definition or a context is meaningless. Data is only the raw material from which information may be produced.

2.3.2.2 Information

If data is the raw material, information is a finished product. Information is data in context. Information is usable data. Information is the meaning of the data, so facts become understandable. The previous example of data becomes understandable information when one knows that ‘+1 (919) 555-1212’ is the telephone number of the information directory for Raleigh, North Carolina and surrounding areas. It includes the country code 1, the area code 919, the telephone exchange 555 and the number within the exchange 1212. Information quality requires quality of three components: clear definition or meaning of data, correct value and understandable presentation (the format represented to a knowledge worker). Non-quality of any of these parameters or components could cause a business failure or wayward decision-making. Information is applied data and may be represented as follows (English, 1999):

Information = f(Data+Definiton+Presentation)

From a business perspective, information may be well defined, the values may be accurate, and it may be presented meaningfully, but it still may not be a valuable enterprise resource. Quality information, in and of itself, is useless. But quality information understood by people can lead to value.

2.3.2.3 Knowledge

Quality information becomes a powerful resource that can be assimilated by people. Knowledge workers plus quality information provide the potential for information to have value. A database without knowledge workers using it produces as much value as a product warehouse without ordering customers. Knowledge is not just information known, but it is information in context. Knowledge means understanding the significance of the information. Knowledge is applied information and can be represented by the following formula (English, 1999):

Knowledge = f(People+Information+Significance)

Knowledge is the value, added to the information by the people who have the experience and acumen to understand its real potential. With the continuing evolution of information technology, organizations are now able to capture knowledge electronically, organize its storage and make it sharable across the enterprise. It is possible, however, to have a wealth of enterprise knowledge but still see an enterprise fail. Knowledge has value only to the extent that people are empowered to act based on that knowledge. In other words, knowledge has value only when acted upon.

2.3.2.4 Wisdom

The penultimate goal in any organization is to maximize the value of its resources to help accomplish its mission. The information resource is maximized when it is managed in a way that it has quality and when it is easily accessible/available to the decision-maker or to the user. People resources are maximized when they are trained, provided resources (including information) and empowered to act, carry out the work of the enterprise and satisfy the end customers. Wisdom is applied knowledge and may be expressed in the formula (English, 1999):

Wisdom = f(People+Knowledge+Action)

The goal of information quality is to equip the knowledge workers with a strategic resource to enable the intelligent learning organization. Peter Senge defines the learning organization as one that "is continually expanding its capacity to create its future" through learning and shared experiences (Senge, 1994). An intelligent learning organization is one that maximizes both its experience and its information resources in the learning process. An intelligent learning organization shares information openly across the enterprise in a way that maximizes the potential of the entire organization. So after all this discussion, how can Information Quality be defined?

2.3.3 Information Quality: Definition

Information Quality is defined as "consistently meeting the knowledge-workers and end-customers expectation", through information and information services (English, 1996), enabling them to perform their jobs efficiently and effectively. Information quality describes the attributes of the information that result in user (customer) satisfaction (Nayar, 1996). There are two significant attributes or definitions of Information Quality. One is inherent and the other is pragmatic (English, 1999).

- *Inherent Information Quality* is the correctness or accuracy of the data. If all facts that an organization needs to know about an entity are accurate, that data has an inherent quality - it is an electronic representation of reality.

- *Pragmatic Information Quality* is the degree of usefulness and value data has to support the enterprise processes that enable accomplishing enterprise objectives. In essence, pragmatic information quality is the degree of customer satisfaction derived by the knowledge workers who use it to do their jobs.

Data in a database or data warehouse does not have any actual value; it only has potential value. Data has ‘realized value’ only when someone uses it to do something useful. It is possible to have inherent information quality without having pragmatic information quality. Data that is not required to support any business processes, or required to make any business decision, or data not used for the purpose of trend analysis, is irrelevant. Even if the values are correct and have an inherent quality, that data is useless, and has no value to the enterprise. In fact, it is non-quality information since it costs the enterprise money and resources to obtain and maintain that data which adds no value. It has a negative net worth.

Earlier we saw that information can be represented by the formula (English, 1999):

Information = f(Data+ Definition + Presentation)

The three components that make up the finished product of information are separate and distinct components that must each have quality to have overall information quality. If we do not know the meaning (definition) of a fact (data), any value will be meaningless and we have non-quality for information. If we know the meaning (definition) of a fact, but the value (data) is incorrect, it results in non-quality. If we have a correct value (data) for a known (defined) fact, but its presentation (whether in the form of a written report, on a computer screen, or in a computer-generated report) lacks quality, the knowledge worker may misinterpret the data, and again results in non-quality.

Thus information quality is not an esoteric notion; it directly affects the effectiveness and efficiency of business processes. Information quality in its simplest form can be expressed as (English, 1999):

Table 2.2: Quality Characteristic v/s Knowledge Worker Benefit (English, 1999)

Quality Characteristic	Knowledge Worker Benefit
The *right* data	The data I *need*
With the right *completeness*	*All* the data I need
In the right *context*	Whose *meaning* I know
With the right *accuracy*	I can *trust* and rely on it
In the right *format*	I can use it *easily*
At the right *time*	*When* I need it
At the right *place*	*Where* I need it
For the right *purpose*	*I can accomplish our objectives and delight the customers*

2.3.4 Dimensions of Information Quality

Studying the 5-dimensional Information Quality model creates another form of representing the information quality phenomenon (Figure 2.8 (Albrecht, 1999)). The Data logistics and data protection parts are concerned with the capture and storage of the data. The Information behavior encompasses what human beings do with the data and information, viz. recording information manually or with the aid of a computer, paraphrasing it, getting information from others, etc.

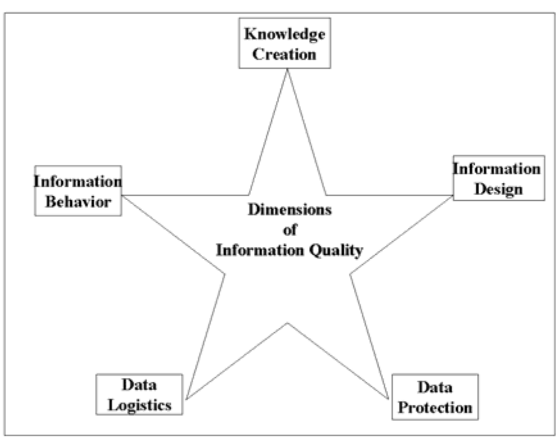

Figure 2.8: Albrecht's Five Dimensions of Information Quality (Albrecht, 1999)

Information design is at the heart. It uses software's and other tools to create new information and knowledge by transforming source information into meaningful form. This meaning is then used for knowledge creation, wherein the human skill of drawing insights and conclusions from the existing information comes into play. It could also lead to new inventions, conceptualizing new ideas, conceiving new strategies and building new models and rethinking existing beliefs. Thus, the five dimensions further strengthen the Knowledge Process/creation and the Knowledge phases concepts that were discussed earlier and will provide us with a strong foundation to design a new approach.

All the above, discussed literature points, in the direction of the need to develop a fundamentally new and a unique methodology that could be used as a knowledge management tool for rationalizing data and information (data utilization) and enhancing information quality, so as to reduce the overload (information overload) that tends to occur in the day-to-day functioning of the plant operation and make it simple for the personnel/knowledge worker to make a right decision. It is the "meaning content" of the information or information quality enhancement characteristic, vis-à-vis the knowledge worker (the decision-maker) that needs to be studied. Further, it is necessary to address and understand the decision-making process used by the knowledge worker in order to process the information and knowledge, so as to be able to make the appropriate, right decision.

2.4 Decision-Making -

Decision-Making is an integral part of the management of any kind of organization. More than anything else, competence in this activity differentiates the manager from the non-manager and, more importantly, the effective manager from the ineffective manager. In discussing decision-making, it is customary to focus on one or more of the following three points: the decision-making process, the decision-maker and the decision itself. The decision-maker is the knowledge worker who processes the information using the decision-making process to reach to a decision. This means that it is important for us to understand a decision and its different types, as well as understand the basis of the decision-making process along with its function. This will provide the necessary tools to process information quality vis-à-vis the knowledge management process, resulting in effective and efficient decision-making.

2.4.1 Decision

Simply stated, the term decision would mean a moment or an instance in an ongoing process of evaluating alternatives and meeting an objective. Although there are several definitions of the term decision, as per Ofstad, the most common use of the phrase "to make a decision" means to make a judgment regarding what one ought to do in a certain situation after having deliberated on some alternative course of action (Ofstad, 1961). Decisions are action oriented. They are judgments that directly affect a course of action. The decision process involves both, thoughts and actions, culminating in an act of choice. Decisions have varying degrees of significance. The decisions made by top management are often vital to the long-term strategy of the organization, so that clearly such choices are highly significant. On the other hand, the day-to-day decisions made by the operating and manufacturing management in the technical plant floor areas of the organization provide a foundation for the commitments and changes initiated by decisions made at the higher levels of management.

2.4.1.1 Types of Decisions

Decisions are classified in several different ways, but perhaps the most common types are the "programmed and non-programmed" decisions, as per Simon (Simon, 1960). Another classification of decisions is composed of "routine, adaptive and innovative" decisions (Gore, 1962), while Delbecq classifies them as "routine, creative and negotiated" decisions (Delbecq, 1967). It is fairly easy to see these several classification schemes, which could easily be compiled into two basic categories; routine, recurring and certain on one hand, and the non-routine, non-recurring and uncertain decisions on the other hand. It is significant that a decision is simply a means to an end, not, as is frequently assumed, an end in itself. The end is, of course, the outcome that will result from the choice; an outcome, it is hoped, that will attain the objective that gave rise to the integrated process of decision-making.

2.4.2 Decision-Making Process

Similar to the various definitions of the term decision, there are several views on the process of decision-making. In Simon's words, decision-making comprises three principal phases: finding occasions for making a decision; finding possible courses of action; and choosing among courses of action (Simon, 1960). Another notion of the decision-making process entails information gathering, development of alternatives, evaluation of alternatives and finally making a choice (Witte, 1972). One other thought process looks at three distinct elements: problem recognition, problem diagnosis and action selection (Schrenk, 1969). Without a doubt, decision-making is the most significant activity engaged in by managers in all types of organizations and at any level. The current and lasting impact of managerial performance is inextricably centered in the efficacy of managerial choices. Most of the managerial behavior can be explained in a context of decision-making. Making decisions of all types and at all levels is the principal thrust of significant managerial actions. The true measure of management is reflected in the success of its decisions over time.

2.4.2.1 Functions of Decision-Making

The components of the decision-making process are the functions of decision-making. These functions are as follows (Simon, 1960):

1. Setting managerial objectives –The decision-making process starts with the setting of objectives, and a given cycle within the process culminates upon reaching the objectives that gave rise to it.
2. Searching for alternatives – In the decision-making process, searching involves scanning the internal and external environments of the organization for information. Relevant information is formulated into alternatives that seem likely to fulfill the objectives.
3. Comparing and evaluating alternatives - Alternatives represent various courses of actions, which singly or in combination may help attain the objectives.
4. The act of choice – Choice is 'the moment' when the decision-maker chooses a given course of action from among a set of alternatives.

5. Implementing the decision - Implementing causes the chosen course of action to be carried out within the organization, resulting in transforming the choice from an abstraction into an operational reality.
6. Follow-up and control – This function is intended to ensure that the implemented decision results in an outcome that is in keeping with the objectives that gave rise to the total cycle of functions within the decision-making process.

The decision-making process is an orderly process beginning with the discovery by the decision-maker of a discrepancy between the perceived state of affairs and the desired state. This desired state is usually between an ideal and a realistically attainable state. Alternative actions are selected, and one of these alternatives emerges as the action of choice followed by justification for it. This is followed by its implementation. The process is completed with a feedback about whether the action resulted in movement toward the desired state of affairs. If the perceived and the desired state of affairs have not narrowed sufficiently, a new cycle is likely to commence.

The significance of decision-making stems from the fact that it affects all the functions of managers in formal organizations. It is the one activity that most nearly characterizes the behavior of managers, and the one that clearly differentiates managers from other occupations in the society. Decision-making is at the heart of what administrators and managers do (Hickson, 1995). In fact, it is important to know that decision-making is a more comprehensive process than problem solving; the latter is only part of the former. They are differentiated by the fact that problem solving involves the process of thoughtfully and deliberately striving to overcome obstacles in the path toward a goal, while decision-making is the choice process, in which one among several possibilities is selected. Particular kinds of decisions may necessitate problem solving; but the presence of problem solving is not sufficient to justify claim of decision-making. The terms then are interrelated, but not interchangeable. The reason for this clarification is due to the closeness of the use of these two activities in the real world, as well as in the context of the case studies in this research too.

This discussion gives an understanding of the various components and types of decisions, as well as the relevant functions of the decision-making process that influence the decision-maker. It is the collective understanding of knowledge management, information quality and decision-making attributes that will assist in proposing an effective and efficient preliminary decision model, which would form the basic underlying foundation for developing an appropriate methodology for investigating and mapping the weave-room performance decision-making process.

3 PRELIMINARY DECISION MODELING

3.1 Development of Decision Model -

As seen in chapter two, knowledge is a function of information, people and significance. Knowledge is not just information, but information put into context. Information becomes knowledge only when it's meaning is understood and used by the decision-maker. Knowledge Management is the practice of finding, understanding and using this knowledge to create value, and it is precisely the need to study this value-enhancement in decision-making that formed the basis of the National Textile Center's (NTC) project titled "Information Engineering: Textile Industry's Value-Adding Key to Effective Decision-Making" (Hodge, 1999). The initial part of this research was an integral part of that NTC project and led to the development of the Decision Cycle Model explained in the following sections and forms part of the basis for this research study.

3.1.1 Self-Generated Information

Before computers became a primary source of information to textile production managers, these managers relied extensively on "self-generated" information to make decisions (such as machine changeover schedules that were often determined by counting the number of "boxes" of yarn available in the spinning room; when the number of boxes got low, more number of machines were assigned to run that count) (Cahill, 1988). Consequently, the type of information needed and the time it was needed was highly recognizable to that production manager. In effect, this information had a high use value to that individual. This high use value was because the user's needs and the information generated were from the same source, namely the plant personnel. There was an immediate and clear "matching" between the information presented and the requirements of the user. But as automated sensing replace human observation, the managers began to lose that personal sensitivity between what the "numbers" meant and their personal awareness of the plant "situation". Furthermore, as computers were used as "data-digesters", this personal sensitivity to numbers was further reduced. This gap between what computerized information "tells" a manager and what the manager "needs to know" is a major impediment to the use value of information.

3.1.2 The Information "Gap"

This gap, which presently exists in many information systems in textiles, must be converted into an interface. A "gap" means that there is an open space between two different parts of the system, in this case, the user and the information source. An interface, however, is a point of contact between two different functions where an efficient transfer occurs between these two functions. Changing this gap into an interface is perhaps one of the most important issues in the design of an efficient and effective information system. In 1965 it had been anticipated that the success of an information system would not be its ability to generate large quantities of information, but its ability to integrate the human user into the system (Cahill, 1988). It is only when the user, the decision-maker, becomes an involved participant in the information system can information begin to approach its full use potential. As the human decision-maker is progressively integrated into the system, that system then evolves from being an information system into a communication system.

3.1.3 The Information Dilemma

The information systems developed over the last 30 years have been heavily technology based, while decision-making remained a human thinking process (Cahill, 1988). It can be envisioned that the information system was a sort of a pipeline through which information would flow past various users in the organization. As particular users desired/needed some information to make decisions, they "tapped" the pipeline. This basic approach of people tapping the information flow as needed to make decisions is basically the same today. Unfortunately, as businesses became more complex and the system could generate increasing quantities of information, then the discriminating power of the user to select and digest the "right" information was stretched to the limit. This phenomenon, also known as information overload, resulted in inferior or downgraded decision-making, due to the sheer volume of information that had to be processed in a given decision-making time frame (Morgan, 1996) As this dilemma of the information system and the human user increased, it evidently developed into a communication "barrier".

3.1.4 Communication "barrier" – What is it?

A communication barrier exists when a human user is impeded from gaining the full "use value" of the information available to him. Such barriers are a natural byproduct of attempting to bring together dissimilar functions such as information technology and human decision-making. In order to smoothly bring together dissimilar functions it is necessary to convert the barrier into an interface. The peculiar characteristic of an interface is that it allows smooth and efficient flow, which in this case is flow of information from the system to the user. It is the design of this interface between the technology of the information system and the human decision-maker, which will greatly determine the value realized from that information (Cahill, 1988).

3.1.5 Information ≠ Communication

Information systems primarily involve generating and distributing information throughout an organization. Such information transmission is the necessary first step in developing any communications capability. But information has no use, and therefore no value, until a decision-maker utilizes it. It is the human decision-maker who constitutes the second component of a communications system. The point of integration, as seen in figure 3.1, where the human decision-maker "taps" into the information system is what forms the interface. And the design of this interface will influence the proficiency of converting information into decisions.

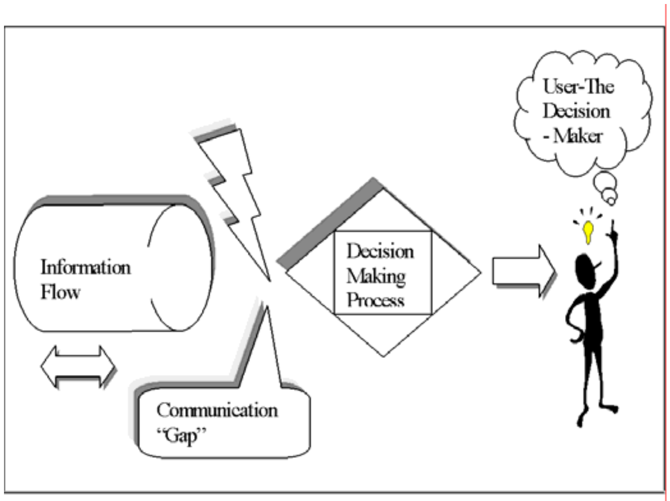

Figure 3.1: Users "Tap" the information flow to make decisions

3.1.6 Decision-Making

"You cannot solve a problem with the same level of thinking that created it" -Albert Einstein

Decision-making is one of the main tasks of a manager. Whether it is at the department level, facility management level or enterprise management level, some form of manufacturing information in some level of detail is a key requirement. Davenport & Prusak (Davenport, 2000) also reiterate this fact in their book, "Working Knowledge: How Organizations manage what they know?" Data are objective description of facts, and information is the subjective interpretation of that data. Decision-Making requires up-to-date and accurate information. Data must be meaningful and understandable and also relevant to the problem or decision. Knowing what is happening accurately and in a timely fashion and by making data-compilation and information-gathering more efficient, one is able to think better (Yudkowsky, 2004). The Knowledge Management concepts discussed earlier clearly indicate that information and data are needed to gain knowledge and make the right decision.

Often managers must make decisions in spite of the imperfections of data found in databases. Effective decision-makers can compensate for various deficiencies the data may possess, especially if the decision-maker is acquainted with the data's idiosyncrasies (Chengalur-Smith, 1999). The success of a company is strongly related to the successful decisions of its managerial team. For decision-making procedures to be kept active there is a continuous need of information acquisition and processing. But as Herbert Simon points out, that it is usually not possible to obtain all the relevant information to a problem by the time a decision has to be made (Schwartz, 1998). The final information to be provided to the particular levels has to be precise, complete, ready at the right time and free of excessive element (redundant information). The ability of the users to make "right" decisions does not depend on information itself, but on the meaning and understanding derived from that information. The asymmetry of information, or relative lack of vital, relevant information, added to the imprecision or uncertainty about the meaning of some information, adds to the burden of effective decision-making. If information access is a key driver, providing the right information filtering capabilities emerges as a major challenge. It is here that Information Engineering (IE) plays a vital role. The term Information Engineering has been more extensively used in the computer science industry and is defined in several different ways[1] (Martin, 1989) (Grant, 1992). But for our research purpose, IE is defined in context with the decision-making process.

3.1.7 Information Engineering

Information Engineering can be defined as a technique for extracting the "meaning" contained in information to allow the understanding needed by a user to make a "right" decision. Another definition could be providing the right information, in the right form, quantity, quality and the right time, so as to enable the manager to efficiently and effectively perform his/her job. It is Information Engineering that allows a computer to digest the constant stream of data being generated by the computerized sensors and monitors of the plant, and then extract from that, information that has some meaning content. According to Mr. Neil Cahill, VP of Institute of Textile Technology, "When one has to make a decision, it is the meaning contained in the information that is needed to make a "right" decision, and not the information alone". Of all the information available in existing plant reports today, only about 10-15% of the information contained in these reports is actually utilized. This low information utilization occurs due to the desired

[1]Definitions: Information Engineering is the application of an interlocking set of automated techniques in which enterprise models, data models, and process models are built up in a comprehensive knowledge base and are used to create and maintain data processing systems or an organization-wide set of automated discipline for getting the right information to the right people at the right time.

information (vital information) being buried in the report and requiring more diagnostic time than the user can provide" (Cahill, 1997). It must be realized that 80% plus of the time to reach a decision is used simply to find the right information. According to Myers, "While all communication contains information, not all information has communication value" (Cahill, 1985). Therefore, the goal should be to optimize the quality of the messages transmitted through the interface from the information system to human user. Information Engineering assists in this process.

3.1.8 Message Interface

The ability of the user to make “right” decisions does not depend on information itself, but on the “meaning and understanding” derived from that information. The sender attempts to convey meaning through the message of the information. It is the message contained in the information that transfers meaning. This suggests that one way to improve the value of information is the designing of a message interface. This interface enhances the meaning of information in order for the user to better understand the business situation in which he/she must make a decision.

The information contained in a report describes various characteristics about a business situation. However, the information content of a report does not ensure that the user has grasped the meaning of the situation. In other words, the user may have the information, but he may not have the “message”. Every report containing information has a message. If it didn’t, then the report would have no intended purpose. Therefore, messages can be thought of as the intended meaning to be conveyed by the information in the report. When the user of that report grasps the intended meaning, it can be said that he “gets the message”. The transmission and reception of the messages is the communication process.

3.1.9 Message Content

Information is the raw material of the human thinking. But it is the “meaning and understanding” that is the raw material of decision thinking. Information by itself has no meaning or understanding. The human decision-maker acquires meaning and understanding not from the raw information, but rather from the "message content" of that information. This conversion process by which raw data is translated into decisions is the Decision Cycle Model (figure 3.2), and one way of utilizing the Information Engineering approach is by analyzing and understanding this model.

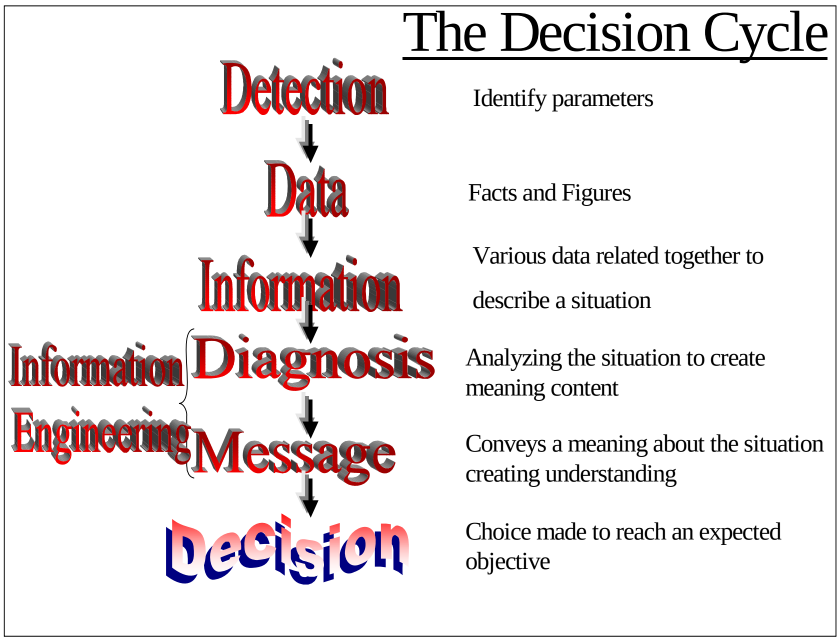

Figure 3.2: Decision Cycle Model (Cahill, 1997; Hodge, 1999)

In this model of a communication system, the goal is to optimize the quality of the message transmitted through the interface from the information system to the human user. One primary consideration is to assess both the "message" and the quality of the interface. Since message quality and content deal with the degree of meaning conveyed to the decision-maker, it becomes evident that the decision-maker must be actively involved in the design of this message interface. By designing information in such a way that it's fit for use - making what we can call "actionable information" in today's fast-paced, information overloaded environment - one can construct meaning out of the clutter of disjointed data fragments (Linder, 2000).

The “Detection” and “Data” parts of the model represent a data warehouse, which is a repository of the company’s historical data. The “Information” part of the model is comparable to data mining, which involves extraction of meaningful and useful information. The “Decision” part at the other end of the model is synonymous with expert systems (decision support tools relying on the concept of Artificial Intelligence and going beyond just programmable decisions). While the data being generated and information processed is at one end, the outcome of the decision being made is on the other end. But if one looks at the center of the cycle, one realizes that right decisions are not made merely by obtaining information, but by the correct diagnosis of the meaning of that information. If the meaning is interpreted correctly, then one gets the right message, which means one will probably make the right decision. It is here, in the center of the Decision Cycle Model that machine intelligence can be created and it is here that Information Engineering can be applied to the manufacturing system (Karpe, 2001). This type of intelligence can give the competitive edge and this competitive intelligence seems to highly influence decision-making in many aspects of a company’s operations (Gehner, 2004). Information Engineering can thus be used to bridge the gap between the Data to Decision phases. It is the right decision that leads to favorable outcomes for that company and this is where information actually creates value (Cahill, 1985).

In order to effectively utilize all the relevant literature reviewed (knowledge management, information quality and the data to decision cycle model) for analyzing and understanding the weave-room decision-making process and developing the Information Engineering methodology, it is imperative that one first understands the concept of process mapping and modeling, especially since there is a need to model all the information that would be gathered during the research process.

3.2 Process Mapping –

Process Mapping is a management tool initially developed and implemented by General Electric as part of their integrated “Best Practices” and “Process Mapping” strategy to significantly improve their bottom-line business performance. The process mapping concept is used to describe, in workflow diagrams and supporting text, every vital step in the business processes. Process Mapping is a proven analytical and communication tool intended to help improve the existing processes or to implement a new process-driven structure in order to reengineer the business processes. It is an excellent tool to better understand the current processes and to eliminate or simplify those requiring change.

3.2.1 Process Mapping Concept

The fundamental concepts of process mapping are based on the idea of structured analysis, which has produced significant payoffs in diverse business enterprise application such as banking, insurance, manufacturing, pharmaceuticals, etc. The benefits of process mapping include reductions in product and service development costs, fewer system integration failures, uniformly better process understanding, and improvement in overall business enterprise operations and performance. The following two points can summarize the basic process mapping concept:

1. Understanding a process or system by creating a “process map” that graphically shows things (objects or information) and activities (performed by men or machines). The process map is designed to properly relate both, things and activities.
2. Structuring the process map with a hierarchy, where major functions are at the top level and successive process map levels reveal well-bounded details. Each process map should be internally consistent.

The output resulting from these concepts leads to the formation of a process map, or alternatively also called a ‘Model’. Process mapping and modeling are terms that are interchangeably used. Lets understand the basic concept behind Modeling.

3.3 Modeling –

" A modeling process is a set of activities to be followed for creating one or more models of something (defined by its universe of discourse) for the purpose of representation, communication, analysis, decision-making, design or synthesis, or control" (Vernadat, 1996). Further, a model is a useful representation of some object. It is (more or less) an abstraction of reality (or universe of discourse) expressed in terms of some formalism (or language) defined by modeling constructs for the purpose of the user (Vernadat, 1996). In other words, A is a model of reality B for an observer C, if C can use A to obtain information on B (Minski, 1968). Models are highly prone to subjectivity. A model is a presentation of complex reality. Models are more easily created, evaluated and manipulated than the reality they present. Modeling is an application of a standard, rigorous, structure methodology to create and validate physical, mathematical or otherwise logical representation of a system, entity, decision, phenomenon or process (Anon2, 1996). Several different types of models exist which can be used to describe aspects of an enterprise; such as descriptive, formal, programming and analytical models.

With reference to the Decision Cycle model that was discussed in the earlier chapter, the "Detection" and "Data" parts of the model represent a data warehouse, which is a repository of the company's historical data. In regards to these stages, studies have been conducted (at the College of Textiles at North Carolina State University) on the profiling, classification and standardization of the data. Attempts were made to describe and define the data elements of specific relevance to decision-makers, such as superintendent, foreman, operator, maintenance personnel, etc., in knitting mills, one of the components of the textile supply chain (Cete, 2001). Modeling (Integrated Definition (IDEF) Modeling in particular) was used for this purpose. As part of developing the present Information Engineering approach, IDEF modeling/mapping technique will be used. Results obtained will be utilized in mapping out a particular decision-making process in the weaving industry of the textile supply chain.

3.4 IDEF Process Mapping/Modeling -

IDEF stands for Integrated DEFinition language. It is a methodology for describing, managing and improving complex processes and systems. It provides a common, public-domain language for modeling and describing processes, data, requirements, as well as functions (Cete, 2001). It was first developed as part of the US Air Force Integrated Computer Aided Manufacturing (ICAM) Program in the early 1980s (ICAM, 1981) to graphically capture characteristics of manufacturing (Le Clair, 1982). The overall methodology is called ICAM and its specification techniques are the I(CAM)DEFinition methods (Godwin, 1989). Since then, it has become the most well-known and widely used method worldwide for modeling because of its simplicity. Originally, IDEF method comprised of three non-integrated modeling techniques, namely - IDEF0 (for functional modeling), IDEF1x (for data and information modeling) and IDEF2 for dynamic modeling (Vernadat, 1996). IDEF0 added features to the Structured Analysis and Design Technique (SADT) methodology, which made it a standard for use as the language to describe decisions, actions and activities that make up today's complex organizational environments (Wizdom-Software, 1998).

An IDEF process map or model, as it is referred to in IDEF, is developed to facilitate process understanding, analysis, improvement or replacement of processes. Processes are composed of interfacing or interdependent parts that work together to perform a useful process function. Process parts can be any combination of things, including people, information, software, processes, equipment, products or raw materials. The process map can be used to describe what a process does, what controls it, what things it works on, what means it uses to perform its functions and what it produces. Two important components of an IDEF process map are graphic diagrams and a glossary that define all of the function names, arrow labels and acronyms used in the model.

3.4.1 IDEF0 Process Modeling

IDEF0 is a method designed to model decisions, actions and activities of an organization or system. IDEF0 models help to organize the analysis of a system and to promote good communication between the analyst and the customer. As a communication tool, IDEF0 enhances domain expert involvement and facilitates decision-making through simplified graphical devices (Cete, 2001). As an analysis tool, it assists the modeler in identifying what functions are performed, what is needed to perform those functions, what the current system does, both right and wrong. Thus, IDEF0 models are often created as one of the first tasks of a system development effort. An illustration of a basic IDEF0 model is shown in the figure 3.3.

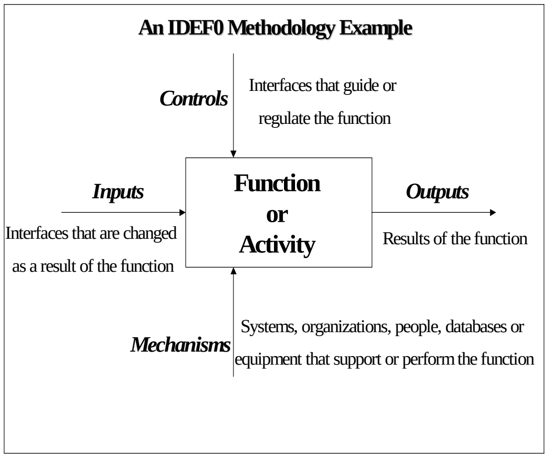

Figure 3.3: Basic IDEF0 Process Model

The text in the box is the name of the activity for which it stands, typically a verb or verb phrase (here called function or activity). Each side of an activity box has a specific meaning. The left side is reserved for inputs, the topside is reserved for controls, the right side is reserved for outputs, and the bottom side is reserved for mechanisms (resources). This reflects system principles; Inputs are transformed to outputs; Controls constrain or dictate under which conditions transformations occur; and, Mechanisms describe the resources needed to accomplish a function. A top-down diagramming method such as IDEF0 goes from the general to the specific, from a single diagram that represents an entire system to more detailed diagrams that explain how the subsections of the system work. The IDEF0 Methodology is primarily used for understanding the AS-IS (Present State) environment - the functions that are carried out, the relationships between them, and the logical breakdown of those functions into their sub-functions. The AS-IS scenario is then utilized to design and develop the TO-BE (Future Proposed State) environment (Ang, 1996), thus allowing for process or function or decision improvement.

3.4.2 Fundamental Concepts of IDEF0

There are seven fundamental concepts of IDEF0 and they are described as follows (Wizdom-Software, 1998):

1. A problem must be understood to be solved. IDEF0 is used to build a model of the subject. Then this model answers questions about the subject.
2. IDEF0 stands top-down, modular, hierarchic and structured.
3. As a functional modeling methodology, IDEF0 is not an organization chart, nor flow diagram. Moreover, there is no organization and time dependency.
4. As a diagramming methodology, IDEF0 shows component parts, interrelationships among them and how they fit into the hierarchical structure.
5. Supporting disciplines and coordinated teamwork is essential for IDEF0 methodology. That means the results will reflect the best thinking of the team.
6. Structured and rigorous IDEF0 method follows rules and requires that all analysis and design decisions and comments be in written form.
7. It is the principle of gradual exposition of detail that IDEF0 follows. A basic diagram starts with a progression of a general diagram, and then gives a more specific breakdown. The whole system, as a single unit in a single box is the starting point of the representation of an IDEF0 model. The single box has a general name and then there are general interface arrows. The top-level single box is decomposed into its sub functions, which have more specific names with specifically named arrows. Then, those second level boxes will be decomposed in turn into their sub-functions and so on.

3.4.3 Benefits of IDEF0

IDEF0 has the following key benefits (Wizdom-Software, 1998):

- "It provides an understanding of the AS-IS environment.
- It is a widely accepted means for communicating and presenting results.
- In order to interview people, a forum and structure can be established.
- Opportunities for improvement are easily identifiable.
- The relationships of data and unneeded functions are revealed.
- In order to evaluate baseline and further analysis, AS-IS model can be documented using IDEF0.
- IDEF0 can be used to draw a roadmap from the AS-IS to the TO-BE model."

3.4.4 IDEF0 Standards

An IDEF0 diagram page consists, typically of three to six activity boxes with arrow interconnections. Each activity may be described in greater details in another diagram, one level lower in the diagram hierarchy. The lower level diagram may be thought of as a set of activities contained within the higher-level activity. The lower level shows the insides of the parent. The process of creating detail diagrams is called decomposition. An IDEF0 model may contain hundreds of pages; from the top-level single box to a detailed diagram several levels down the model hierarchy.

Each process map should have a top-level context diagram that not only establishes the top-level function, but also the context of that function. This is called the A-0 diagram (pronounce "A minus zero"). The arrows on this process diagram interface with process functions outside the process area to establish a focal point for the process map. Since the single box can represent a whole process, the descriptive name written in the box is generic. The same is true of the interface arrows since they also represent the complete set of external interfaces to the process. The A-0 diagram also sets the process map scope or boundary and orientation. The A-0 context diagram also presents a statement specifying the process maps' viewpoint and purpose, which help to guide and constrain the creation of the process map. The viewpoint determines what can be "seen" within the process map context and from what perspective. The purpose expresses the reason why the process map is created and actually determines the structure of the process map. Part of the mapping discipline is to review the lower-level diagram to verify that the viewpoint has not changed. Thus a viewpoint that represents a specific person, such as a "manager", is verifiable; but a generic viewpoint, such as the "industry" is not, and could lead to an ambiguous model creation.

Boxes represent functions, which may be activities, processes, decisions, etc. A function describes what happens in a particular environment and could be performed by people, machines, computers, etc.. Labels are words that name functions, data and objects. Boxes and arrows are labeled. Words are chosen to aid communication. Function labels are verb phrases and are placed inside the box. Arrow labels (for Inputs, Controls, Outputs, Mechanisms – ICOM's) are nouns or noun phrases and placed alongside or tied to the arrows. Arrows represent data, and are always connected to a box, on at least one end. The interfaces of boxes and arrows show relationships. Parent arrows can separate into two or more branches. Branching illustrates how one entity group constraints multiple functions. Similarly, two or more component arrows can come together to form a single arrow. Feedback is very important because they close the loop between the functions. Feedback is sometimes expressed as a two-way arrow, if the information going between the two functions is closely related. Two-way arrows sacrifice some clarity on higher-level diagrams in order to gain simplicity.

3.4.5 IDEF0 Functional Hierarchy

Limiting the representation to 3-6 boxes can control complexity within IDEF0 process mapping. Boxes are numbered from 1 to 6 in the lower right hand corner. Each activity on an IDEF0 diagram may be described in further detail in a lower diagram, which in turn would show the details of its parent box. Each box on a lower diagram, may in turn, be further detailed in more diagrams. This forms a hierarchy of diagrams, that are represented by a node index, with the node numbers starting with "A", which identifies them as "Activity" diagrams (Wizdom-Software, 1998).

When decomposing a function box on an IDEF0 diagram, all arrows entering or leaving the box must appear on the child diagram. First, the parent box must be decomposed into its sub functions. Starting with the first input, determination needs to be made as to which sub functions on the child diagram has that input. The input needs to be shown on the appropriate child sub function with the same label name. Similar steps need to be followed for all other inputs, outputs, controls and mechanisms. Tunneling an arrow at the unconnected end indicates that the data conveyed are not relevant to or supplied by the parent diagram. Tunneling an arrow at the connected end indicates it does not appear in details diagrams. It is possible for the arrow to disappear for one or more levels of detail, and then be reintroduced.

In addition to node number entries (activity box numbers) and the ICOM's, diagram hierarchy is tracked in several other ways, such as diagram title, context number (C-number), DRE (Detail Record Exposition) number and parent context entry. The title of the diagram comes from its parent. Each diagram is assigned a C-number in the lower right hand corner of the diagram. The C-number is the author's initials followed by the next sequential diagram number for that author. When a function box is decomposed, the (DRE) number is place under the right hand corner of the parent box. The DRE number is the C-number of the child diagram. If no reference number exists, the box is not decomposed. Parent context appears on the upper right hand corner of the diagram. The parent entry shows a miniature of the function boxes of the parent diagram, with the parent box shaded. Figure 3.5 shows an example of the standard IDEF0 Frame, with an explanation of its various functions.

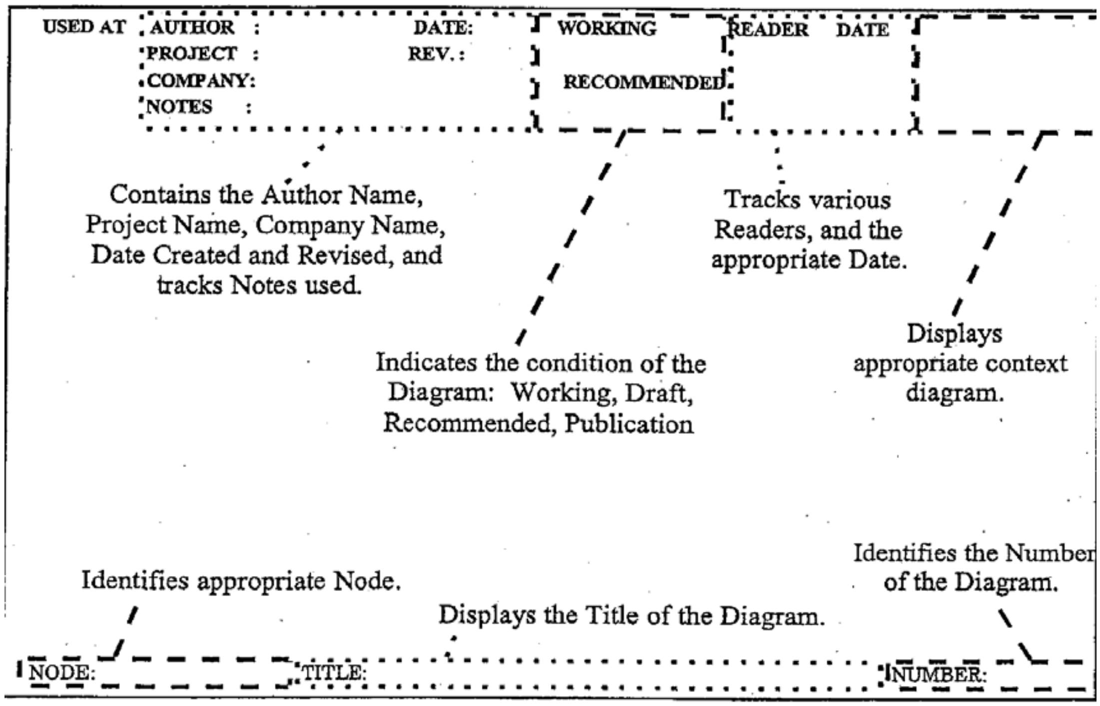

Figure 3.4:Standard IDEF0 frame, along with brief explanation of its functions (Wizdom-Software, 1998)

One of the most important features of IDEF as a process mapping concept is that it gradually introduces greater and greater levels of detail through the process mapping diagram structure comprising the process map. In this way, providing the reader with a well-bound topic and a manageable amount of detail to learn from each process map diagram enhances communication. One such brief example of the use of IDEF0 in the textile knitting plant process mapping is illustrated below.

3.4.6 Knitting Process Model

A brief example of the use of IDEF0 modeling in the knitting process mapping is shown in the figure 3.5 (Cete, 2001). The base model is the A-0, followed by its decomposed diagrams. When one clicks on the "circular weft knitting operations" activity box, the box pops up into another page that shows the presented A0 diagram (middle). From the A0 diagram, if the "knitting" activity box is clicked, it goes to the lower-level diagram, named as A2 (bottom) because the activity selected in the A0 diagram is the second one, "knitting". The number seen on the lower right corner in “knitting” activity process box on A0 diagram formulates the lower level diagram node. Knitting represents the large diameter circular weft knitting machines’ operations.

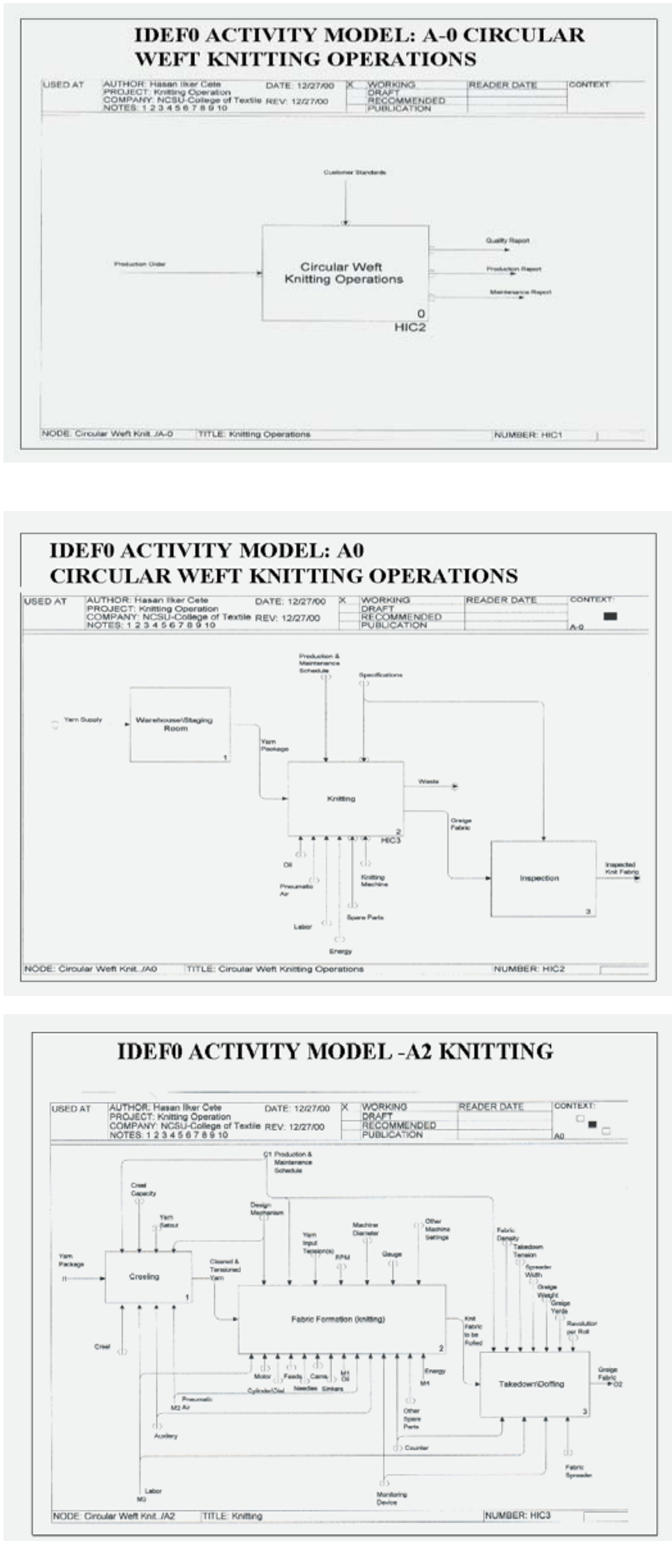

Figure 3.5: Knitting IDEF0 Process Models (Cete, 2001)

This mapping of the knitting process was accomplished with the use of a commercial software called Wizdom Software, wherein the Process Works module of the software assisted in building the IDEF0 process models. Similar use of IDEF0 will be made, to model and map the decision-making process for the individual case studies research, and assist in developing an Information Engineering methodology.

4 RESEARCH METHODOLOGY

4.1 Primary Research Objective –

The main purpose of this research was to understand and define the weave-room performance decision-making process by mapping AS-IS and TO-BE models, and developing and Information Engineering Methodology that could result in more effective and efficient decision-making by textile plant personnel.

4.2 Research Goals –

The primary research objective can be broken down into the following five specific goals:

4.2.1 Goal 1: As-Is Decision-Making Process Model using IDEF0

Develop an "AS-IS" map of the weave-room performance decision-making process (using IDEF0 technique) for each plant case study.

The IDEF0 methodology was primarily used for understanding the AS-IS (present state) environment- the functions that are carried out, the relationships between them, and the logical breakdown of those functions into their sub-functions. The AS-IS approach was then utilized to design and develop the TO-BE (future proposed state) environment, thus allowing for process or function or decision improvement.

4.2.2 Goal 2: To-Be (Best Practices) Decision-Making Process Model using IDEF0

Propose a generic "TO-BE" Best Practices map, based on the "AS-IS" maps, literature reviewed and interaction with subject experts.

4.2.3 Goal 3: Performance Improving Tasks

Define key performance improving tasks for enhancing the weave-room decision-making process, based on the results of the "AS-IS v/s TO-BE" comparison.

4.2.4 Goal 4: IDEF0 SWOT Analysis

Evaluate the usability/functionality of IDEF0 as a tool for analyzing plant-specific manufacturing decisions by means of a SWOT (Strength-Weaknesses-Opportunities-Threats) analysis.

4.2.5 Goal 5: Information Engineering Methodology

Propose a generic Information Engineering Methodology for decision mapping, which could be utilized across different departments of a manufacturing plant.

4.3 Research Approach –

Based on the literature reviewed, the research information was gathered using a case study approach, focused on the current decision-making processes of U.S. textile companies. Case study research is a widely used and accepted approach in the development of modern management theories and models, since it enables development of new ways of describing reality using qualitative information (Yin, 1994) (Gummerson, 2000). Furthermore, it provides reasonably good potential for result generalization from very few cases, or even a single case, based on the opportunity for holistic view of a phenomenon or series of events. The case-study approach enables a fundamental understanding of the structure, process and driving forces, rather than a superficial establishment of correlation or cause-effect relationships (Gummerson, 2000). Personal interviews assisted in this case study approach and added an interactive element to the findings. The industry sample included manufacturing sites from one segment of the textile complex, viz. weave room or the weaving plant. Thus, the unit of research analysis was a textile (weaving) manufacturing plant, and not the entire textile industry. The main study focused on three textile weaving plants, with one or more decision-makers in each plant.

In order to obtain information for the case study and analysis of the decision-making process, the plant managers at the three weaving plants were contacted, via telephone, mainly to introduce them to the research topic to be studied, and also to gain their permission for participating in the case study approach. A formal introductory letter

(Appendix D), along with background research information for their review and feedback, followed the initial personal telephone call. Concepts and ideas learned from the literature reviews were utilized and interpreted to formulate a pilot interview questionnaire (Appendix E). Initial rounds of interviews were conducted at the three weaving plants. Once that aspect was accomplished, several rounds of visits were carried out to these three plants on different occasions, based on the availability of the plant personnel for personal one-to-one interview meetings. At this stage, the questions were based on the individual situations and scenarios and hence the use of a personal recorder was important to capture all the information during the discussion phase. Additionally, several types of reports, as well as screen-shot examples of the processes to identify the data and information elements used in the decision-making process were collected. After completion of the plant visits at each weaving plant, all the different types of information gathered was interpreted and converted to a readable format. This information, coupled with the concepts reviewed in the literature [pertaining to the decision-making process, knowledge phases (Socialization, Externalization, Dissemination, Internalization) and information quality], along with the Wizdom Software's IDEF0 Process Works module, were used to define the AS-IS map/model and propose a structured TO-BE map/model for the decision-making process with regards to the weave room performance decision. All efforts were made to collect and analyze plant reports, forms and such other documents that are deemed fit for information collection and analyzing situations. The information obtained was graphically represented using the standards for process modeling (IDEF0) methodology. This process also assisted in identifying and isolating the inherent deficiencies in the current decision-making processes at the three weaving plants and map a best practices decision-making process for the weave room efficiency decision. The following snapshot comparison of knowledge management v/s decision-cycle was also utilized as a basic underlying foundation to develop the appropriate approach to data collection.

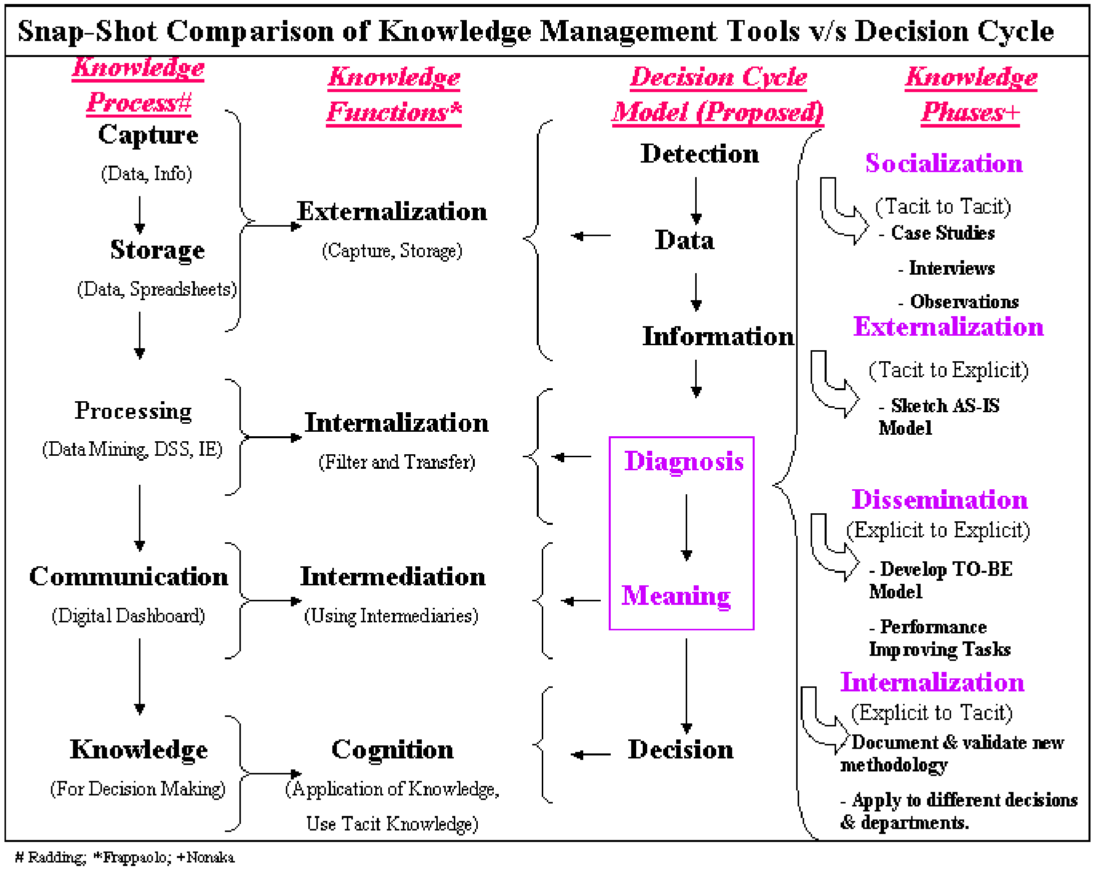

Figure 4.1: Snap-Shot Comparison of Knowledge Tools & Decision Cycle Model

As can be seen in figure 4.1, the initially proposed Decision Cycle Model draws a close resemblance with the different principles of knowledge management. Further, Information Engineering (which is at the heart of the Decision Cycle Model, and represented by the 'Diagnosis' and the 'Meaning" components), is being compared and explained using the four knowledge phases, and this approach, in conjunction with the IDEF0 process mapping technique, forms the basic foundation for conducting the research study. The knowledge phases can be further explained in the following manner:

- *Socialization Phase* (Tacit -to- Tacit) - Document current method of decision-making in the textile plant(s) for the particular decision. This was accomplished by the use of case studies, personal interviews and sharing insights and experiences by spending "work time" with the decision-maker.

- *Externalization/Articulation Phase* (Tacit -to- Explicit) - Based on the information gathered through questionnaires, interviews and experiences gained, the AS-IS scenario for the particular decision-making process was developed.

- *Dissemination/Combination Phase* (Explicit -to- Explicit) - The inferences drawn from the AS-IS model were used to design and create a TO-BE model for the particular decision process, in the form of a Best Practices decision-making process for the weave-room that identified and explicitly illustrated the important, relevant components with reference to the particular decision.

- *Internalization (Explicit -to- Tacit)* - With the information obtained from the TO-BE model, the information engineering methodology was developed that could result in reduced information overload, increased data utilization and enhanced decision-effectiveness. This methodology can be later applied to different decisions across different departments of a manufacturing plant.

4.4 Research Contributions -

The main purpose of this research was to understand, define and map the AS-IS and TO-BE models for the weave-room performance decision-making process, and develop an Information Engineering methodology. In addition to benefiting the industry, this research will also provide an insight to the academic world (teaching, research and students) into the decision-making process in one sector of the textile industry. Hence, the expected research contributions encompass the following:

- *Contribution to published management theory* – Illustrate and demonstrate the conceptual understanding of knowledge management, information engineering and quality with reference to the decision-making process, especially in one sector of the textile industry; develop an Information Engineering methodology for effective and efficient decision-making by the textile plant personnel; analyze the use of IDEF0 as a tool for capturing decisions.

- *Contribution to industry viability* – The resulting AS-IS decision-process models could be used as reference models by each of the textile weaving plants, to understand their respective current decision processes and compare them with the Best Practices TO-BE model. Additionally, the benefits of the TO-BE model can be extended to other weaving plants that would be seeking to enhance the decision-making process of their weaving plants.

4.5 Research Deliverables –

Based on the research goals and approach, the research deliverables are:

- A structured, well-defined AS-IS weave-room performance decision-making process map for each plant.
- A TO-BE Best Practices map that could be used by and weave-room plant.
- A listing of key performance improving tasks for enhancing the weave-room performance decision-making process.
- A SWOT analysis of the usability/functionality of IDEF as a tool for analyzing plant-specific manufacturing decisions.
- A generic Information Engineering methodology for mapping manufacturing decisions across different plants.

4.6 Research Summary –

The goal of the research was to fundamentally enhance the decision-effectiveness of the textile personnel on the plant floor, using the Decision Cycle Model as the basis, as well as using the knowledge management principles reviewed in the literature. The Information Engineering approach could prove to be a valuable asset in improving data and information quality with the use of knowledge management and modeling tools, thereby reducing the overload (information overload) that tends to occur in the present generation highly automated machinery. In combination with Knowledge Management, Information Quality and Decision-Making, the Information Engineering Methodology can eventually lead to the development and creation of a kind of Digital Decision Dashboard (D^3), which would be the decision-making tool of the next generation for the textile industry. A digital dashboard is defined as a customized solution for the knowledge workers that consolidates personal, team, corporate and external information and provides a single click access to analytical, and collaborative tools (Microsoft, 2000a). It brings an integrated view of a company's diverse sources of knowledge to an individual's desktop, enabling better decision-making by providing immediate access to key business information. Dashboards are a sophisticated way of presenting vital information in an "at-a-glance" graphical format, always with the option of drilling down into the details of the data (Ricketts, 2005). The D^3 can be a similar tool for decision-making in textiles, capturing and disseminating vital management information for effective and efficient decision-making, thus addressing a critical need presently facing the textile industry.

5 DATA COLLECTION & ANALYSIS

5.1 Introduction -

To completely describe a manufacturing system, several models are usually created, each from a different viewpoint. Traditionally, these models were created independently using different methodologies and in different environments. The ICAM developed IDEF standards provide techniques for function and information modeling. These techniques are widely accepted in the government and commercial sectors (Peters, 1997). IDEF provides a means of capturing the dataflow and ancillary properties of a process and is more discipline than structured analysis. The one significant capability that it lacks is capturing the dynamics of the process. IDEF0, the standard for function modeling, is widely applied to analysis of business processes, including textile processes, wherein it was used to study and develop the textile and apparel industry AS-IS and TO-BE enterprise models (Lovejoy, 2002) (Jayaraman, 1992). IDEF's use permits an understanding of the broad perspective of the intrinsic component functions of the manufacturing process, and the flow of information and materials between them (Harrington, 1985). Although the IDEF literature states that it could be used for modeling decisions (in addition to processes), not much research has been conducted in this particular application of IDEF. The following case studies use IDEF0 for decision mapping/modeling. As stated in the research approach section of chapter 4, three textile weaving plants were selected for the case study approach. The identities of the three plants have not been revealed for disclosure risk reasons; and have been referred to as Case_1, Case_2 & Case_3. Wizdom Software's Process Works module was used to map the various components of the decision-making process of the three plants that were studied and analyzed as part of this research process. All the standards and principles for IDEF have been followed in defining and developing the AS-IS maps for the case studies. The viewpoint and the purpose for all the cases studies was consistently the same, in order to maintain stability and integrity of the IDEF mapping technique. Three main outputs of the Wizdom software are the graphic IDEF diagrams (that are shown as part of the case study write-up), the IDEF0 glossary (terms and their definitions) and text (in the form of attachments of reports/screen-shot examples that are part of the Appendices). In this respect, one specific custom addition to the maps was in the form of "dotted arrows" that signify the presence of some form of attachment (document, report, process example, etc.) that was present in the appendix for that relevant decision/task.

5.1.1 IDEF0 Glossary

This glossary consists of all the terms (activities/tasks, as well as the input, control, output and mechanism arrows) that are used in the development of the three weaving plant AS-IS process models, as well as the TO-BE, Best Practices process model.

Term	Definition
1st Shift Technician	Technician from 1st. shift
3rd Shift Personnel	Personnel working in 3rd. shift
3rd Shift Supervisor	Supervisor working in 3rd. shift
3rd Shift Technicians	Technicians from 3rd. shift
Action Plan	Planned course of action
AFS Report	Available For Sell Report from MainFrame System that provides information on weekly demand, production in-process, orders, net fabric available, etc.
Airjet Technician Training Sheet	An Exercise completion sheet for training an employee for the Airjet Technician position
Allocate Appropriate Resources	Allocation of Resources in an appropriate manner
Allocate Cleaning Resources	Allocate Cleaning Resources
Allocation Plan	Structure approach to allocate resources
Alternative	Possible solution for the problem
Assess Situation	Evaluate the situation
Atmospheric Condition Management	Manage atmospheric conditions
Attend Morning Meeting	Attend Morning Meeting
Availability Plan	Plan with reference to available resources
Availability Procedures	Availability of cleaning personnel, material resources needed and time to perform the required tasks
Background Information	Background Information

BARCO	Loom Monitoring System that provides all the relevant information about the looms
BinStock	Warehouse where all the yarn received is stored and regular inventory is carried out by warehouse staff
BOM Example	An example of a Bill of Material (BOM) inquiry to estimate the material required to manufacture the selected pattern
Bookings Report	Week-To-Date Bookings Report provided by Corporate Office
BPCS System	An ERP type computer system that is primarily used for purchasing, planning production schedules, financials, customer service and generating several other types of reports
Check & Provide Feedback	Check & Provide Feedback
Check Completed Work Order	The completed work order is reviewed and feedback provided to the MWRS system for use in the future
Check Inventory Levels	Check Inventory Levels
Check Plant Floor Issues Regularly	Safety, working conditions and other plant floor issues, keeping a constant watch on all matters of the weave room
Check Vendor Yarn Availability	Check with major vendors as to their availability of yarn for filling and warp
Clean Plant	Clean the Plant
Cleaned Plant	Plant that is cleaned
Cleaning Material	Dusting, mopping, cleaning, etc. supplies
Cleaning Plan	Carefully drafted cleaning approach
Cleaning Tasks	Examples of cleaning tasks
Cleaning Tasks (Sweeper)	An example of cleaning tasks for sweeper for all 3 shifts
Control Plant Conditions (Engineering)	Unit that is responsible for controlling all the atmospheric and the facility engineering related conditions within and outside the plant
Controlled Conditions	Controlled atmospheric conditions as a result of regulating the conditions as per production needs
Controlled Optimal Atmospheric Conditions	Best possible atmospheric conditions
Coordinate Order Delivery	Customer Service coordinates with other units for on-time delivery of customer orders
Coordinate Production Activities (Production)	This unit is responsible for coordinating the production related functions within the plant.

Coordinate Sample Weaving	Coordinate all activities related to weaving samples as per instructions from the central design team
Coordinate Training	Coordinate training activities/schedules for employees and develop training manuals for specific job functions
Coordinate Weaving (Production,Technical, Engineering,HouseKeeping)	This unit is responsible for coordinating all the production related functions within the plant, as well as technical, housekeeping and plant conditions (maintenance and atmospheric conditions)
Corporate Sales & Forecast	Forecast and sales requirements as submitted by the corporate team
Create Production Orders	Create Production Orders that have all the information needed for the weave-room personnel to weave that order on the specific loom
Create Shop Orders	Shop orders are work orders that have all the information needed for the weave-room personnel to weave that order on the specific loom
Create Work Orders	Create Work Orders
Customer Demands	Customers tend to demand or change their requirements with regards the due dates for the order delivery
Customer Orders	Customer Service submits order requirements through the BPCS system
Customers	Customers who submit their orders to the company
Daily Morning Meeting	Senior management meets every morning @ 8:30am to discuss various ways to optimize resources for maintaining or improving efficiency
Daily Sample Report	Daily Sample Report sent to the Central Design Team to review the latest status of the sample weaving progress
Deliver Piece Ticket	Deliver ticket with all relevant information for weaving the particular style to the weave-room
Deliver To Weaving	Style Master and Piece Ticket delivered by planning associates to weave-room
Delivery Dates	Dates by which customer orders need to be delivered
Design Flow Example	Steps to get the list of Mfg To Print Head End specification sheets so that all the relevant needed raw material and information for the particular sample that needs to be woven can be obtained
Design Team	The Designing team based at a remote location
Determine Available Resources	Determine Available Resources
Determine Need to Mfg	Decision to manufacture or not, based on the inventory levels, loom availability and customer delivery schedules
Determine Raw Material Requirement	Based on the demand from planning, determine filling and warp requirement
Determine Style Requirement	Determine Style Requirements

Discuss Mechanical Breakdowns	Discuss mechanical breakdowns constantly with the technologist and his team
Discuss Potential Alternatives	Discuss Potential Alternatives
Discuss Potential Solutions	Discuss Potential Solutions
ERP System	An ERP information/computer system that is primarily used for purchasing, planning production schedules, financials, customer service and generating several other types of reports
Estimate Yarn (warp, filling) Requirements	Estimate both, warp and filling yarn requirements
Evaluate High Stop Looms	Evaluate and analyze reasons for stopped looms
Evaluate Potential Solutions	Evaluate potential solutions based on interaction with plant personnel and reviewing and researching information using BARCO
Example of Researching info	An example of researching information to resolve production problems
Examples of Reports	Examples of a few reports generated for senior management
Execute Style Change	Do the needful for style change
Execute Work Order	Complete the Work Order
Execution Plan	Plan to execute the Work Order
Existing Cleaning Tasks	Existing Cleaning Tasks
FabTrack	Information System that provides all information on yarn and cloth inventory and position
Facility Maintenance Management	Facility Maintenance Management
Feedback	Provide information on latest status of the situation
Filling Report	Yarn Filling Report
Generate New Orders List	Generate and print out the list of new planned orders that need to be woven
Generate Reports	Design and generate various daily, weekly, monthly plant level reports on production, efficiency, quality, cost, labor, performance, etc.
HeadEnd Sheet	Design specification sheet that spells out the information needed to weave the sample
Historical Information	Information on past customer orders and style history, as seen on MainFrame System
HVAC	System to control the atmospheric conditions
Implement Solution_Production	Implement Appropriate Solution for production related problems

Implement Solution_Production-Technical	Implement Appropriate Solution for production and technical related problems
Implement Solution_Technical	Implement the best possible solution for technical related problems
Inprocess Inventory	Material that is in-process (somewhere in the plant)
Inspection Report	Greige fabric inspection quality report
Internal Yarn Availability	Yarn available in-process or internal inventory
Inventory Levels	Loom/Machine Parts availability in supply room
Keep Plant Clean	Responsible for housekeeping and maintaining a clean plant environment
Keep Plant Clean (House-Keeping)	HouseKeeping unit that is responsible for keeping all the sections (inside and outside) of the plant clean, including offices, machines, restrooms, parking lots, etc.
Late Order Report	Bookings report, providing information on orders that are late and upcoming in the next several weeks
List of Reports	A summarized version of the different types of daily, weekly and monthly reports that are generated for the plant level senior management
Loom Report	Loom Schedule report that lists all the looms and the status of material running on them
Loom Status	Handwritten status report of the various patterns running on the looms and their corresponding information related to warps and time left for warp-outs
Looms	Equipment that manufactures cloth
Machine Shop	Machine shop used for engineering, replacing weave-room equipment parts and maintaining atmospheric conditions
Machines	Looms and all other weave-room equipment
MainFrame System	Computer system that is primarily used for planning production schedules, generating different reports and other planning functions
Maintain Optimal Conditions	Maintain the best possible atmospheric conditions
Maintain Optimal Facility Conditions	Maintain the best possible plant facility conditions
Maintain Optimal Weave-Room Performance	Maintain the best possible weave-room performance
Maintain Optimal Weave-Room Performance (CONTEXT)	The overall top-level objective of every weave-room is to maintain the most optimal performance levels, that are measured in terms of efficiency, picks inserted and other similar parameters
Maintain Optimal Work Conditions	Maintain best possible working conditions

Maintain Production Machinery (Technical)	Technologists are responsible for maintenance and settings of all the production machinery, including break-down and preventive maintenance
Maintain Quality (Quality Control)	Address and attend to all quality control related matters with reference to both, yarn and fabric
Market Trends	Trends based on market demand and customer needs
Mfg or Not Mfg	Manufacture or not manufacture the style
Monitor Atmospheric Conditions	Monitor the atmospheric conditions (temperature, humidity, etc.)
MWRS	Maintenance Work Request System (MWRS) - contains all information to with reference to maintenance work order status and updates
MWRS History Example	An example of the MWRS History Display Menu, Display by Name and specific listing of a work order
MWRS Menu	MWRS Main Menu Display
New Cleaning Tasks	New Cleaning Tasks
New Orders	New sampling orders that arrive from the corporate office
OJT	On the job training instructor; employee whose additional function is to train a new employee
Ontime Delivery	Ontime delivery of customer orders
Open Order Report	To-Date Bookings Report providing detailed information on the style requirements
Optimal Weave-Room Performance	Best possible weave-room performance, especially with reference to plant efficiency
Ordering example	A step-wise snap-shot system example of ordering yarn required as per requirements from planning
Orders	Customer Orders that come in via EDI, fax or email
OTOM Report	On Time Order Management System Report providing information on the filling yarn requirements
Personnel- Cleaning	Contract Personnel
Piece Ticket	Ticket with all relevant information for weaving the particular style
Plant Maintenance System	A comprehensive plant maintenance computer information system, that could assist in maintaining information of all the plant-wide maintenance work requests, as well as monitor and regulate the atmospheric conditions of the plant
Plan Production (Planning)	Planning unit is responsible for planning and scheduling the looms in the most optimal way.
Planned Orders Report	Report that lists all the new items that need to be woven, along with their corresponding warp item numbers and quantities needed
Planner	Responsible for production planning and scheduling looms

Planning Dept	Unit responsible for planning and scheduling functions
Plant Manager	Plant Manager
Plant Personnel	All personnel involved in particular plant functions
Plant X Schedule	Source of warp and filling yarn
PlantFloor Interaction	Continuous plant floor meetings, interactions and discussions with plant personnel
PM List	Preventive Maintenance check list
Prepare Samples (Product Development)	Develop new samples as per the direction of the central designing office
Preventive Maintenance	Maintenance schedules performed to on a regular basis for maintaining machinery and equipment in continuous working and good condition
Prioritize Resource Allocation	Based on urgency and need of the Production (Work) Order, determine priority of resource allocation
Problem Issues	All issues that are causing problems in that unit
Process Customer Orders	Enter data into the system with reference to the customer orders as they are received via some form of written documentation
Process Customer Orders (Customer Service)	Customer Service unit receives customer orders via EDI, fax or email, enters into the system and generates the planning and purchasing requirements
Process Example	A snap-shot screen printed example of the process
Product Parameters	All aspects of products (yarn, warp, fabric)
Production Dept	The Production unit that is responsible for manufacturing the cloth
Production Schedules	Production scheduling with reference to looms and plant personnel
Propose Suggestions	Propose Appropriate Suggestions
Purchase Raw Material (Purchasing)	Purchasing department that is responsible for ordering filling yarn and warp
Purchasing Dept	Purchasing department that is responsible for ordering yarn
Purchasing Manager	Manager responsible for purchasing of raw material
QC Manager	Quality Control Manager
QC Stop Ticket	Loom stopped due to Quality related problems
Quality Labs	Quality labs that test yarn quality issues
Quality Notice	Report on quality related problems; provides information on problem, its origin, present status, etc.

Raw Material Purchased	Raw Material purchased based on order requirements
RBS Report	Requirements By Style (Weaving Requirements) Report
Receive Style Orders	Style orders are received by the Planning Dept.
Regulate Conditions As Needed	Keep control on atmospheric conditions
Research Historical Information	Research Historical Information
Resolve Standing Looms	Allocate plans for looms that are standing due to any reason
Return Material	Based on the yarn/fabric quality as compared to the standard, return the material(yarn) back to the supplier for exchange of quality yarn; or if fabric, as seconds
Review Inventory	Continuously review inventory levels, for current and future needs, as well as to maintain optimal inventory levels
Review Production Problems	Review and address production problems with technologist and 3rd. shift supervisors
Review Production-Technical Problems	Review and address production and technical problems/issues with 3rd shift supervisor and technicians
Review Quality Problems	Any yarn/fabric quality related problems
Review Technical Problems	Review Technical Problems
Review Work Orders	Review Work Orders
Roaming Inspector	Roams the weave room and checks swatches of cloth against standards, both for accuracy and quality
Run Out Form	Production Run Out form filled by supervisors from different shifts and handed to Plant Manager; contains information on warp outs, style changes, no fillings/warps, mechanical problems, etc.
Run Out Report	Production Run Out form filled by supervisors from different shifts and handed to Plant Manager; contains information on warp outs, style changes, no fillings/warps, mechanical problems, etc.
Sample Instructions	Instructions for actions/status of sample weaving
Sample Specs	Designers from the central design team provide sample specifications for weaving different samples with various combinations
Schedule Cleaning	Schedule Cleaning
Schedule Cross-training	Schedule cross-training to ensure all weave-room housekeeping tasks are performed during the absence of any cleaning personnel

Schedule Loom	Schedule loom for weaving
Schedule Loom Set-up	Schedule Loom Set-up
Senior Management	Unit/Department Managers
Shift-End Report	Shift-end report prepared by shift supervisors/technicians that provides information on warp run-outs, material/machinery issues/problems, miscellaneous problems
Solution	Best possible solution for solving the problem at hand
Source & Maintain Yarn Quality (Sourcing & Quality Control)	Address and attend to all quality control related matters with reference to both, yarn and fabric
Source New Yarn	Obtain yarn from new vendors
Special Projects	Coordinate and develop training modules and methods; perform Industrial Engineering studies; generate various production related company-wide reports for senior management
Stops Report	BARCO report that provides information on warp and filling related loom stops status
Style Changed	Raw material for new style introduced on the loom, as per requirement
Style Master	Provides all information with reference to the style that needs to be woven
Submit Purchase Order	Submit order for raw material based on requirements, availability and inventory levels
Supervise Plant Conditions	Responsible for maintaining optimal plant and atmospheric conditions
Supervise Supply Room	Keep a check on supply room inventory for prompt availability of supplies as required by the weave room
Supervise Warp-Filling Changes-Issues	Style Changes, Warp Changes, Filling Changes; in-charge of all personnel and activities related to these tasks
Supply Room clerk	Clerk keeps all records of supplies that come in and go out of the supply room and provides a regular report to weaving supervisor and plant manager
Technicians	Technical folks that are cross-trained and responsible for and assigned all types of electronic, as well as mechanical tasks to fix
Technologist	Technical Specialist
Vendor Inventory	Availability of filling or warp yarn with the vendor
Vendor Yarn Availability	Vendor Yarn Availability
Warehouse Inventory	Material that is available for use in the supply room
Warp Crew	Responsible for warp changes, run-outs, style changes

Warp Patrol Sheet	Status of warp at different places within the weave room
Warp Report	Report that displays the status of the warp running on different looms for different styles
Warp Status Report	Handwritten warp status report created by weaving supervisor in charge of the warp requirements for weaving (Warp outs, warp on floor, warp changes, style changes)
Warp Teams	Teams that are responsible for style change, warp-outs
Warping Dept	Warping Department is responsible for producing and delivering all warp on schedule
Weaving Manager	Manager in charge of production and other related functions
Weaving Supervisor	Weaving supervisor in charge of production activities
Work Order	Facility maintenance related work request
Woven Sample	Sample woven as per designer instructions
Yarn Availability	Availability of yarn from the new vendor when needed
Yarn Expeditor	Sample yarn hauler who is responsible to collect all the required yarn for sample and regular production weaving
Yarn Inventory	Yarn that is available for use
Yarn Planner	Staff responsible for planning the yarn requirements
Yarn Shows	Attend a few yarn shows to find out the new varieties and vendors of yarn
Yarn Suppliers	Yarn purchased from outside parties
Yarn Vendor Report	Vendor report stating the availability status of yarn within their facility
Yarn Vendors	Yarn purchased from outside parties

5.2 Case_ 1_Study -

5.2.1 Introduction

Case_1 study was conducted at a jacquard weaving plant. The plant operations began in the late 1980's. The original ownership changed to a new owner in early 2000. The original product-mix of the plant included upholstery and mattress-ticking. According to the Plant Manager, since the upholstery related business partners relocated to an international location, the plant's upholstery business also moved offshore. Presently the plant's core business is only mattress-ticking. The new parent company, which has bought a few other textile businesses in the domestic market, has been consolidating most of its domestic operations, while exploring new international partnerships and collaborations. The plant purchases most of its raw materials (yarns) from one of its sister companies, while some is being purchased from a few other yarn vendors. The warp is primarily polyester and the filling is cotton, rayon, acrylic and other diversified types of yarn as per the style requirements. The plant has more than 150 looms, but operates only about 60-65 at the present time, based on market orders. The production levels are in the range of 400,000 yards/week. The plant operates on a 5 day/week and 3 shifts /day schedule. There are slightly more than 150 total employees, including salaried staff and hourly employees. The Weave-Room performance decision-making process for Case_1 is modeled with the aid of diagrams using IDEF0 methodology. (Please refer IDEF0 Glossary section 5.1.1 for term definitions).

5.2.2 Level A-0

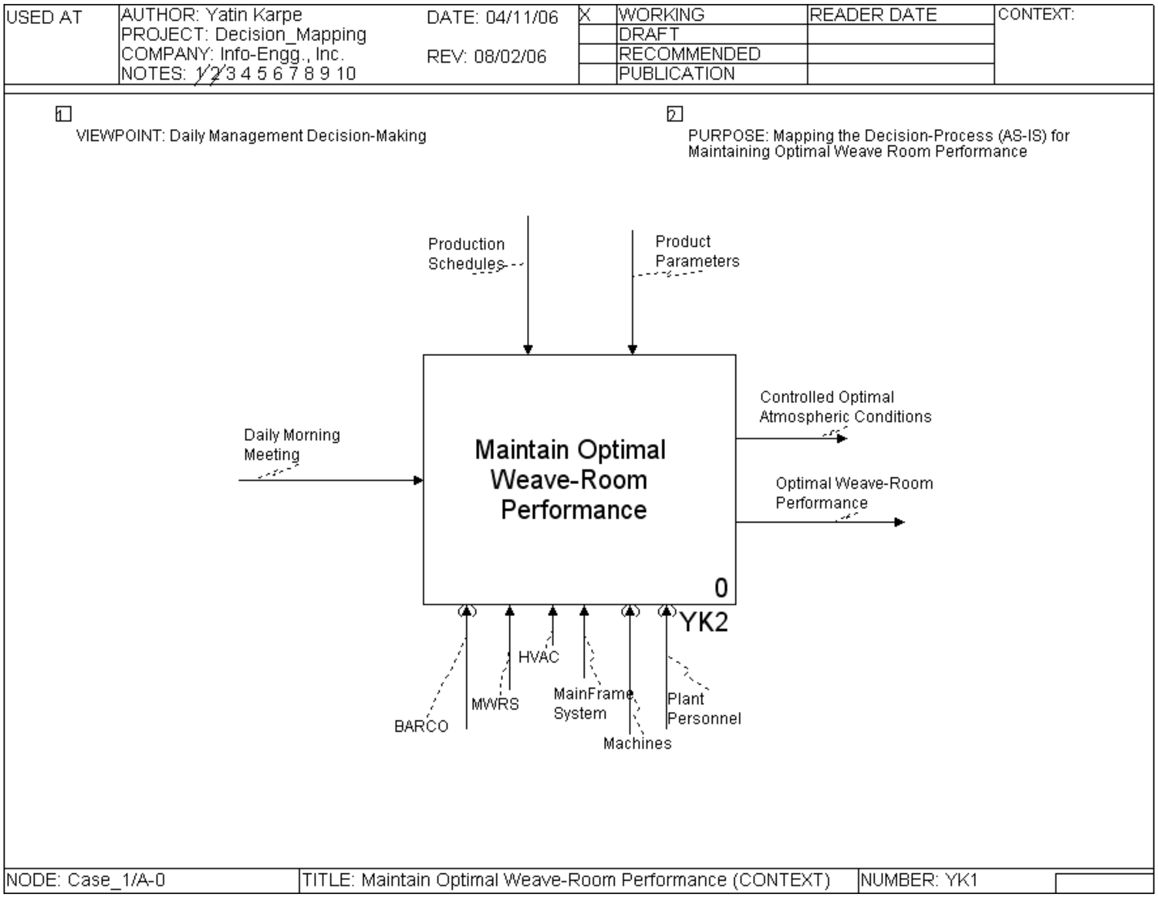

Figure 5.1: Context Diagram-Case_1 (A-0)

The main function of the plant is to maintain optimal weave-room performance, which is shown in the top-level Context Diagram (figure 5.1). The key decision-makers meet during the daily morning meeting to discuss various day-to-day production and related issues, and try to come up with the best possible alternatives to resolve them and to maintain the best possible weave-room performance. Product parameters and production schedules constrain the weave-room performance, while various information systems (such as BARCO, Main-Frame systems, MWRS) prove to be valuable resources in maintaining optimal weave-room performance. The Context Diagram shown in figure 5.1 subsequently breaks down into lower functional levels as shown in figure 5.2, so as to understand the different decision-making units and their corresponding decision-makers.

5.2.3 Level A0

Figure 5.2 identifies the key decision-making units and the corresponding decision-makers. At this level, the Plant Manager is the overall decision-maker and coordinator of the various decision-making units. The decision-makers are:

House-Keeping (H.K. Manager)

Engineering (Plant Engineer-P.E.)

Production Planning (Planning Manager)

Technical (Technologist)

Production (Weaving Supervisor)

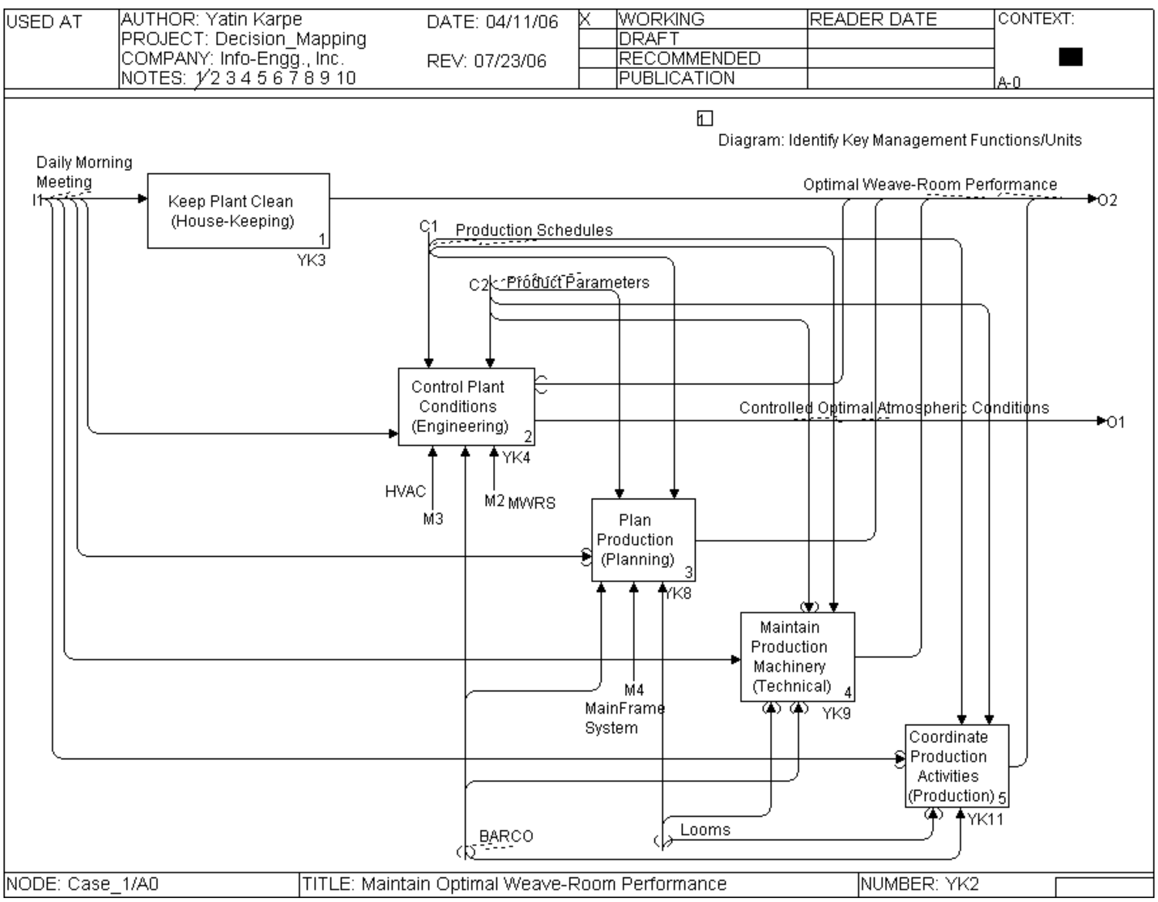

Figure 5.2: Maintain Optimal Weave-Room Performance (A0)

Each of these decision-making units are explained in some detail in the following diagrams, in context of their daily decisions and tasks that they perform, along with a couple of examples wherever possible.

5.2.4 Level A1

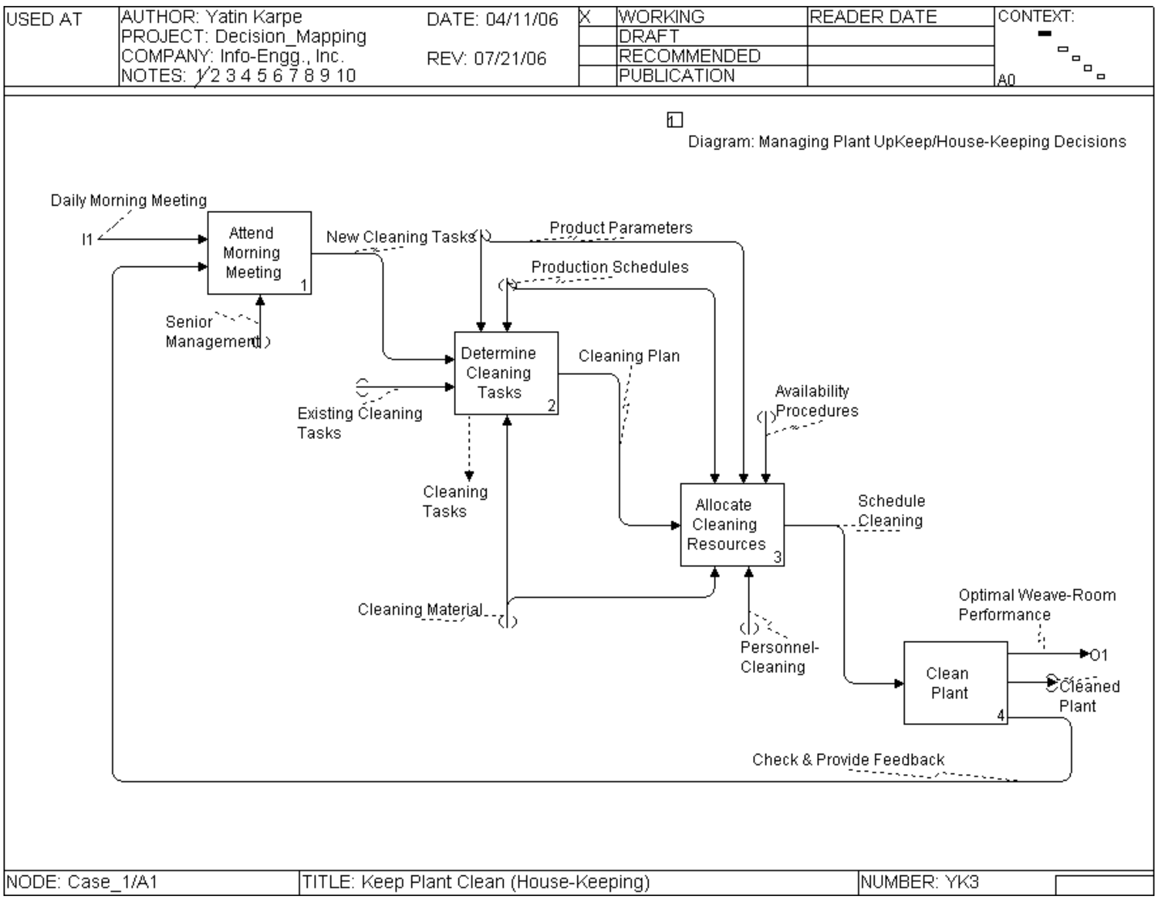

Figure 5.3: Keep Plant Clean (A1)

In this process, the decision-maker is the House-Keeping (H.K.) Manager. The H.K. services are contracted out to a company and they have a manager in charge of maintaining a clean weave-room atmosphere. The kind of decisions and tasks that are carried out by the H.K Manager are shown in figure 5.3 and described as follows:

1. Attend Morning Meeting: The H.K. Manager attends the morning meeting and gets feedback on any new cleaning tasks from the senior management, or is updated if there are any tasks that need special attention.
2. Determine Cleaning Tasks: Based on this input, the H.K. Manager determines the daily cleaning tasks, taking into consideration the existing daily cleaning routines that need to be followed by the cleaning personnel. An example of the cleaning tasks involved in maintaining a clean weave-room is attached in Appendix A, figure A1 to A3. Figure A1 lists all the building & areas in the weaving plant that need house-keeping. Figures A2 and A3 are examples of tasks that need to be performed at the inter-plant offices and restrooms, respectively. Similar cleaning tasks exist for cleaning other parts of the plant. Cleaning in the weave-room area is dependent on the production schedules, as well as product parameters.
3. Allocate Cleaning Resources: Based on the cleaning plan and availability procedures, the H.K. Manager allocates the cleaning resources to schedule cleaning of the weave-room. At the same time, the Manager coordinates and schedules cross training of the cleaning personnel, especially due the uncertain nature of their attendance at work.
4. Clean Plant: Once cleaning resources are allocated and tasks scheduled, the plant is cleaned. Feedback is provided to the senior management, either at the daily morning meeting or by personal contact.

5.2.5 Level A2

In this process, the decision-maker is the Plant Engineer (P.E.), who is mainly responsible for two functions: Facility Maintenance Management, and Atmospheric Conditions Management within the plant. The kind of decisions and tasks performed by the P.E. are shown in figure 5.4. The Facility Maintenance is managed using a unique, custom-built Maintenance Work Request System (MWRS), while the Atmospheric Conditions are managed using the computer system that monitors the temperature and humidity conditions at various points within the weave-room and allows for systems-based modifications of conditions from one central computer.

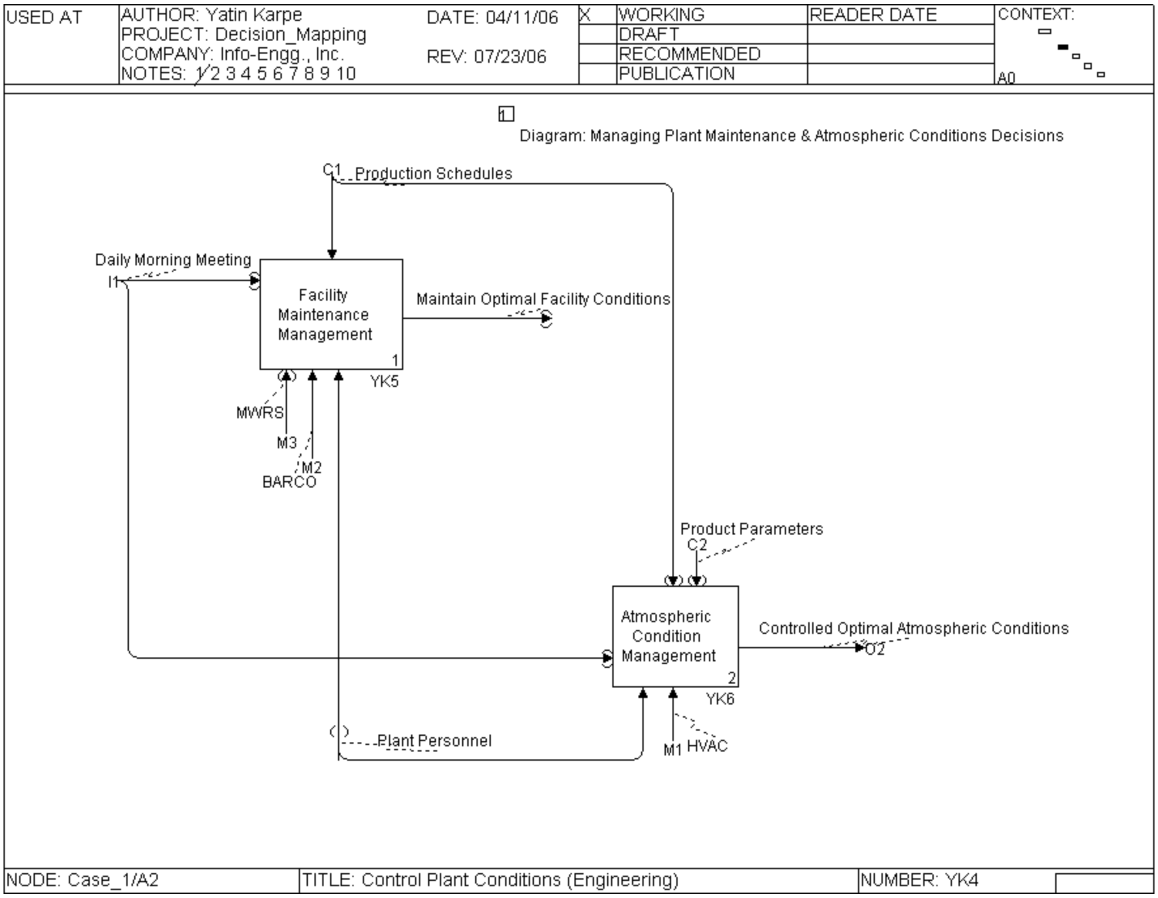

Figure 5.4: Control Plant conditions (A2)

Figure 5.5 further explain the Facility Maintenance Management and figure 5.6 shows the Atmospheric Conditions Management.

5.2.5.1 Level A21

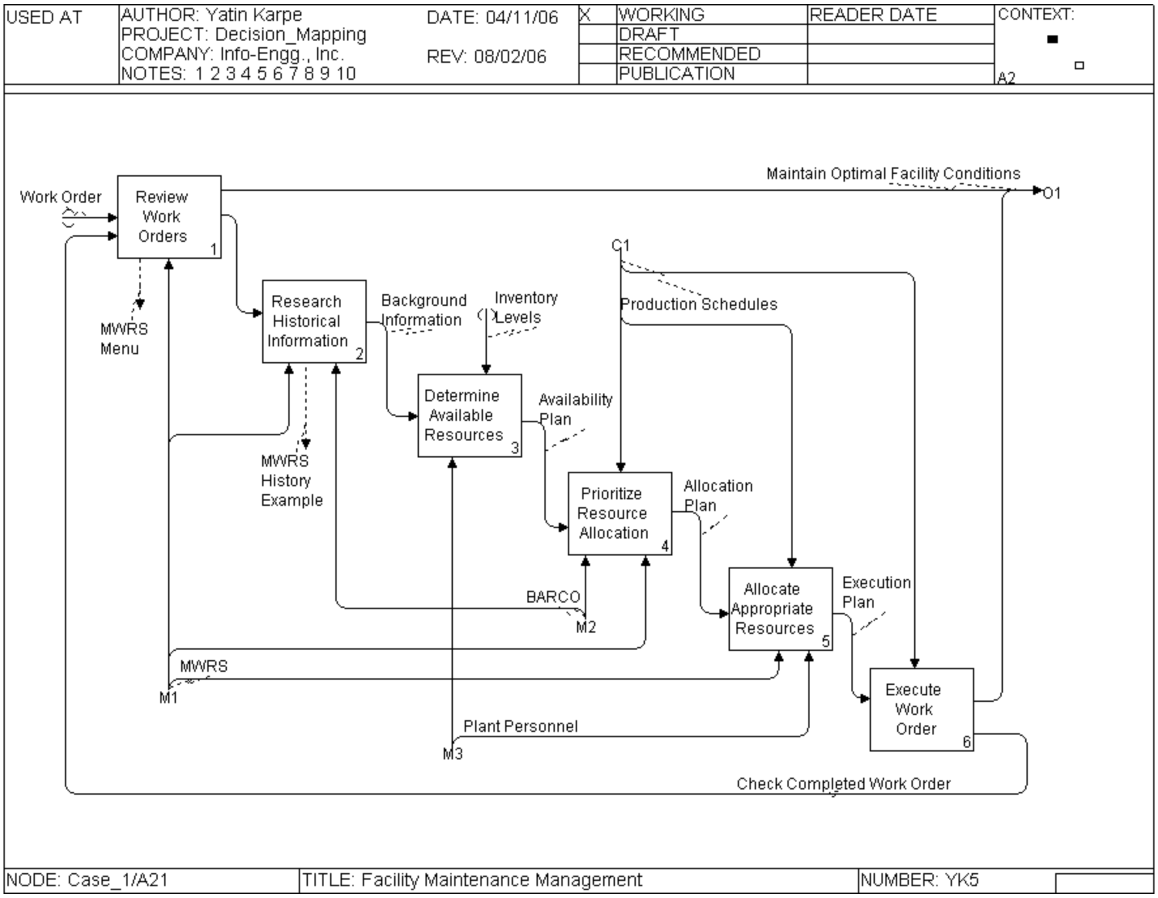

Figure 5.5: Facility Maintenance Management (A21)

1. Review Work Orders: Whenever there is a maintenance work order request, it is entered into the MWRS and the P.E. reviews all new and old orders every morning. Appendix A figure A4 shows the screen-shot of the main menu of the MWRS, which displays different options for viewing the work orders. The options used at this step are either “Display All Requests” or “Quick Response Display”.
2. Research Historical Information: In this step, the P.E. uses the “History Display Menu” option and reviews historical information for the work order, in order to research the problem further, along with BARCO, if necessary. Appendix A figure A5 shows an example of the screen-shot of the History Display Menu, History Display by Name and an example of a specific work order listing. Other options could also be chosen from the History Display Menu, based on the

requirement for researching the problem. This listing gives the P.E. information on the specific problem, its time of occurrence and the steps taken to resolve the same, in the form of notes in that work order listing. It also specifies the location and how long the problem persisted. This information is used as background information to move to the next step.

3. Determine Available Resources: At this step, based on the historical research and the inventory levels, the P.E. determines the availability plan in terms of available resources and plant personnel.
4. Prioritize Resource Allocation: Based on the production schedules and the need or urgency of the work order, the P.E. prioritizes the orders that need to be attended and determines an allocation plan.
5. Allocate Appropriate Resources: The P.E. then allocates the resources for attending to the Work Order and discusses the execution plan along with his staff.
6. Execute Work Order: Based on all the previous steps, the appropriate plan is executed to complete the work order. Entering the information in the MWRS provides a feedback, so that the same information can be used in the future as historical data for researching similar problems.

5.2.5.2 Level A22

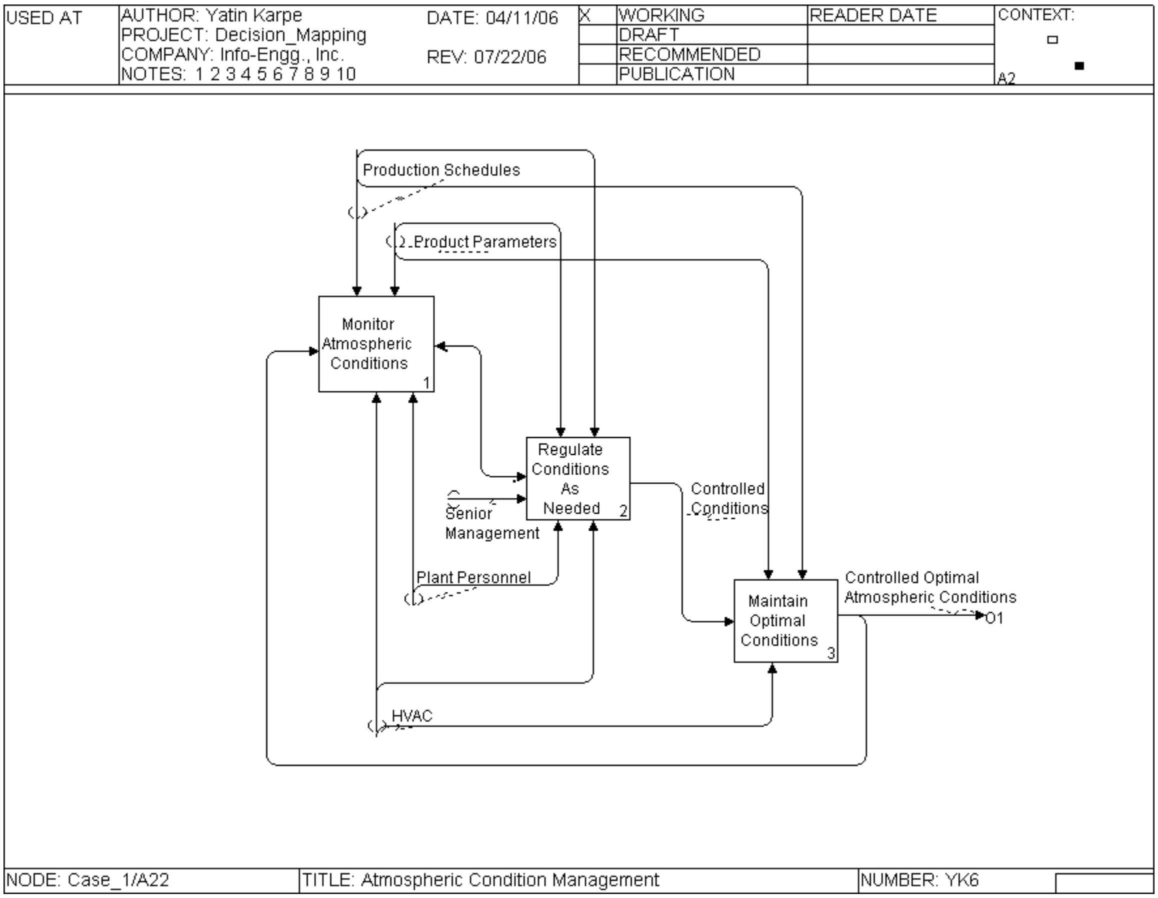

Figure 5.6: Atmospheric Conditions Management (A22)

1. <u>Monitor Atmospheric Conditions</u>: The P.E. monitors the atmospheric conditions using a HVAC control central computer system.
2. <u>Regulate Conditions As Needed</u>: Based on the requirements of the production schedules and product parameters, the P.E. in consultation with the plant personnel, regulates the temperature and humidity conditions as needed, resulting in controlled conditions.
3. <u>Maintain Optimal Condition</u>: The previous steps lead to maintaining optimal atmospheric conditions needed for the efficient running of the weave-room plant.

5.2.6 Level A3

In this process, the decision-maker is the Planning Manager, who is responsible for planning and scheduling looms, based on the orders received from the corporate office. The types of decisions and tasks performed by the Planning Manager are shown in figure 5.7 and described as follows:

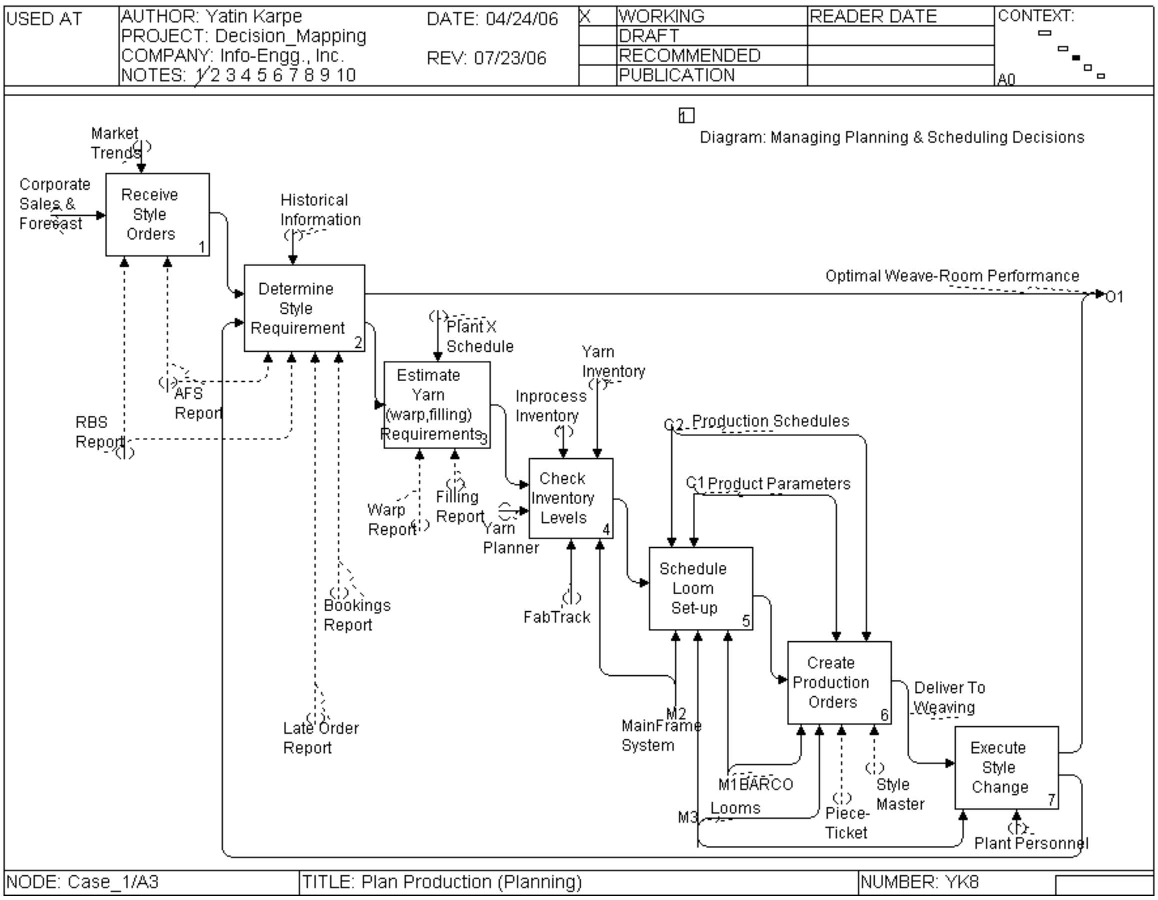

Figure 5.7: Plan Production (A3)

1. <u>Receive Style Requirements</u>: The Planning Manager receives the style requirements from the corporate office, based on market trends.
2. <u>Determine Style Requirement:</u> The Planning Manager then reviews the Late Order Report (Appendix A, figure A6) and the Bookings Report (Appendix A, figure A7) to determine the style requirements for new orders, as well as check on the late orders. Simultaneously, the

Planning Manager also reviews the Available for Sell (AFS) Report (Appendix A, figure A8) and checks if the late orders are in process or if there is any potential to meet the late orders with in-process production orders or if there is a need to schedule them on an urgent basis. Once that matter is resolved, the Planning Manager reviews the historical information of the customer who is ordering new bookings, and reviews the Requirements by Style (RBS) Report (Appendix A, figure A9) order to determine the style requirements for the new orders.

3. Estimate Yarn (warp, filling) Requirements: At this stage, the Planning Manager reviews information obtained from the Warp Report (Appendix A, figure A10) and the Filling Yarn Report (appendix A, figure A11) to estimate the raw material that is being used at that moment, so that it can be compared to the requirements of the new styles that need to be produced. An important consideration at this point is the schedule of a sister concern, Plant X schedule, which manufactures and delivers all warp and most of the filling yarn.

4. Check Inventory Levels: At this step, the Planning Manager in consultation with the Yarn Planner, review the in-process inventory, as well as the yarn inventory using FabTrack and the MainFrame system.

5. Schedule Loom Set-up: Once the inventory levels and the raw material requirements are reviewed, the Planning Manager schedules the loom for the particular style item number, based on the information gathered from the previous steps. Both the BARCO and the MainFrame system is extensively used at this stage to review and schedule the appropriate loom, based on the product parameters of the item that is to be woven, as well as the production schedules of the looms in the weave-room.

6. Create Production orders: At this stage, once looms are scheduled, Production Orders are created for particular looms. Appendix A, figure A12 shows an example of the Piece Ticket and figure A13 shows the Style Master that is generated. Again, this step is constrained by the current production schedules and the product parameters, as well as

ever-changing customer demands to obtain their orders earlier than scheduled.

7. Execute Style Change: At this point, the personnel from the planning department will take the Piece Ticket and the Style Master to the weave room area that triggers the production plant personnel to execute the style change for weaving the new styles.

5.2.7 Level A4

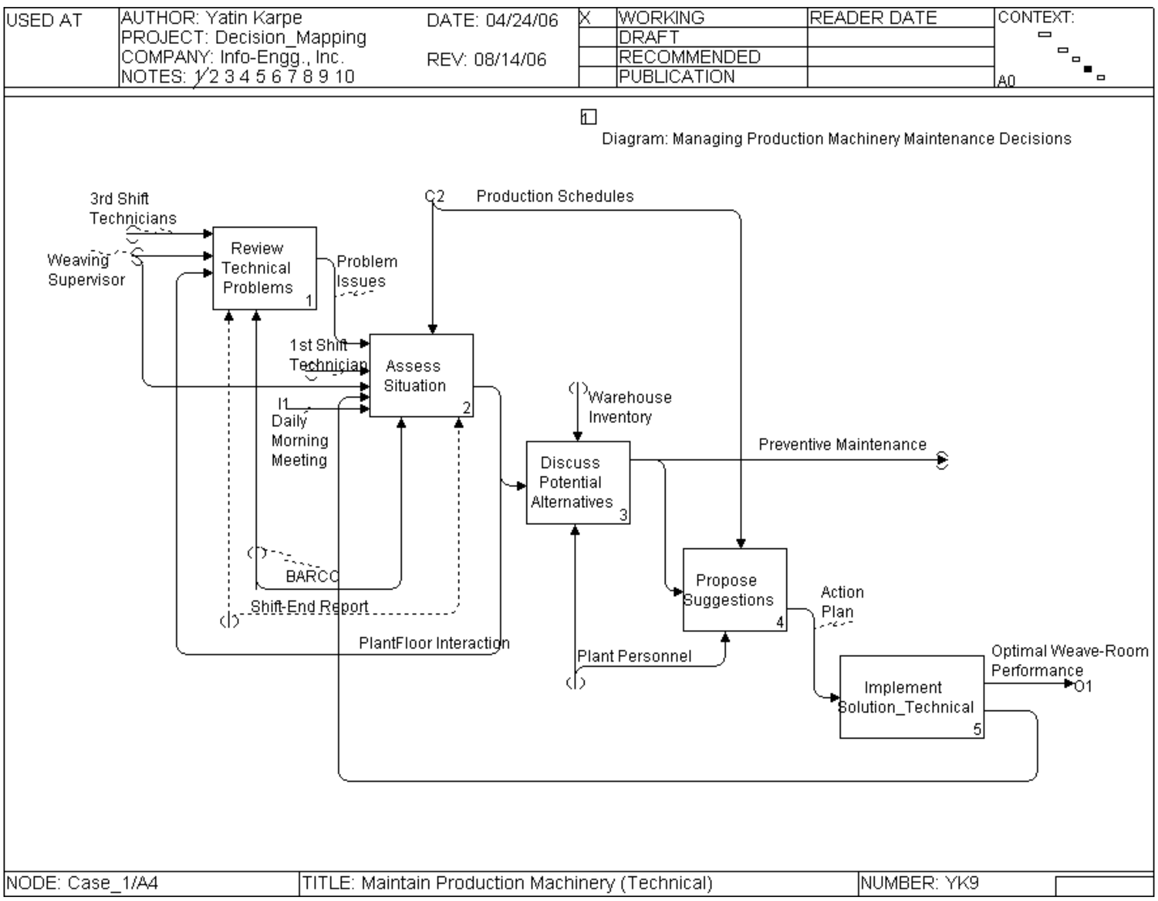

Figure 5.8: Maintain Production Machinery (A4)

In this process, the decision-maker is the Technologist, who is responsible for all technical issues and problems that arise in the weave-room with reference to machinery. The Technologist interacts on a constant basis with the technicians, Weaving Supervisor and other senior management. The decisions and tasks performed by the Technologist are shown in figure 5.8 and described as follows:

1. Review Technical Problems: The Technologist, on a daily basis, first reviews technical problems from previous shifts, along with the 3rd shift technicians and the Weaving Supervisor. The Shift-End Report (Appendix A, figure A14) and BARCO are used as a tool for identifying old, as well as new technical problems.
2. Assess Situation: In addition to the interaction in the previous step, the Technologist discusses any new problems with the 1st shift technicians, as well as with the Senior Management, in order assess the overall situation.
3. Discuss Potential Alternatives: The Technologist then discusses the potential alternatives and possible solutions to resolving the problems at hand along with the plant personnel as needed. The Technologist is also responsible to keep an eye on the warehouse inventory for maintaining the optimal inventory of parts needed for maintenance of machinery and equipment. Based on the problems and tasks on hand, the Technologist may schedule Preventive Maintenance schedules.
4. Propose Suggestions: The Technologist then determines an Action Plan and proposes appropriate suggestions, prioritizing on the urgency of the problem and the production schedules in progress. For example, if the Shift-End Report shows that the efficiency levels of certain sections is bad, the Technologist will be more attentive to that section and review their performance using BARCO, as well as a regular visit.
5. Implement Solution_Technical: Based on the information and knowledge obtained in the previous steps, the Technologist implements the best possible solution to address and solve the problem.

5.2.8 Level A5

In this phase, the Weaving Supervisor (W.S.) is the decision-maker, who is mainly responsible for the weave-room production related decisions. The decisions and tasks performed by the W.S. are shown in the figure 5.9 and described as follows:

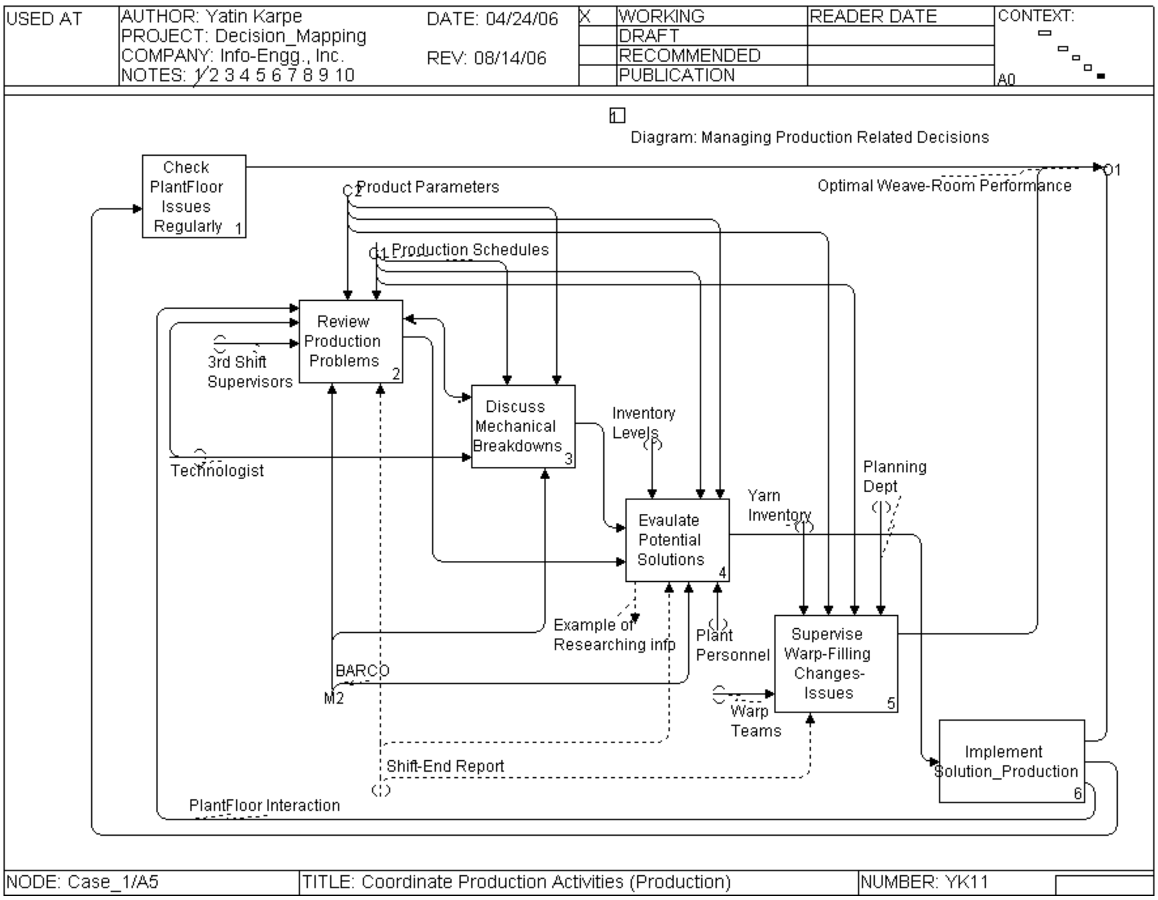

Figure 5.9: Coordinate Production Activities (Production) (A5)

1. <u>Check Plant Floor Issues Regularly:</u> The W.S. constantly patrols the weave-room to keep an eye on various aspects of production, safety, housekeeping and working conditions in general.
2. <u>Review Production problems</u>: The primary task performed by the W.S. in the morning is to review the Shift-End Report (Appendix A, figure A14) for any production issues along with the 3rd shift supervisor and

the Technologist. Whatever problems could not be covered in the 3rd shift, will be given first priority.

3. Discuss Mechanical Breakdowns: The W.S. will constantly interact with the Technologist to discuss the mechanical breakdowns in order to keep the production schedules on target and provide any assistance to the Technologist and his team so that the production is not affected. Several times, the mechanical breakdowns are due to production-related problems, and hence there is a continuous back-and-forth between the W.S. and the Technologist, complementing each other's functions.

4. Evaluate Potential Solutions: All matters that need attention within the Shift-End Report (Appendix A, figure A14) are addressed first and potential solutions are sought, in consultation with the Technologist, Plant Manager and other plant personnel. One of the Miscellaneous problems in the Shift-End Report is that loom 528 has "fuzzing out ends", which could be due to various reasons such as bad sizing process, etc. The W.S. will try and research any historical problem with that loom or similar problem on other looms. Appendix A, figures A15 to A17 show an example of the BARCO system used to research historical information. Figure A15 shows the screen-shot of the main menu, from which option 1 (Stops & Efficiency Menu) is chosen; figure A16 is a screen-shot in which option 1 (machines) from the Stops & Efficiency Menu is chosen; figure A17 shows the history on loom 528 and information on the stops and efficiency for 9 previous shifts for the same loom. The information shows that the loom had several warp stops in the previous 6-8 shifts, which prompted the W.S. to study and identify the cause for the recurring problem. The W.S. works with the Technologist to modify settings if needed, or try some other solutions to reduce the warp stops within acceptable limits. Similarly, other problems on the Shift-End Report are reviewed and potential solutions sought for them. In addition, inventory levels (both yarn and parts) are definitely some

constraints around which potential solutions for the stopped looms need to be addressed.

5. Supervise Warp-Filling Change Issues: The W.S. is also responsible for supervising the warp-filling change issues. Here again, the Shift-End Report (Appendix A, figure A14) assists the W.S. in keeping an eye on the latest status of the looms with reference to the warp-outs and the filling yarns; as well, there is constant interaction with the Planning Department to keep an eye on style changes that are being planned. The W.S. continuously evaluates the yarn inventory levels and interacts with his warp teams with regards to keeping a close watch on warp-outs and style changes.

6. Implement Solution_Production: Based on all the interactions and discussions that are conducted between the W.S. and the various plant personnel on all the issues or problems within the production floor, the best possible solution is implemented for maintaining optimal weave-room performance.

5.2.9 Observations

Although the decision-makers work cohesively towards attaining the optimal weave-room performance, certain limitations in the decision-making process were observed during the research of this case study with reference to the following characteristics.

- Information Quality – As discussed in chapter two, information is a function of data, definition and presentation. If any of these functions don't exist, it affects the information quality. One example observed in this case study was that the Shift-End Report contained a lot of data reported by the production supervisors, as well as a few other production personnel in a random format, due to which there was a need to perform an additional step to coordinate and get feedback from them on the exact problems. Additionally, the knowledge needed by the decision-maker is a function of information quality and significance and this lack of understanding of the situation results in limiting the efficiency of the decision-making process.

- Information Overload – The presence of several different and independent information management systems, especially for the planning unit, results in excessive information needed to be reviewed by the planning personnel, which in turn results in the information gap and overload as discussed in chapter three. The planning unit needs to spend more time in coordinating with other units on several issues such as yarn availability, and the time lost due to this information overload issue definitely results in limiting their coordination efforts.
- Implicit/Explicit Knowledge – Quality is an important parameter that influences the weave-room performance and it is very important for the weave-room to maintain quality, for both the incoming raw material, as well as the outgoing cloth manufactured. The absence of an independent quality control unit and designated personnel, adds onto the responsibilities of the production and technical personnel to maintain quality of the finished cloth, while adding the responsibility of the incoming raw material quality on the planning unit. Maintaining quality is more a component of tacit (implicit) knowledge that deals with the human mind, having both, a technical as well as a cognitive dimension. Hence, lack of such a quality unit results in limiting the performance of the weave-room.

These limitations that were observed during the case study will be addressed in the results section and suitable performance improving options or alternative will be presented as part of this research outcome.

5.3 Case_2 Study -

5.3.1 Introduction

Case_2 study was conducted at a jacquard weaving plant. The original plant was built in the early 1900's and was situated in a typical mill village. The ownership of the plant changed hands several times, and was finally bought by the present owners in the early 1980's. The original product-mix of the plant included upholstery and mattress-ticking. But with the shift in business practices, the plant's core business was converted to only upholstery weaving in mid 2000. Approximately 40-50% is regular upholstery weaving (direct orders received by the company), while the remaining 50-60% is contract upholstery weaving. Most of its operations are in the domestic market, along-with some international presence. This plant has some winding machines (that are used for making novelty yarns), as well as warping machines that perform all the warping required for the plant. The plant purchases all its raw materials (yarns) from outside vendors. The warp is primarily polyester and the filling is cotton, rayon, acrylic and other diversified types of yarn as per the style requirements. The plant has more than 100 looms, but operates only about 60-65 at the present time, based on market orders. The production levels are in the range of 160,000-180,000 yards/week. The plant operates on a 6 day/week and 3 shifts /day schedule. There are over 200 total employees, including salaried staff and hourly employees, due to the fact that the plant also has winding and warping units. The Weave-Room performance decision-making process for Case_2 is modeled with the aid of diagrams using IDEF0 methodology. (Please refer IDEF0 Glossary section 5.1.1 for term definitions)

5.3.2 Level A-0

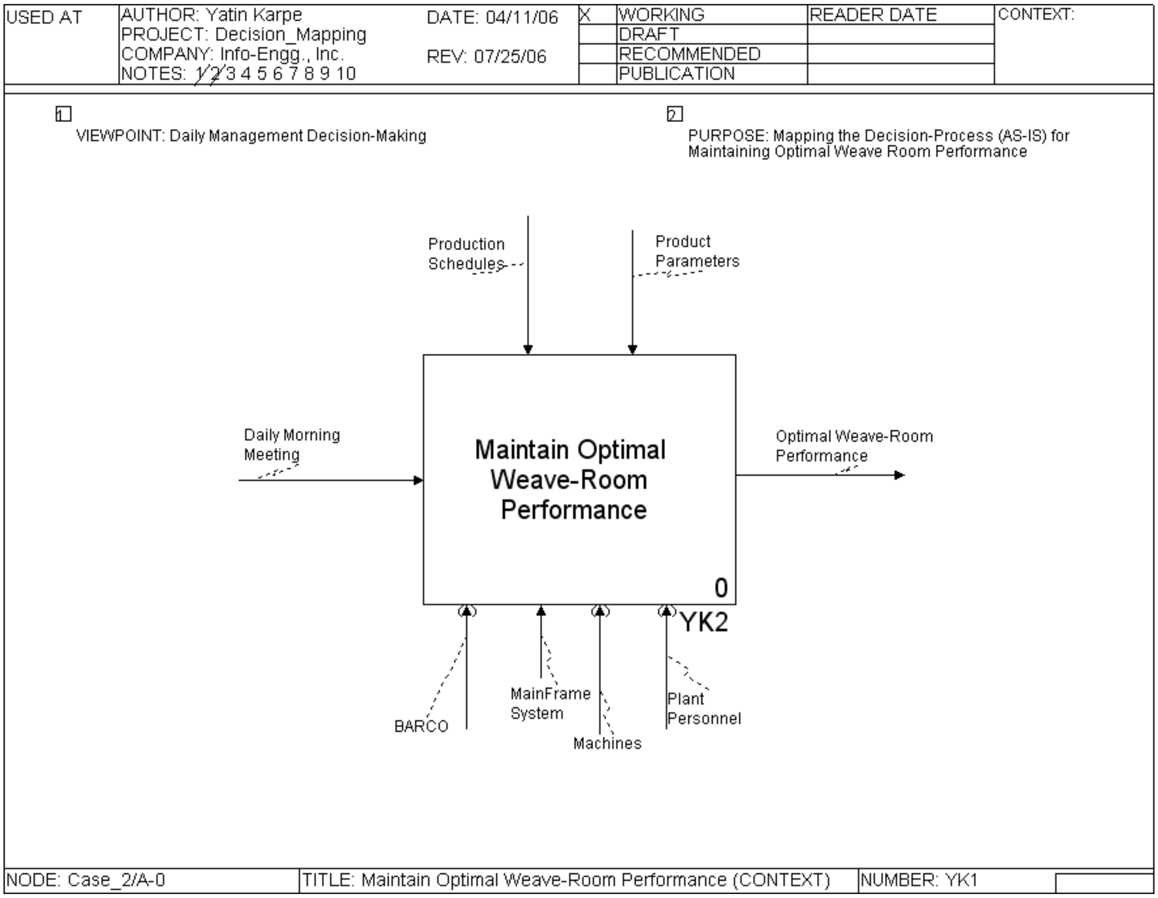

Figure 5.10: Context Diagram-Case_2 (A-0)

The main function of the plant is to maintain optimal weave-room performance, which is shown in the top-level Context Diagram (figure 5.10). The key decision-makers meet during the daily morning meeting to discuss various day-to-day production and related issues, and try to come up with the best possible alternatives to resolve them and to maintain the best possible weave-room performance. Product parameters and production schedules are the primary constraints for the weave-room performance, where as the various information systems (such as BARCO, MainFrame systems) prove to be valuable resources in maintaining optimal weave-room performance. The Context Diagram shown in figure 5.10 subsequently breaks down into lower functional levels as shown in figure 5.11, so as to understand the different decision-making units and their corresponding decision-makers.

5.3.3 Level A0

Figure 5.11 identifies the key decision-making units and the corresponding decision-makers. At this level, the Plant Manager is the overall decision-maker and coordinator of the various decision-making units and the decision-makers. They are:

1. House-Keeping (House-Keeping (H.K) Manager.)
2. Product Development (P.D. Supervisor)
3. Engineering (Maintenance Manager- M.M.)
4. Production Planning (Planning Manager)
5. Quality Control (Q.C. Manager)
6. Production (Weaving Supervisor- W.S.)
7. Special Projects (Project/Training - P.T. Coordinator)

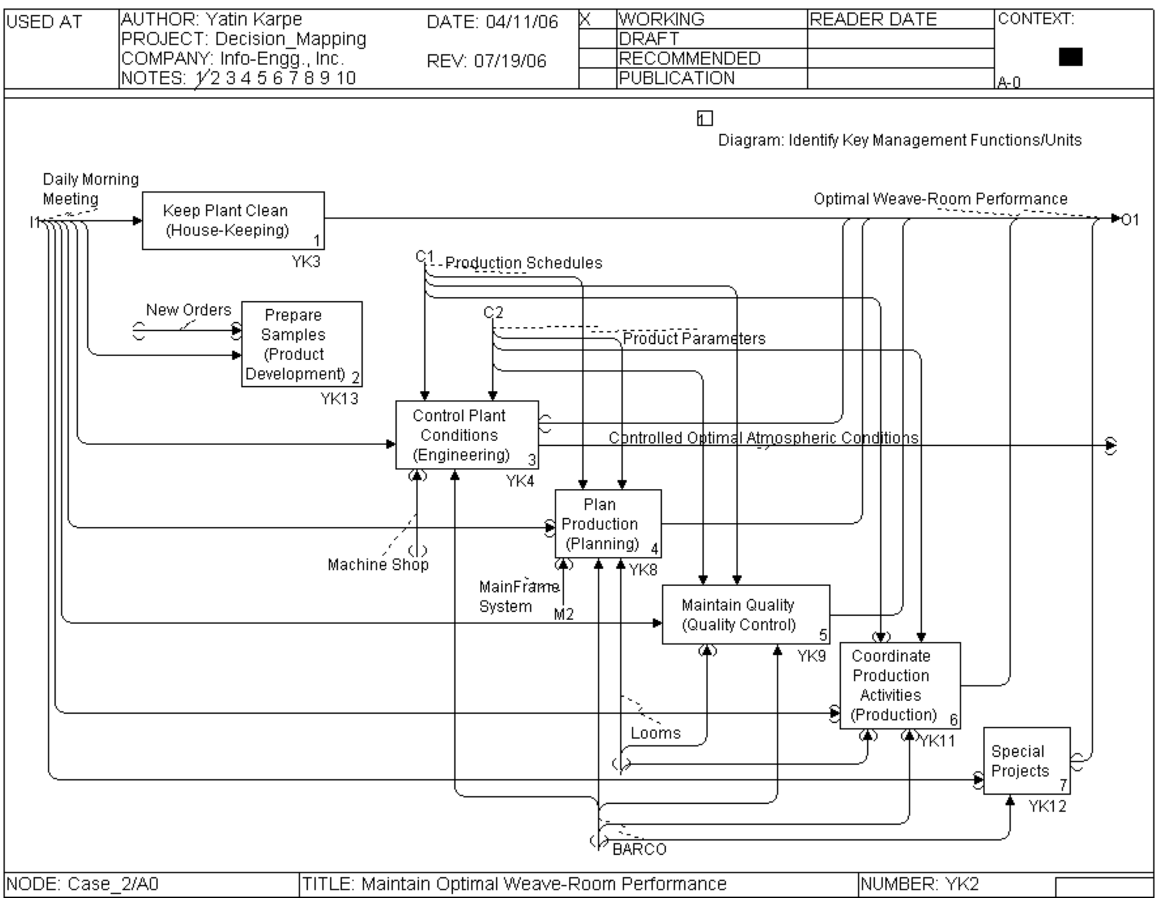

Figure 5.11: Maintain Optimal Weave-Room Performance (A0)

Each of these decision-making units are explained in some detail in the following diagrams, in context of their daily decisions and tasks that they perform, along with a couple of examples wherever possible.

5.3.4 Level A1

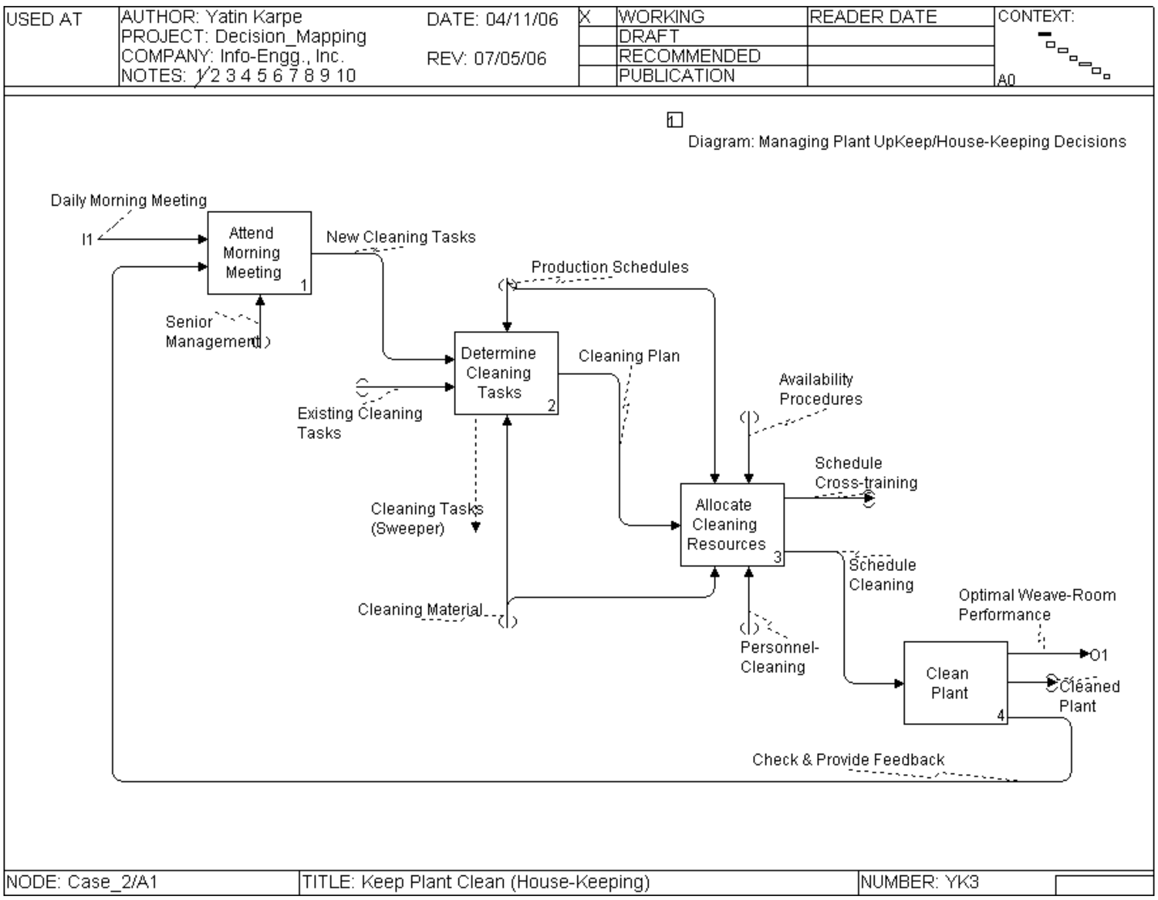

Figure 5.12: Keep Plant Clean (A1)

In this process, the decision-maker is the House-Keeping (H.K.) Manager. The H.K. services are contracted out to a company and they have a manager in charge of maintaining a clean weave-room atmosphere. The kind of decisions and tasks that are carried out by the H.K Manager are shown in figure 5.12 and described as follows:

1. Attend Morning Meeting: The H.K. Manager attends the morning meeting and gets feedback on the any new cleaning tasks from the

senior management, or is updated if there are any tasks that need special attention.

2. Determine Cleaning Tasks: Based on this input, the H.K. Manager determines the daily cleaning tasks, taking into consideration the existing daily cleaning routines that need to be followed by the cleaning personnel. An example of the cleaning tasks of a sweeper are attached in Appendix B, figure B1. As per the H.K. Manager, the sweeper is one of the most important cleaning staff of the weave-room. The example shows the daily (1^{st} shift) regular cleaning tasks that need to be performed for that function. Similar cleaning tasks exist for other cleaning staff such as housekeeper, baler/utility waste, etc., for all 3 shifts.
3. Allocate Cleaning Resources: Based on the cleaning plan and availability procedures, the Manager allocates the cleaning resources to schedule cleaning of the weave-room. At the same time, the Manager coordinates and schedules cross-training of the cleaning personnel, especially due the uncertain nature of their attendance at work.
4. Clean Plant: Once cleaning resources are allocated and tasks scheduled, the plant is cleaned. Feedback is provided to the senior management, either at the daily morning meeting or by personal contact.

5.3.5 Level A2

In this process, the decision-maker is the Product Development (P.D.) Supervisor, who is mainly responsible for making decisions related to sample product development. In particular, the P.D. supervisor is responsible for two main tasks: Coordinate sample weaving and supervise warp-filling change issues. The kind of decisions and tasks carried out by the P.D. supervisor are shown in figure 5.13 and described as follows:

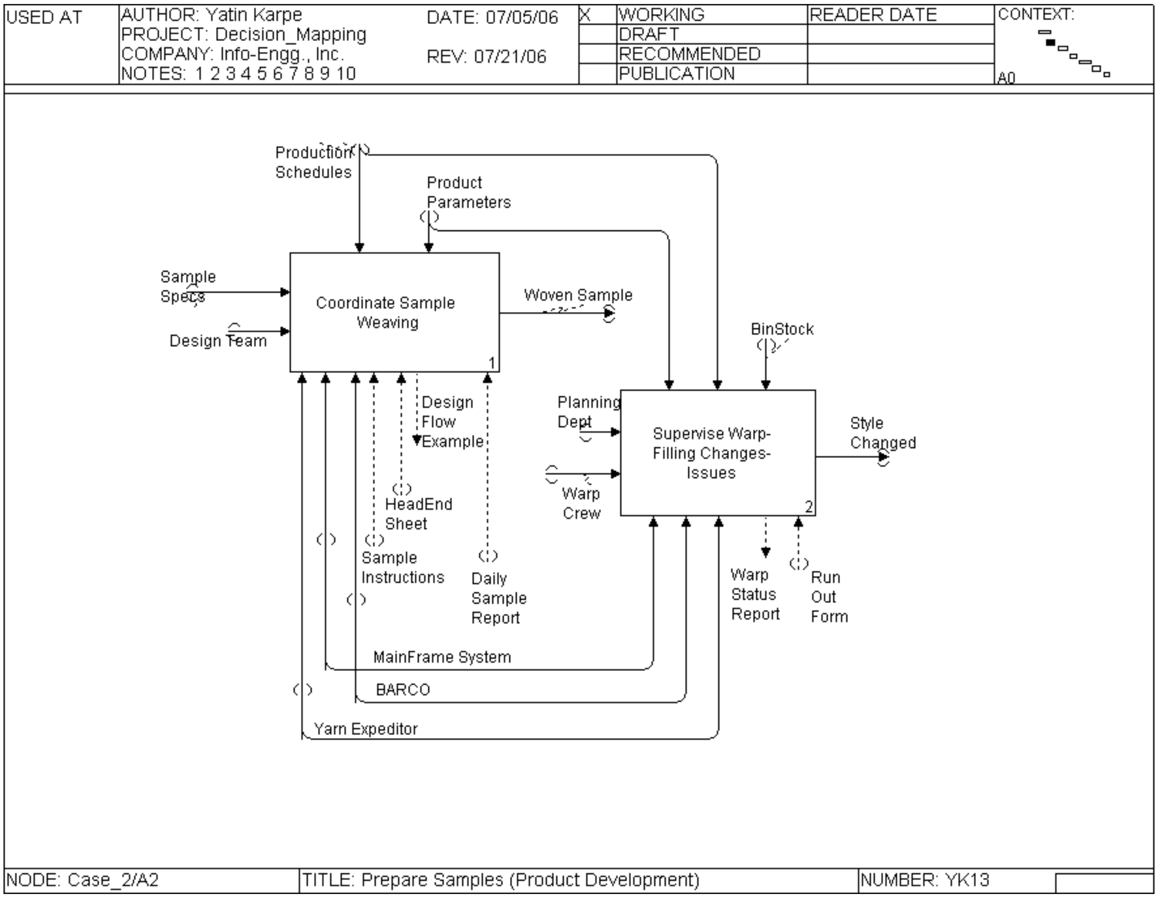

Figure 5.13: Prepare Samples (Product Development) (A2)

1. Coordinate Sample Weaving: The Design Team provides the information and instruction ("Mfg to print" sample instruction- see Appendix B, figure B2) for sample weaving in the form of a Head-End Sheet (Appendix B, figure B3). On a daily basis, the P.D. supervisor reviews and prints out the "mfg to print" head-end sheets provided by the Design Team. An example of the process of generating the "Mfg to Print" list is shown in Appendix B, figures B4 to B7. Figure B4 shows a screen-shot of the main menu, wherein the Design Flow system is chosen; in figure B5, the Head End Inquiry option is chosen; figure B6 shows a list of 3 "Mfg to Print" samples, and figure B7 shows the Head End Pick List which lists the quantity and type of yarn needed for Head End # 145804. The next step is to get the raw material needed for weaving that sample. The Yarn Expeditors are given that information

to collect the needed raw material and take it to the sample-weaving loom, where the sample is woven. A Daily Sample Report (Appendix B, figure B8) is generated by the P.D. Supervisor, for the reference of the Design Team, so that they can monitor what is being woven. Since the samples are woven sometimes along with the warp on production looms, the production schedules and product parameters influence the decisions that are taken at this step of the process.

2. Supervising Warp-Filling Change Issues: The P.D. Supervisor is also responsible for of supervising the warp-filling change issues. The P.D. Supervisor generates a personalized Warp Status Report (Appendix B, figure B9), and compares that with the Run-Out Report (Appendix B, figure B10) to check the status of warp-outs or style changes. The Warp crew patrols the weave-room and monitors the need for raw material on looms that are about to exhaust the warp, or need a style change and along with the Yarn Expeditors, expedite the process of style changes. The P.D. Supervisor is also in charge of the Bin Stock and needs to make sure that all the yarn is being accounted for in the inventory calculations.

5.3.6 Level A3

In this process, the decision-maker is the Maintenance Manager (M.M.), who is responsible for the plant maintenance, as well as the atmospheric conditions within the plant. The kind of decisions and tasks performed by the M.M. are shown in figure 5.14. The work-order system that is followed at this plant is fairly straightforward: if there are any plant maintenance or engineering issues, the particular unit having the problem or their corresponding unit heads will call the M.M. and he will attend to it. The M.M. has a small staff of 4 and assigns them as per priority of the problem. The M.M. himself decides on the priority of attending to a problem, if several problems come together. There is a machine shop that is used to modify or refurbish worn-out parts, as well as to attend to any other maintenance needs. Similarly, the atmospheric conditions are maintained manually, and there is no computer system available for the management of the plant conditions. Based on the requirement of the weave-room and the product parameters, the production personnel will contact the M.M. and provide him with the requirements for the particular item that is being woven and the temperature and humidity is maintained accordingly.

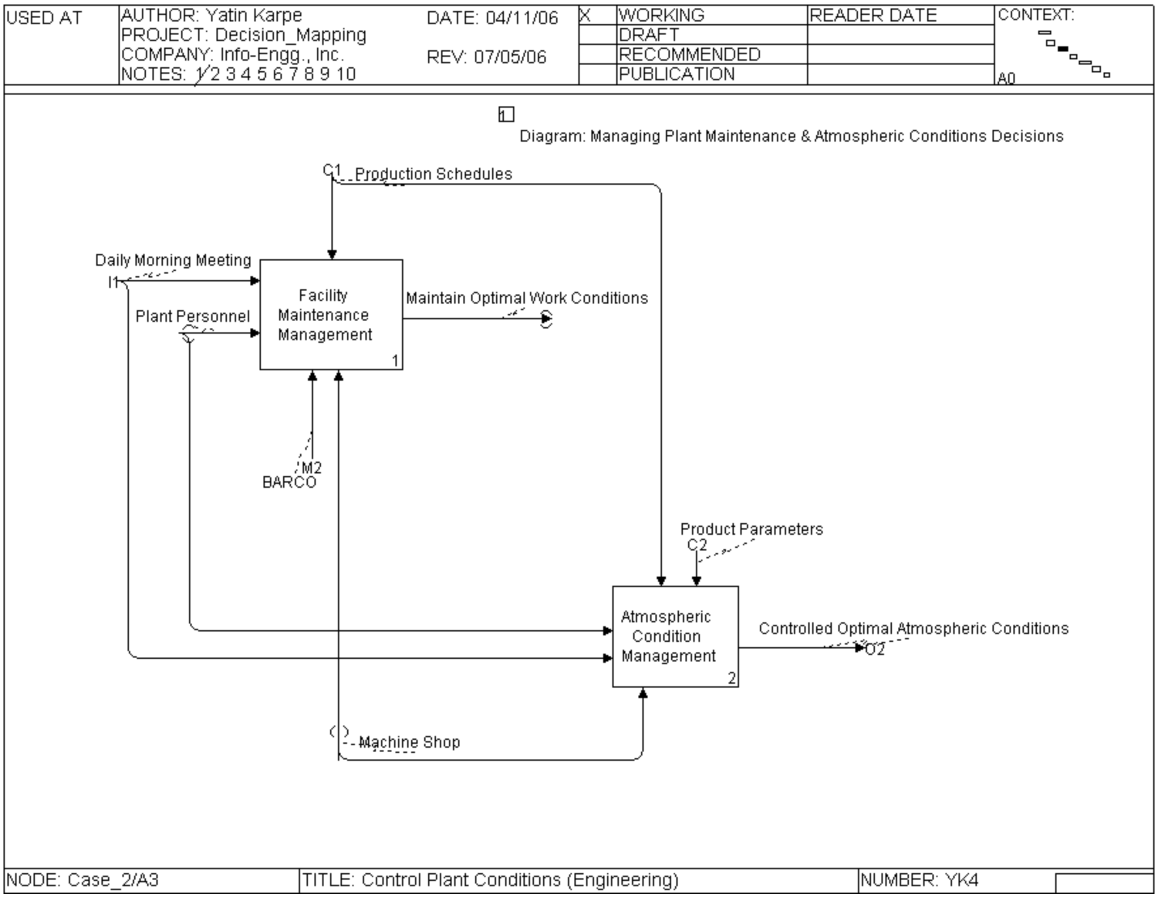

Figure 5.14: Control Plant conditions (A3)

5.3.7 Level A4

In this process, the decision-maker is the Planning Manager, who is responsible for planning and scheduling looms, based on the orders received from the corporate office. The kind of decisions and tasks performed by the Planning Manager are shown in figure 5.15 and described as follows:

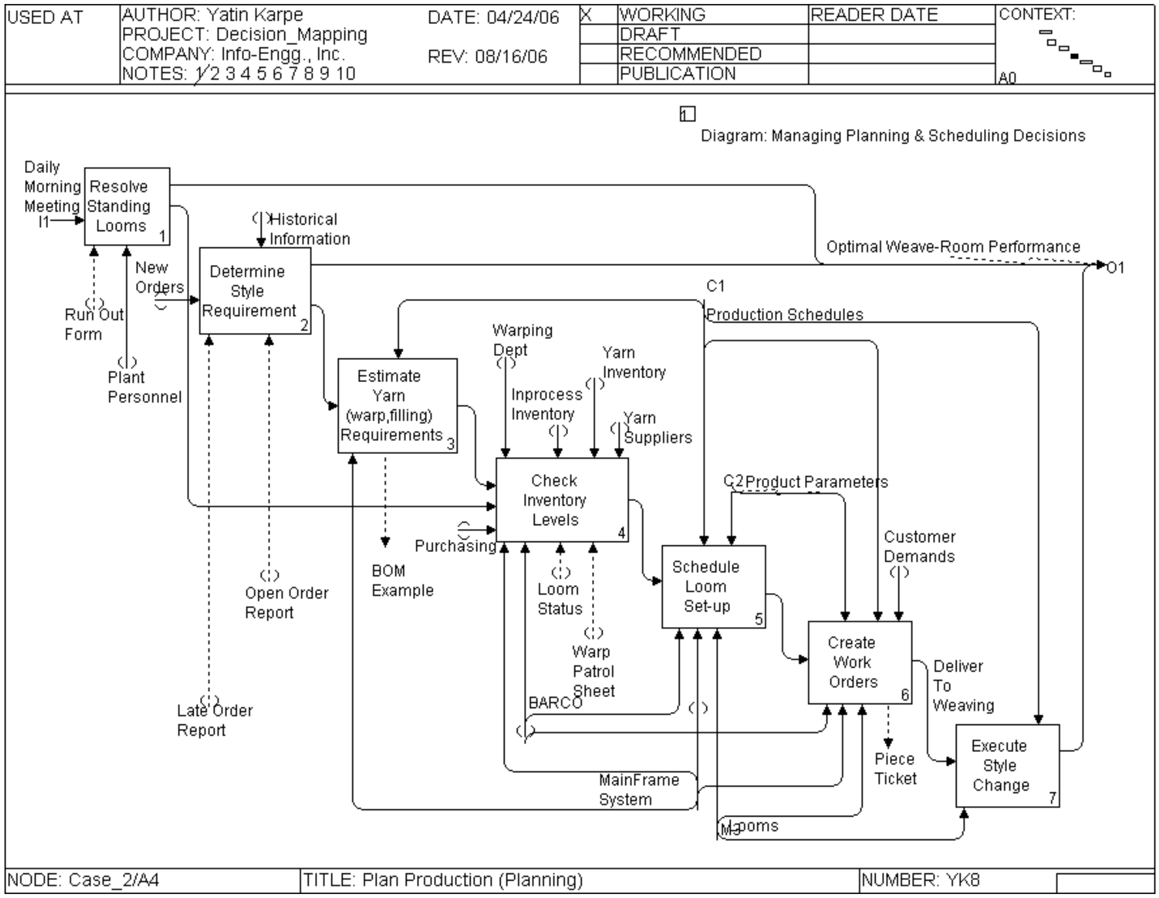

Figure 5.15: Plan Production (A4)

1. <u>Resolve Standing Looms</u>: The first task of the planner is to review the Run Out Report (Appendix B, figure B10), check for any standing looms due to lack of work orders and interact with production personnel to assign new work orders for the looms, so that they keep running. The looms could also be standing due to yarn availability issues, at which point the Planning Manager needs to coordinate with the different plant personnel to resolve that matter.

2. <u>Determine Style Requirement:</u> The Planning Manager then reviews the Late Order Report (Appendix B, figure B11) and the Open Order Report (Appendix B, figure B12) to determine the style requirements for new orders, as well as check on the late orders. Historical customer information is an important consideration at this stage.

3. Estimate Yarn (warp, filling) Requirements: At this stage, the Planning Manager reviews information obtained from different resources. An example of estimating the yarn requirements using the MainFrame system is shown in Appendix B, figure B13 to B18. Figure B13 shows a screenshot of the Master Menu (from which the Engineering Menu (option 4)) is chosen; in figure B14, option 2 (Inquiry Menu from the Engineering Menu) is chosen; in figure B15, option 4 (BOM from Engineering Inquiry Menu) is chosen; figure B16 shows a screenshot in which the style number and the corresponding yards information is entered; figure B17 shows the raw materials required for that particular style and the quantities and figure B18 shows more specific requirements of the style.
4. Check Inventory Levels: At this step, the Planning Manager reviews the Loom Status Report (Appendix B, figure B19) that gives information on the patterns/styles inventory being woven on the different looms, and the time remaining on each of them as well as the Warp Patrol Sheet (Appendix B, figure B20) that provides information on the warps running on the different looms. At this step, it is important to cross-check with the warping department, purchasing department, as well as the yarn supplier to check on potential availability of the raw material, as well as to check to see if there is any in-process yarn inventory.
5. Schedule Loom Set-up: At this step, the Planning Manager schedules the loom for the particular style item number, based on the information gathered from the previous steps. Both the BARCO and the MainFrame system are extensively used at this stage to review and schedule the appropriate loom, based on the product parameters of the item that is to be woven, as well as the production schedules of the looms in the weave-room.
6. Create Work orders: At this stage, once looms are scheduled, Work Orders are created for particular looms. Appendix B, figure B21 shows

an example of the Piece Ticket that is generated. Again, this step is constrained by the current production schedules and the product parameters, as well as the ever-changing customer demands to obtain their orders earlier than scheduled.

7. Execute Style Change: At this point, the personnel from the planning department will take the Piece Tickets to the weave room area that triggers the production personnel to execute the style change for weaving the new styles.

5.3.8 Level A5

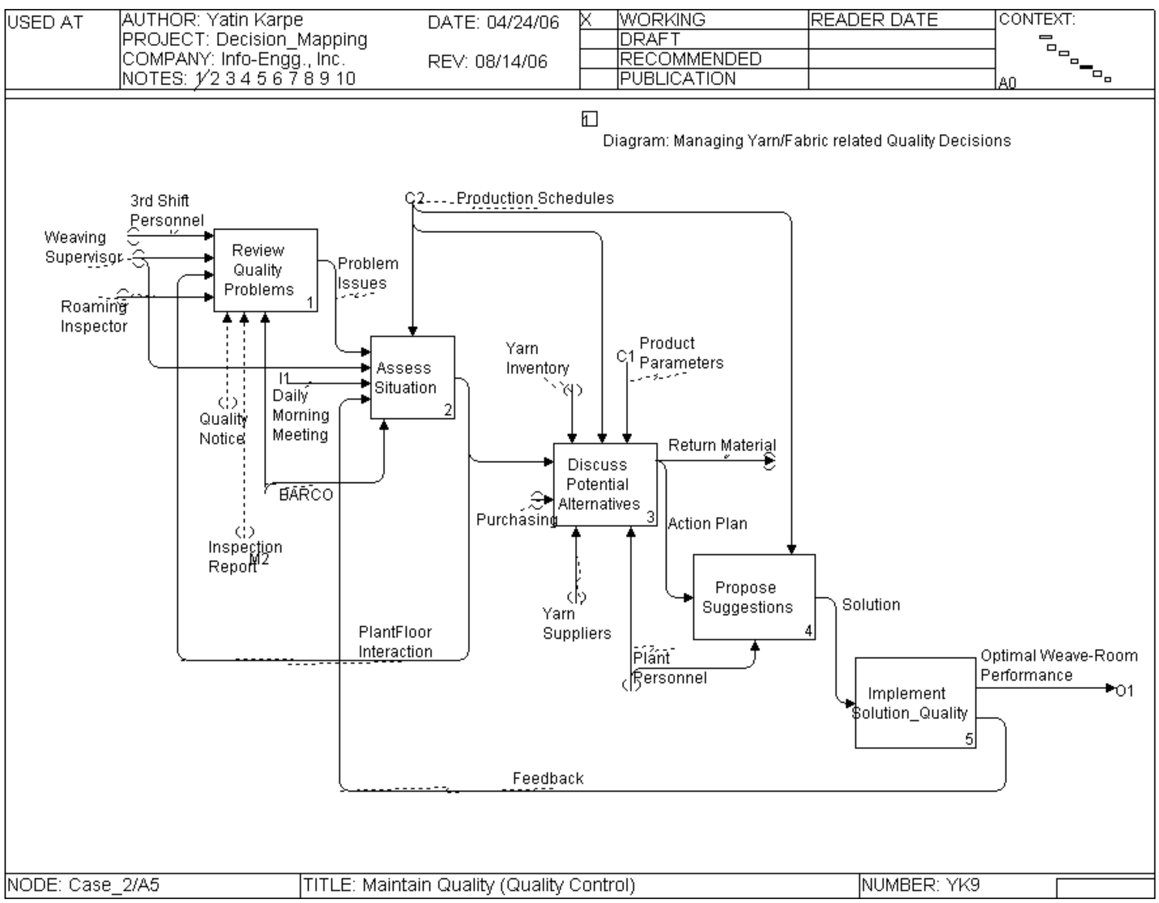

Figure 5.16: Source & Maintain Yarn Quality (A5)

In process level A5, the decision-maker is the Quality Control (Q.C.) Manager, who is responsible for all quality related issues of yarn and greige fabric. The Q.C. Manager constantly interacts with the yarn vendors, as well as the production personnel to resolve any quality issues that arise during production. The decisions and tasks performed by the SQC Manager are shown in figure 5.16 and described as follows:

1. Review Quality Problems: The Q.C. Manager reviews all quality related problems that are brought to his notice by the Weaving Supervisor, Roaming Inspector or any other production personnel from any shift. An example of such a quality problem is documented in Appendix B, figure B22, wherein all the relevant information about the quality related problem is provided for the reference of the Q. C. Manager. Similarly, another example shows the greige fabric Inspection Report (Appendix B, figure B23). Swatches of fabric with quality problems are provided to the Q.C. Manager for evaluation.
2. Assess Situation: The Q.C. Manager will then assess and evaluate the situation, by reviewing any relevant historical information on similar quality problems and discuss with the senior management during the daily morning meeting. The Q.C. Manager will make the best efforts to try and isolate the problem, so as to better understand the extent or cause of that problem. This would also speed up the process to resolve the quality issue at hand.
3. Discuss Potential Solutions: Based on his assessment and interactions with the senior management, the Q.C. Manager will discuss potential alternatives with the Purchasing unit and yarn suppliers, which may lead to more quality testing in the labs, or return the material to the vendor for exchange. Potential solution is also dependent on the yarn inventory and product parameters. Similar efforts are carried out to discuss potential greige fabric quality problems.
4. Propose Suggestions: The Q.C. Manager may propose to find a different supplier for that yarn if repeated problem persists with that

specific yarn. Similarly, appropriate solutions are proposed for resolving fabric quality problems.

5. <u>Implement Solution_Technical:</u> Based on all the previous steps, the Q.C. Manager will implement the most optimal solution to resolve the quality related problem.

5.3.9 Level A6

In this phase, the Weaving Supervisor (W.S.) is the decision-maker, who is mainly responsible for the weave-room production related decisions, including the technical issues. The decisions and tasks performed by the W.S. are shown in the figure 5.17 and described as follows:

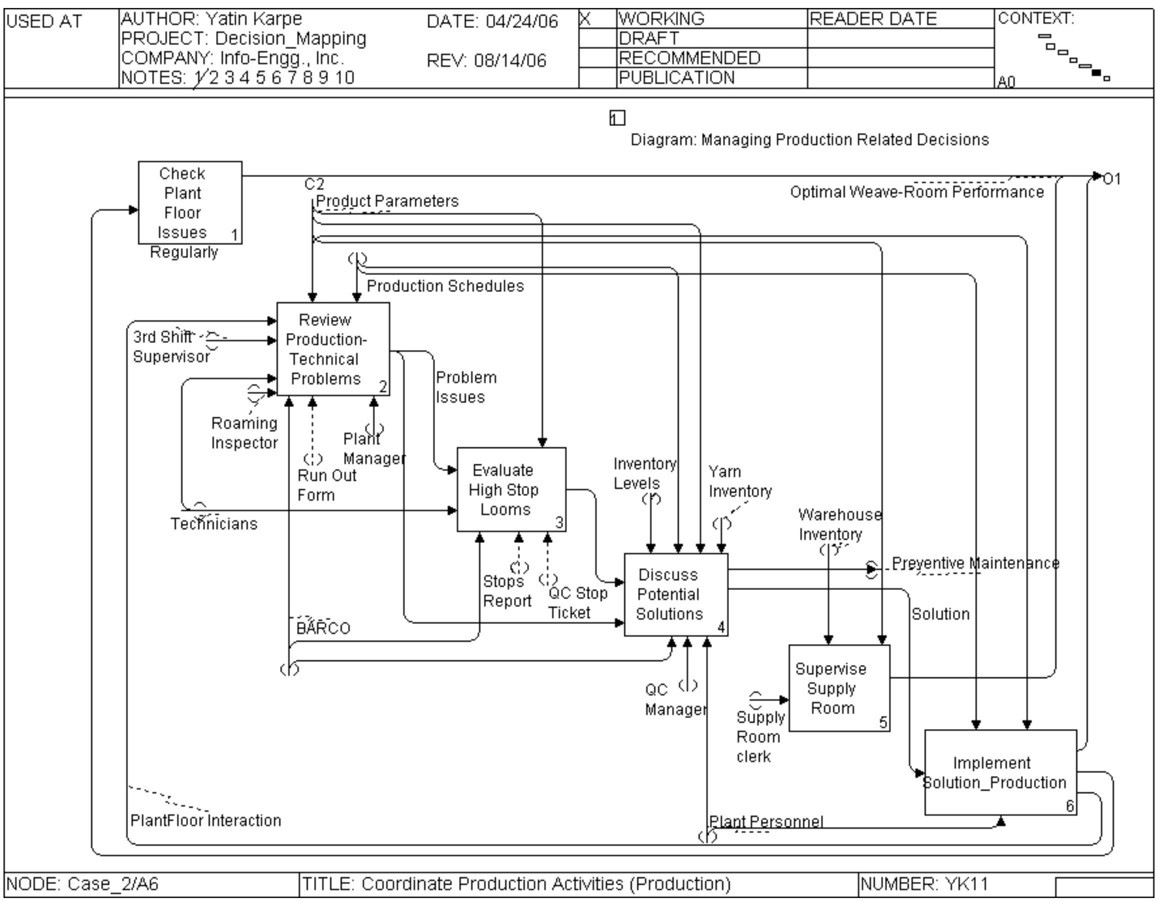

Figure 5.17: Coordinate Production Activities (Production) (A6)

1. Check Plant Floor Issues Regularly: The W.S. constantly patrols the weave-room to monitor various aspects of production, safety, housekeeping and working conditions in general. As per the W.S. it is very important to keep a good vigil during the patrol, so as to have a good feel of activities and issues that need attention.
2. Review Production-Technical problems: The primary task performed by the W.S. in the morning is to review the Run Out Report (Appendix B, figure B10) for any production or technical issues along with the 3rd shift supervisor, technicians, Roaming Inspector, as well as discuss any major problems with the Plant Manager.
3. Evaluate High Stop Looms: The W.S. mainly concentrates on evaluating the High Stop Loom Report (Appendix B, figure B24) using the BARCO system. One reason for stops could be quality issues. The W.S. cross-references the stopped loom with Q.C. Stop Ticket (Appendix B, figure B25) to find out if there were any quality problems at that loom.
4. Discuss Potential Solutions: All matters that need attention within the Run Out Report and High Stop Loom Report are addressed first and potential solutions are sought, in consultation with QC Manager and other plant personnel. Inventory levels (both yarn and parts) are definitely some constraints around which potential solutions for the stopped looms need to be addressed. For certain technical problem solutions, Preventive Maintenance schedules are developed that could potentially reduce the future incurrence of similar technical problems.
5. Supervise Supply Room: The W.S. is also responsible for supervising the Supply Room activities and inventory, and maintain supply costs at optimal levels. The W.S. is responsible for developing strategies and maintaining optimal inventory levels for various production related parts that are needed either on a regular or irregular basis.
6. Implement Solution_Production: Based on all the interactions and discussions that are conducted between the W.S. and the various plant personnel on all the issues or problems within the production floor, the

appropriate ideal solution is implemented for maintaining optimal weave-room performance.

5.3.10 Level A7

In this process, the decision-maker is the Project & Training (P.T.) Coordinator, who performs a dual role of generating different types of reports (management, industrial engineering, etc.), as well as coordinates training for the plant production personnel (figure 5.18).

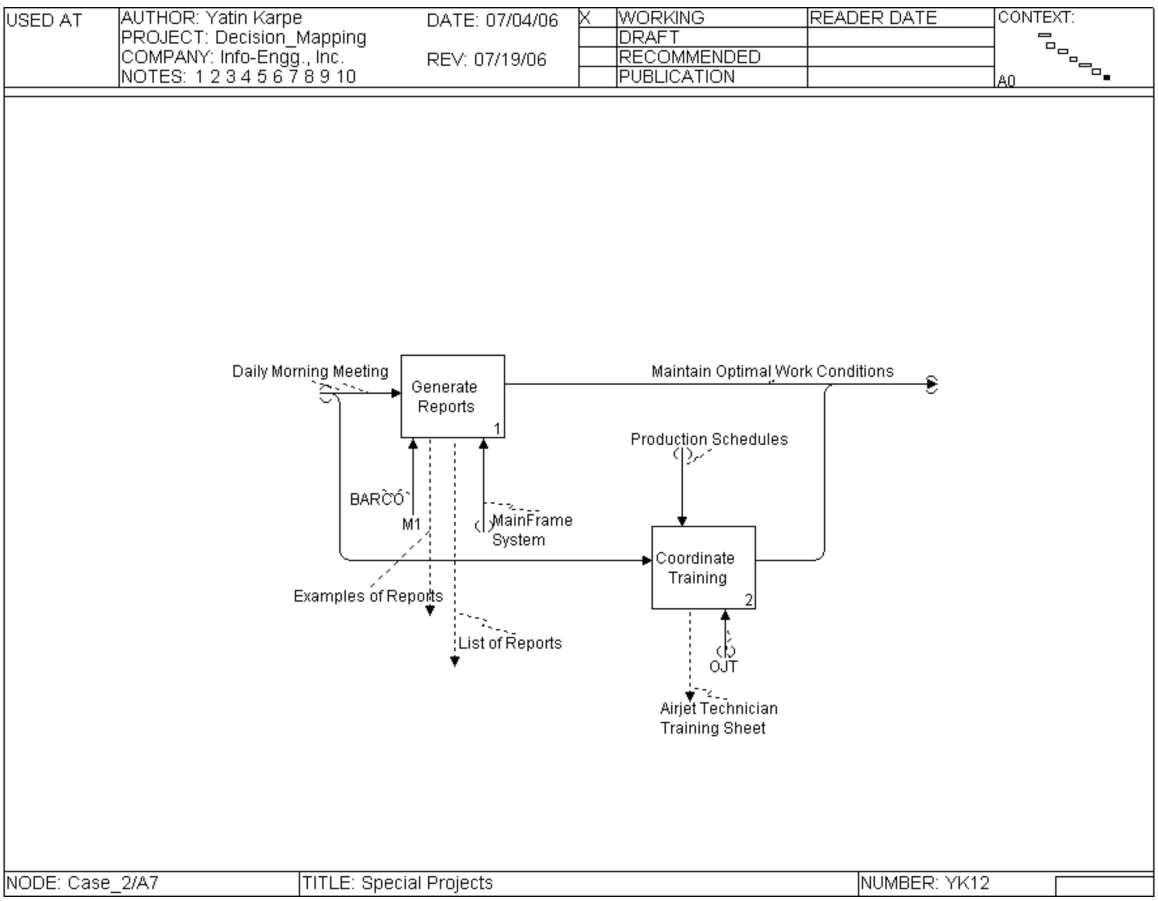

Figure 5.18: Special Projects (A7)

The P.T. Coordinator generates the various reports using the BARCO and the Mainframe system. A list of the regular reports generated can be seen in Appendix B, figures B26, B27, B28 and 2 examples of actual reports can be seen in Appendix B figure B29 (Weekly Production Report) and figure B30 (Plant Efficiency Report). Copies of these reports are circulated among the relevant senior management, as well as sent to the corporate offices for review. In addition to this task, The P.T. Coordinator is also responsible for coordinating the training programs for new production staff. An example of the Air-jet Technician Training Sheet can be seen in Appendix B, figures B31 to B34. An On-The-Job (OJT) instructor supervises the training and completion of the exercise sheet. Such training sheets are available for different production job functionalities.

5.3.11 Observations

Although the decision-makers work cohesively towards attaining the optimal weave-room performance, certain limitations in the decision-making process were observed during the research of this case study with reference to the following characteristics.

- Knowledge vis-à-vis Information Quality – As discussed in chapter two, the knowledge needed by the decision-maker is a function of people, information and significance (or understanding). In this case study, the plant lacked a comprehensive maintenance information management system. The maintenance manager attended to maintenance requests (which came in by phone or personal meetings) and attended to them on a case-by-case basis, without any relevant background or historical information for reference. Thus, in this case, knowledge was created without studying or analyzing relevant historical information on similar problems, which not only lead to non- quality information, but also to inadequate understanding of the significance of that information, thus affecting the effectiveness of the decision-making process.
- Information Gap – One recurring problem faced by the plant was that of information on the yarn availability, for both, the incoming raw material, as well as the yarn that is available in the plant for use. The presence of several different information management systems, especially for the planning unit, resulted in the need for checking yarn availability in several different places, resulting in excessive information needed to be reviewed by the planning personnel, which in turn results in the information gap and

inaccurate information on the yarn status. This resulted in the planning unit needing to spend more time in coordinating with the other units on this issue individually and spending more time than required on this single issue.

- Knowledge Cycle – It is very important to verify that the knowledge cycle (as discussed in chapter two) gets completed with a feedback loop wherever needed. In this case study, it was notices that in some places, the lack of a proper, systematic feedback system, prevents the successful completion of the knowledge cycle. As an example, the corporate sales team takes a customer order and promises a delivery date; that date needs to be verified by the planning unit by checking into various different aspects (such as yarn availability, production schedules, etc.) and provide a feedback to the corporate team, confirming that delivery date. Alternately, if there are any conflicts, there is a need to notify the corporate team of an updated new delivery date, along with a reason, so that the customer can be notified accordingly. Many of these functions have to be performed by the planning unit by means of emails, personal meetings, or telephone calls, which could possibly lead to an absence of a timely feedback system, thus affecting the performance of the weave-room decision-making process.

These limitations that were observed during the case study will be addressed in the results section and suitable performance improving options or alternative will be presented as part of this research outcome.

5.4 Case_3_ Study -

5.4.1 Introduction

Case_3 study was conducted at a jacquard weaving plant, having most of its operations in the domestic market, along-with a few international partnerships and collaborations. The core business of the plant is upholstery. In addition, the plant also leases some of its space for commission weaving. The plant purchases all its raw materials (yarns) from outside vendors. The warp is primarily polyester and the filling is cotton and/or rayon. The plant has approximately 90 looms, but operates only about 60 at any given time, based on market orders. There are approximately 90-100 employees, including salaried staff and hourly employees. The Weave-Room performance decision-making process for Case_3 is modeled with the aid of diagrams using IDEF0 methodology. (Please refer to the IDEF0 Glossary section 5.1.1 for term definitions).

5.4.2 Level A-0

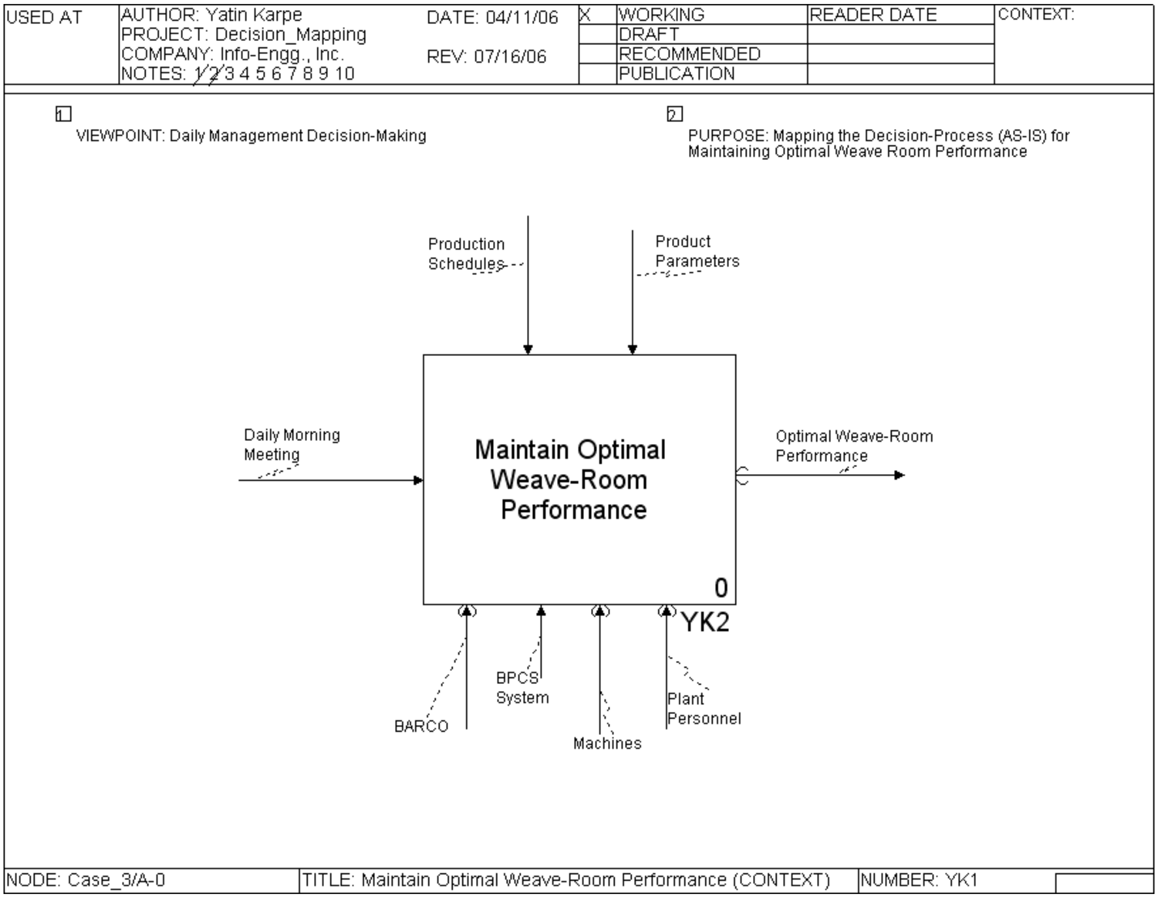

Figure 5.19: Context Diagram-Case_3 (A-0)

The main function of the plant is to maintain optimal weave-room performance, which is shown in the top-level Context Diagram (figure 5.19). The key decision-makers meet during the daily morning meeting to discuss various day-to-day production and related issues, and try to come up with the best possible alternatives to resolve them and to maintain the best possible weave-room performance. The Context Diagram shown in fig 5.19 subsequently breaks down into lower levels as shown in figure 5.20, so as to understand the different decision-making units and their corresponding decision-makers.

5.4.3 Level A0

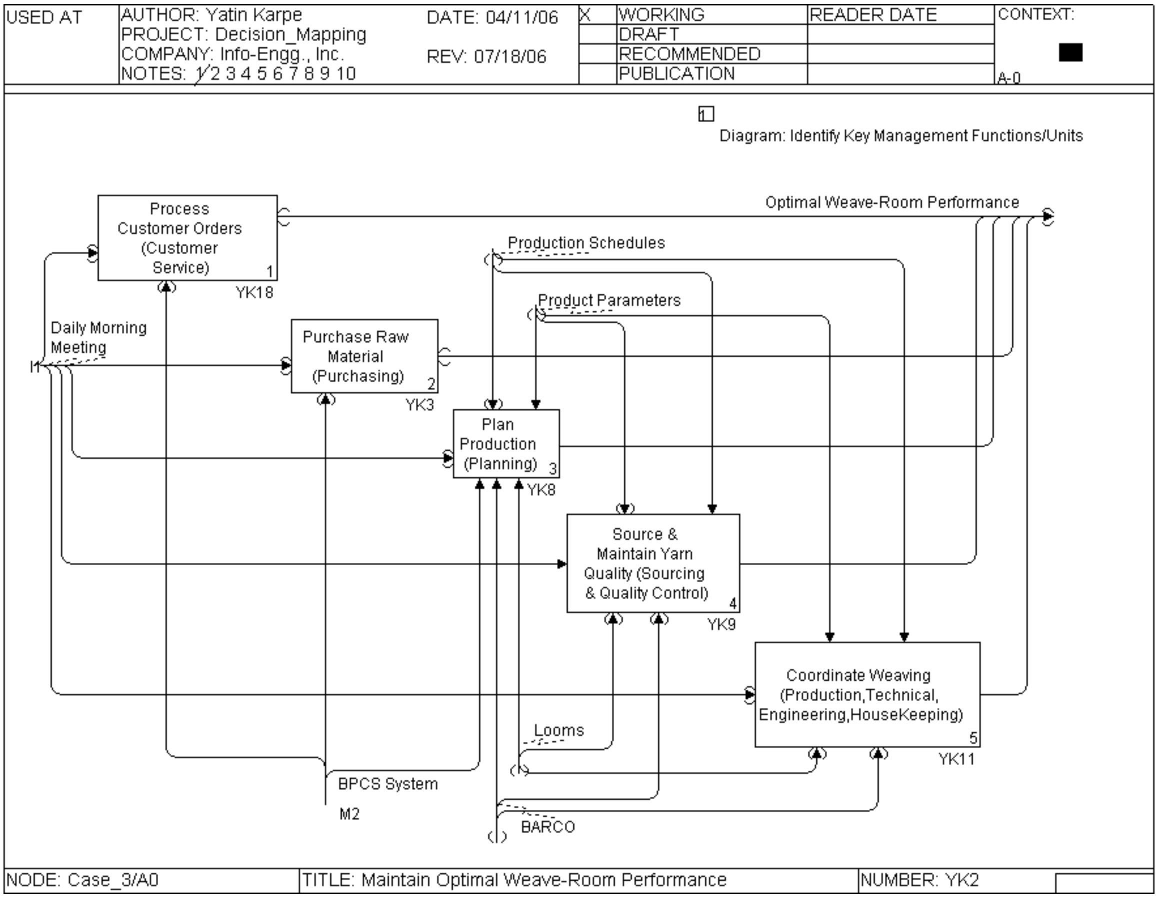

Figure 5.20: Maintain Optimal Weave-Room Performance (A0)

Figure 5.3.2 identifies the key decision-making units and the corresponding decision-makers. At this level, the Plant Manager is the overall decision-maker and coordinator of the various decision-making units and the decision-makers. They are:

1. Customer Service (C.S. Team)
2. Purchasing (Purchasing Manager- P.M.)
3. Production Planning & Scheduling (Planner)
4. Sourcing and Quality Control (SQC Manager)
5. Production, Technical, Engineering and House-Keeping (Weaving Manager- W.M.)

The process begins with the customer service unit receiving orders and entering them into the BPCS system, which will trigger the need for purchasing raw material, planning and production of greige (unfinished) cloth. Some of the decision-makers within these units multitask, such as the Weaving Manager, who is responsible for production, technical, engineering and housekeeping activities. Each of these decision-making units are explained in some detail in the following diagrams, in context of their daily decisions and tasks that they perform, along with a couple of examples wherever possible.

5.4.4 Level A1

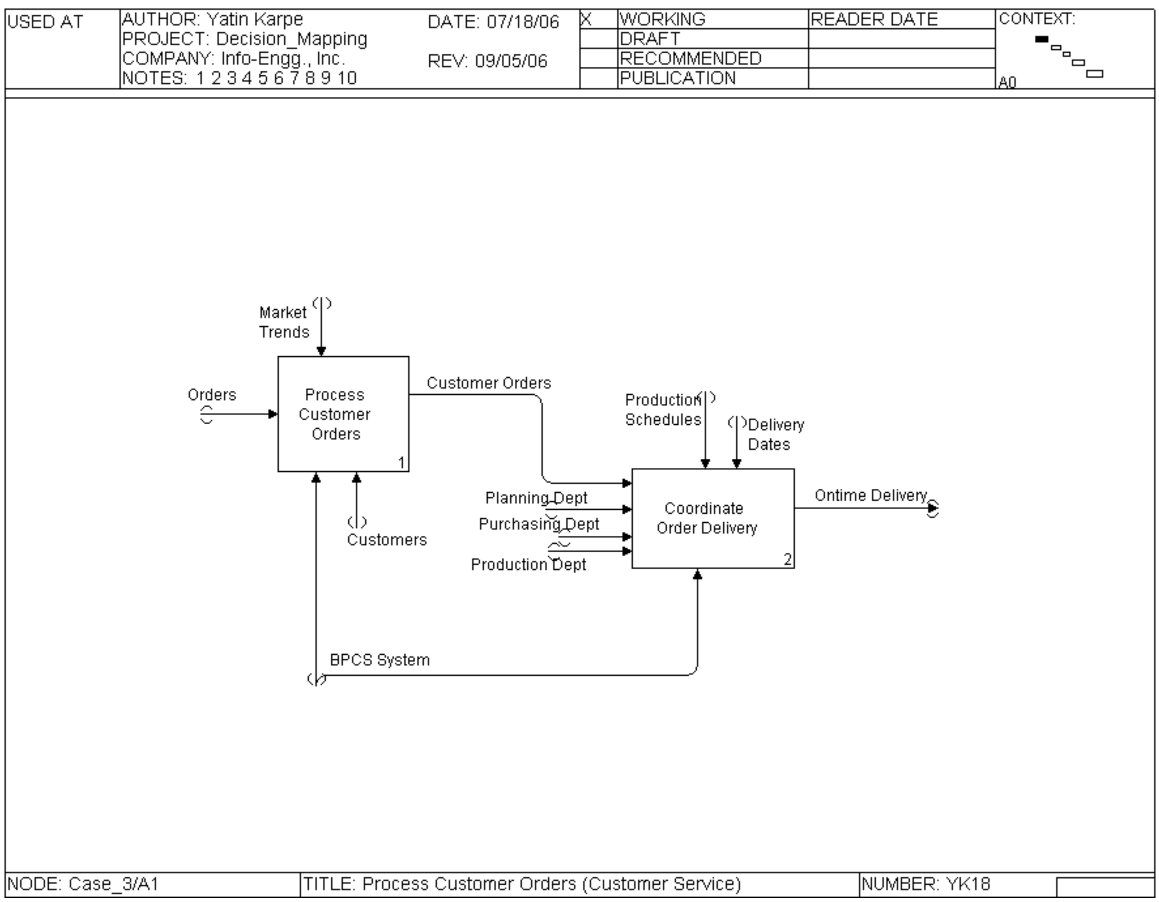

Figure 5.21: Process Customer Orders (A1)

In this process, the decision-maker is the Customer Service (C.S.) Team, which interacts with customers and receives their orders via fax, email or electronically (Electronic Data Interchange-EDI). Once they receive these orders, they enter them into the system that triggers the follow-up units to start their actions/decisions. This unit is constrained by the market trends and ever changing delivery due dates from customers, and hence are constantly interacting with the planning, purchasing and production personnel for the orders to be ready by the due delivery date. A team of 3 Customer Service Team members manages approximately 900 customers.

5.4.5 Level A2

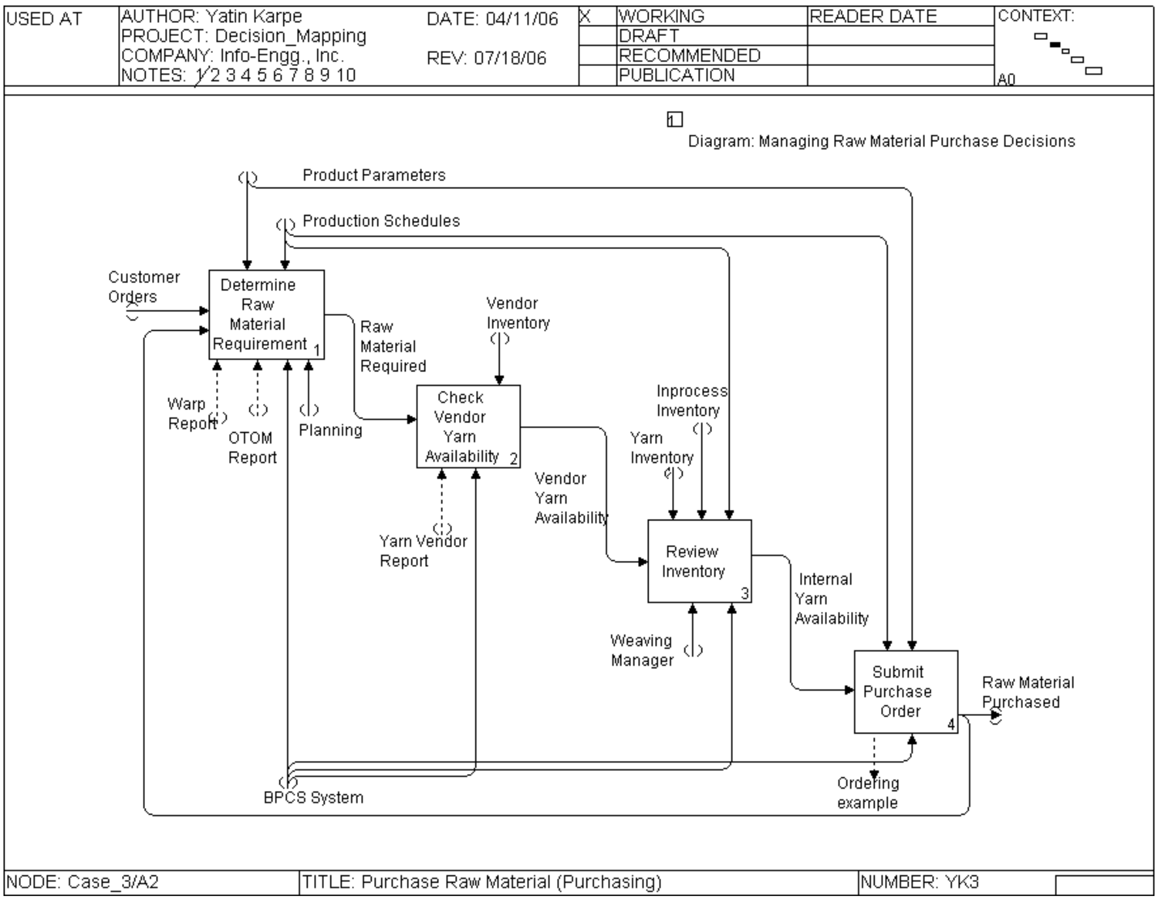

Figure 5.22: Purchase Raw Material (A2)

In this process, the decision-maker is the Purchasing Manager (P.M.), who is responsible for making decisions related to purchasing the appropriate amounts of yarn, based on the requirements as determined by the planning unit and the BPCS system, as well as inventory levels. His decisions are also based on product parameters and production schedule constraints. The kind of decisions and tasks carried out by the P.M. are shown in figure 5.22 and described as follows:

1. Determine Raw Material Requirements: Based on the orders received by the customer service unit, the P.M. reviews the OTOM and the Warp Report (Appendix C, figures C1 and C2) to determine the raw material required.
2. Check Yarn Availability: The P.M. then checks for yarn availability, by reviewing the Yarn Vendor Report (Appendix C, figure C3).
3. Review Inventory: In this step, P.M. checks for yarn inventory using the BPCS system, as well sometimes by interacting with the weaving manager to find out any material in process that has not been restocked.
4. Submit Purchase Order: Once all the background information is reviewed, the P.M. makes the decision to either purchase or not purchase the relevant raw material. An example of the process of ordering filling yarn can be seen in the Appendix C, figures C4-C12. Figure C4 shows the OTOM report that indicates the need for ordering a specific yarn, say number 402920; figure C5 displays a screenshot where the material status is checked; figure C6 displays the output of the purchasing inquiry indicating that the minimum balance (of item number 402920) of 1500 cannot be met by the 1479 on hand material; figure C7 shows the past history of regular delivery from a specific vendor (say tex Inc.) that confirms the need to order from that vendor; figure C8 is the screen shot of the form used to find and enter the Purchase Order for a specific vendor; figure C9 provides information about the delivery specifications for the vendor; figure C10 displays the quantity of yarn needed to be ordered and the date by which it is needed; figure C11 shows the screen shot that prompts the print function and figure C12 shows the final Purchase Order that is sent to the vendor.

A process identical to the one described above is used for purchasing both, the filling yarn and the warp yarn.

5.4.6 Level A3

In this process, the decision-maker is the Planner, who is responsible for planning and scheduling looms, based on the orders received through the BPCS system from Customer Service. The Planner is also delegated the task of making sure that there are no looms lying vacant due to lack of shop orders (work orders) available for the looms. The kind of decisions and tasks performed by the Planner are shown in figure 5.23 and described as follows:

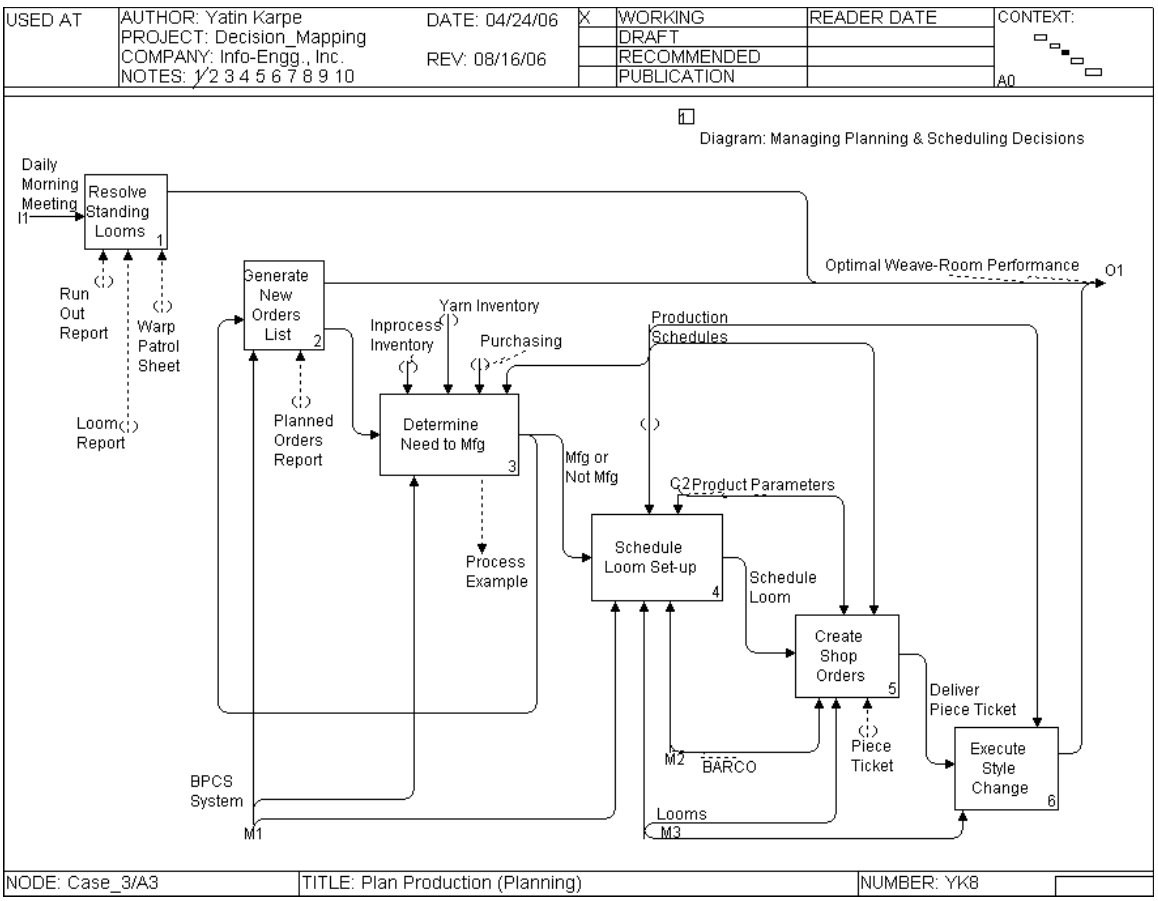

Figure 5.23: Plan Production (A3)

1. <u>Resolve Standing Looms</u>: The first task of the planner is to review the Run Out Report (Appendix C, figure C13), and check for any looms that are lying vacant due to unavailability of shop orders. The Planner will cross reference the Run Out Report with the Warp Patrol Sheet

(Appendix C, figure C14) and the Loom Report (Appendix C, figure C15) and assign new plans for the looms, so that they keep running.

2. Generate New Orders List: The Planner then generates a Planned Orders Report (Appendix C, figure C16). The Planner runs through this entire list, sorted by warp item number, to determine if there is a need to manufacture.

3. Determine Need to Manufacture: At this stage, the Planner reviews information from various sources to determine if there is a need to manufacture new cloth or if there is something in the in-process inventory. Additionally, the planning is also dependent on the availability of yarn, and hence is constrained by yarn inventory or purchasing decisions. An example of the process of determining whether to make cloth or not is shown in Appendix C, figures C17 to C23. Figure C17 shows the screen shot of the Main menu, where the Loom Scheduling option is chosen. Figure C18, option 8 is chosen for planning inquiry. For warp item 401254 on the Planned Orders Report, the Planner makes an inquiry for Weave Item number 703261. Figure C19 shows the status of item no. 703261 and it shows that there are 56 yards are on hand. Figure C20 is selected to find out the finished style number for 703261, which is item no. 915984. Figure C21 shows the status and entire list of orders for the finished style number 915984. Figure C22 shows the details for style 915984 and the due dates for delivery. Since the scheduling is done for up to 4 weeks out, there are 2 orders of 50 yards each that need to be completed within those 4 weeks (7/14/06 and 8/10/06 due dates) which are the dates relevant to when this example was processed. There are 45 yards on hand, and 56 yards on order, a total of 101 yards, which will cover the 2 orders and hence a decision could be reached that there is no need to manufacture that item. The document in Figure C23 is referenced for crosschecking the actual customers that will be consuming the finished items, just in case there are more orders that cannot be seen in the system. This helps to

confirm the decision that there is no need to manufacture anything more for that time period.

4. Schedule Loom Set-up: At this step, the Planner schedules the loom for the particular weave item number, based on the decision made in the previous step. BARCO and BPCS systems are used at this stage to review and schedule the appropriate loom, based on the product parameters of the item that is to be woven, as well as the production schedules of the looms in the weave-room.

5. Create Shop orders: At this stage, once looms are scheduled, Shop Orders are created for particular looms. Figure C24 shows an example of the Piece Ticket that is generated that needs to go to the loom.

6. Execute Style Change: At this point, the Planner will take the Piece Tickets to the weave room area that triggers the style change and weaving processes.

5.4.7 Level A4

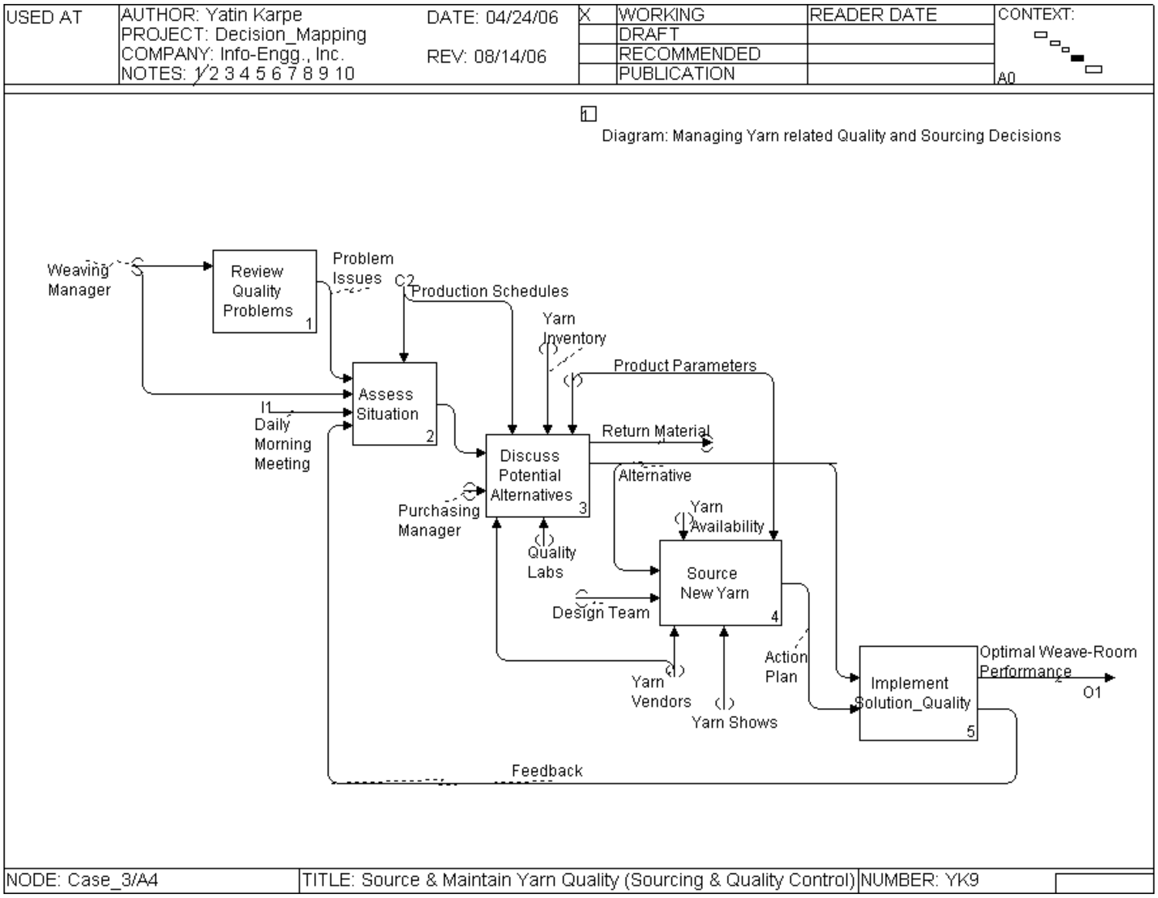

Figure 5.24: Source & Maintain Yarn Quality (A4)

In this process, the decision-maker is the Sourcing and Quality Control (SQC) Manager, who is responsible for sourcing new yarns from different vendors, as well for maintaining quality of all sourced yarn. The SQC Manager constantly interacts with the vendors, especially if there is quality or delivery issues with regard the concerned yarn. The decisions and tasks performed by the SQC Manager are shown in figure 5.24 above and described as follows:

1. Review Quality Problems: The Weaving Manager brings forward any quality related issues to the SQC Manager, who then reviews the problem.

2. Assess Situation: The SQC Manager will then assess the situation and discuss with the senior management during the daily morning meeting.

3. Discuss Potential Solutions: Based on his assessment and interactions with the senior management, SQC Manager will discuss potential alternatives with the P.M. and the yarn vendors which may lead to more quality testing in the labs, or return the material to the vendor for exchange. Again, this decision will also be based on the inventory levels and the various productions schedules that need to be met.

4. Source New Yarn: The SQC Manager may source new yarn, either to replace the bad quality yarn, or in consultation with the design team, for new varieties of items to be woven. The SQC Manager attends a couple of yarn shows that also provide him new avenues for sourcing yarns, as well as sources yarn from current yarn vendors.

5. Implement Solution_Quality: Based on all the previous steps, the SQC Manager will implement the most optimal solution for the quality related problem.

5.4.8 Level A5

In this phase, the Weaving Manager (W.M.) is the decision-maker, who is mainly responsible for the weave-room production, as well as some additional functions such as technical, housekeeping and engineering areas. The decisions and tasks performed by the W.M. are shown in the figure 5.25 and described as follows:

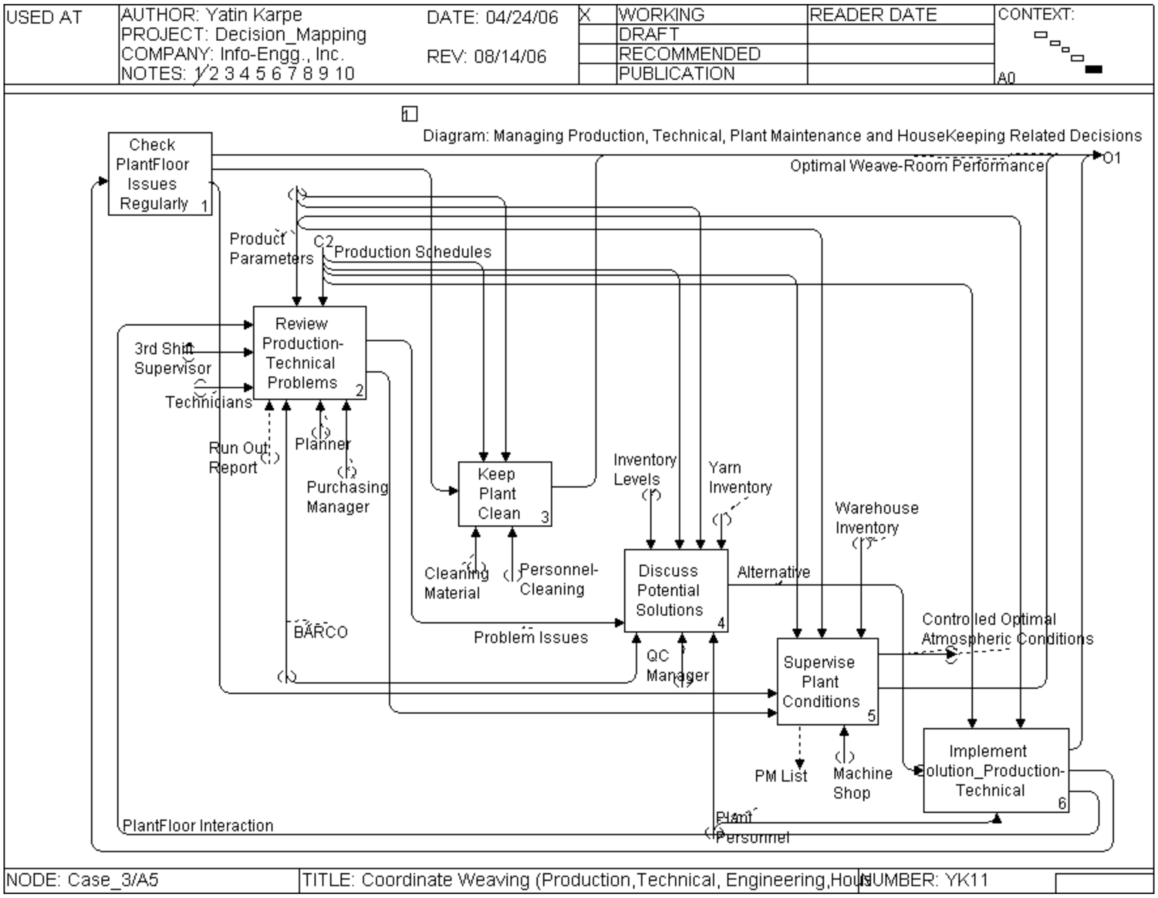

Figure 5.25: Coordinate Weaving (Production, Technical, Engineering, House-Keeping) (A5)

1. <u>Check Plant Floor Issues Regularly:</u> The W.M. constantly patrols the weave-room to keep an eye on various aspects such as safety, working conditions, housekeeping, maintenance, engineering, production and so on.
2. <u>Review Production-Technical problems</u>: The primary task performed by the W.M. in the morning is to review the Run Out Report (Appendix C, figure C25) along with the previous 3rd shift supervisor, as well as the technicians, Planner and the P.M.
3. <u>Keep Plant Clean</u>: Since there is no House-Keeping manager, the W.M. is in-charge of maintaining a clean weave-room and makes it a point to direct the cleaning crew to perform their tasks, both efficiently as well as in time.

4. Discuss Potential Solutions: All matters that need attention within the Run Out Report are addressed first and potential solutions are sought, in consultation with various plant personnel. Examples being, if any loom is standing due to unavailable shop orders, or no filling/warp yarn, the W. M. interacts with the P.M. and the Planner to resolve those issues; also W.M. supervises the yarn and machine inventory levels. Another example is that if there are any technical problems that need to be addressed, appropriate action is taken to resolve those matters, by discussing with the technicians. If there are any quality related problems, then the SQC Manager is consulted to get appropriate solutions.

5. Supervise Plant Conditions: Based on the requirements of the weave-room production schedules and product parameters, appropriate action is taken to maintain the optimal atmospheric conditions. Additionally, if there are any engineering issues the machine shop is used as a resource. Additionally, the Preventive Maintenance List (PM List, see Appendix C, figure C26) is an example of maintenance tasks performed during major shut downs, and is done on a regular basis.

6. Implement Solution_Production-Technical: Based on all the interactions and discussions that are conducted between the W.M. and the various plant personnel on all the issues or problems within the production floor, the appropriate ideal solution is implemented for maintaining optimal weave-room performance.

5.4.9 Observations

Although the decision-makers work cohesively towards attaining the optimal weave-room performance, certain limitations in the decision-making process were observed during the research of this case study with reference to the following characteristics.

- Information Dilemma/Overload – In this case study, it was found that one particular decision-maker was performing four different plant functions, which could potentially influence and affect his decision-making in both, the overall level as well as for the individual functions. The four functions are plant maintenance, production, technical and house-keeping, each having its own importance. Several of these functions have a strong influence of implicit knowledge component to their effective functioning and there is a strong chance of overlooking one function over the other. It was easily noticed that two of the functions, the house-keeping and maintenance functions (each having its own significant relevance and importance), were not given as much importance as compared to the other two. This can be attributed to the fact that there was too much information dilemma to deal with for the decision-maker, leading to information overload, thus affecting the effectiveness of his decision-making process.

- Coordination **–** It was observed that the coordination between the different units was lacking, probably due to the fact that different decision-makers were responsible for multiple plant functions and units. This resulted in reduced time for continuous plant interaction and coordination, as well as regular meetings between the key decision-makers. It is extremely important for the different units and their managers to coordinate the activities, so as to accelerate the smooth functioning of the weave-room plant. Coordination in the form of mandatory meetings during the day, between the decision-makers could facilitate as an effective means to enhance the overall weave-room performance decision-making process.

These limitations that were observed during the case study will be addressed in the results section and suitable performance improving options or alternatives will be presented as part of this research outcome.

6 RESULTS

6.1 AS-IS Models -

In the previous chapter five, three case studies were presented, which described the weave-room performance decision-making process in detail. These three cases study models were developed and built using the Wizdom Software’s IDEF process modeling suite of applications, which resulted in providing three outputs: diagrams, glossary and attachments. The first output were three distinct, detailed, electronic versions of the IDEF0 process models. Each of these models consisted of its own set of graphical diagrams that sketched out the various ICOM components of the decision-making process, from the top-level context diagram, decomposing it to a few levels down. Second, the case study resulted in the development of a comprehensive IDEF0 glossary of the activity and ICOM terms and their definitions, providing a brief description of each term. The third output was in the form of attachments that formed part of the Appendices, and consisted of reports, documents, process steps and computer screen-shot examples that were obtained during the case study. Each of the weaving plant that was studied had various decision tasks or components that were similar in their functions, while other components were different. Some functions were independent, with a lot of care and attention given to the details of the decisions that needed to be performed, along with their related resources that were needed to perform the functions efficiently and effectively. While in some other function, multiple roles were being performed by certain decision-makers, with a limited number of resources, thus making it relatively difficult to make the best possible decision, and attend to every possible problem or issue at hand. The outputs of the three case studies were structured, well-defined AS-IS weave-room performance decision-making process maps for each plant studied for this research. Additionally, certain limitations in the decision-making process were observed during the research of the three case studies with reference to the topics reviewed in the literature in chapters two and three. Solutions in the form of performance improving options for these limitations will be addressed later in this chapter.

6.2 TO-BE/ Best Practices Model -

6.2.1 Introduction

Based on the AS-IS models developed and the various inputs received from the different decision-makers at the three weaving plants, as well as the feedback received from industry experts and the literature reviewed, a Best Practices TO-BE model was developed with reference to the weave-room performance decision-making process with the aid of diagrams using the IDEF0 methodology. This TO-BE model is a combination of the best possible decision-making approach or practices adopted by the different decision-makers at each of the three weaving plants. It should be noted at this point that the TO-BE model proposed here is based on the case studies during this particular research. If plants tend to have a slightly different weaving operations process, they could customize this TO-BE model to suit their needs. The top-level context diagram has been maintained at the same consistent level as with the earlier case studies.

6.2.2 Level A-0

The main function of a weaving plant is to maintain optimal weave-room performance, which is shown in the top-level Context Diagram (figure 6.1). The key decision-makers should meet during the daily morning meeting to discuss various day-to-day production and related issues, and try to come up with the best possible alternatives to resolve them and hence maintain the best possible weave-room performance. Product parameters and production schedules seem to constrain the weave-room performance, while various information systems such as a comprehensive plant maintenance computer information system, that could assist in maintaining information of all the plant-wide maintenance work requests, as well as monitor and regulate the atmospheric conditions of the plant, could prove to be a valuable resource in maintaining optimal weave-room performance. The Context Diagram shown in figure 6.1 subsequently breaks down into lower functional levels as shown in figure 6.2, so as to understand the different decision-making units and their corresponding decision-makers. (Please refer Glossary section in chapter five section 5.1.1 for term definitions)

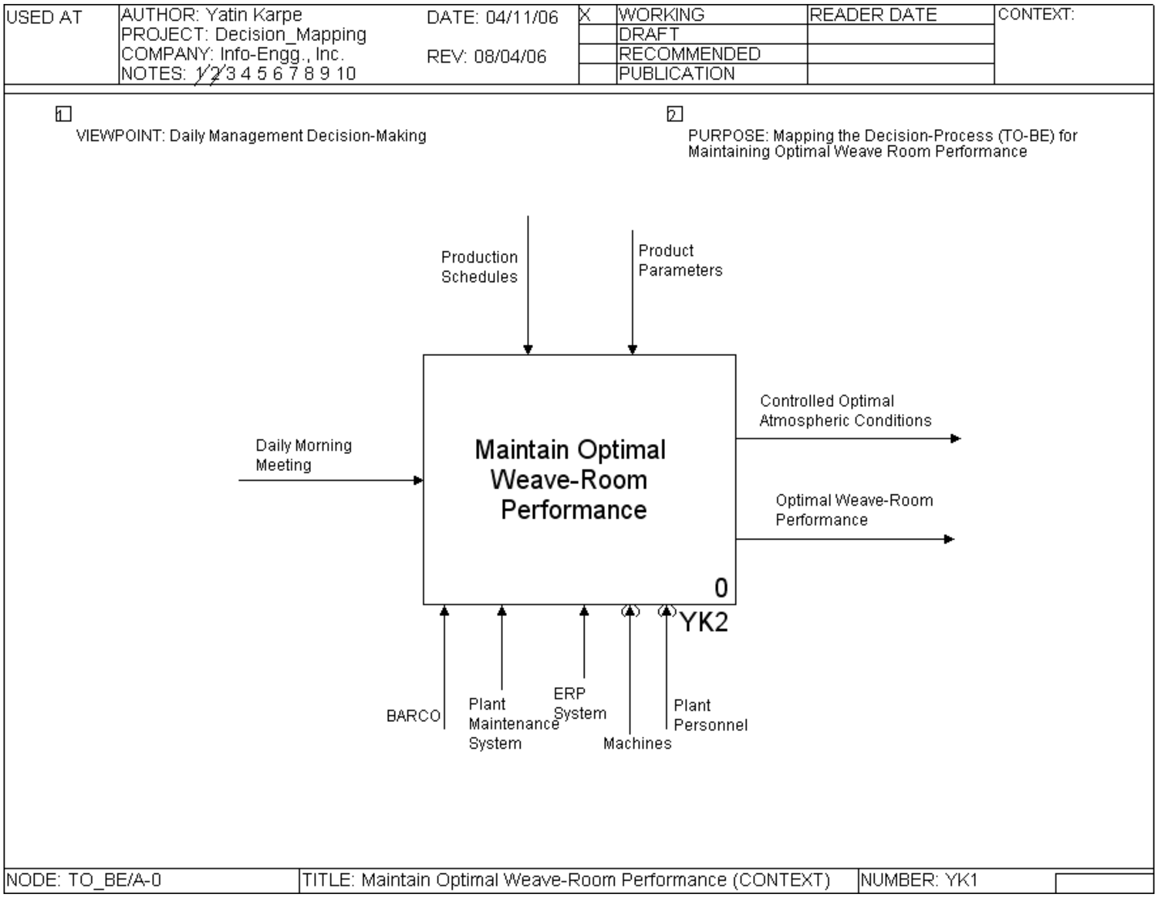

Figure 6.1: Context Diagram- TO-BE (A-0)

6.2.3 Level A0

Figure 6.2 identifies the key decision-making units and the corresponding decision-makers that need to be part of a weave-room plant function. At this level, the Plant Manager is the overall decision-maker and coordinator of the various decision-making units and the decision-makers. In order to distinguish these decision-makers from the previous case studies, the number “2” has been added against their titles. Additionally, it needs to be noted that there is no specific intention to show the decision-making units in the order that they are listed; the order is being chosen, mainly based on the manner in which the case studies were conducted and the way the decision-makers were interviewed during the data collection steps of the research process. The main purpose of the diagram herein is to identify the key management functions, and their corresponding decision-makers, who should meet regularly during the Daily Morning

Meeting, in order to brainstorm and devise different ways to maintain optimal weave-room performance.

1. House-Keeping (House-Keeping Manager-HKM2)
2. Purchasing (Purchasing Manager- PM2)
3. Engineering (Plant Engineer-PE2)
4. Production Planning & Scheduling (Planning Scheduling Manager-PSM2)
5. Quality Control (Quality Control Manager-QCM2)
6. Production (Weaving Manager-WM2)

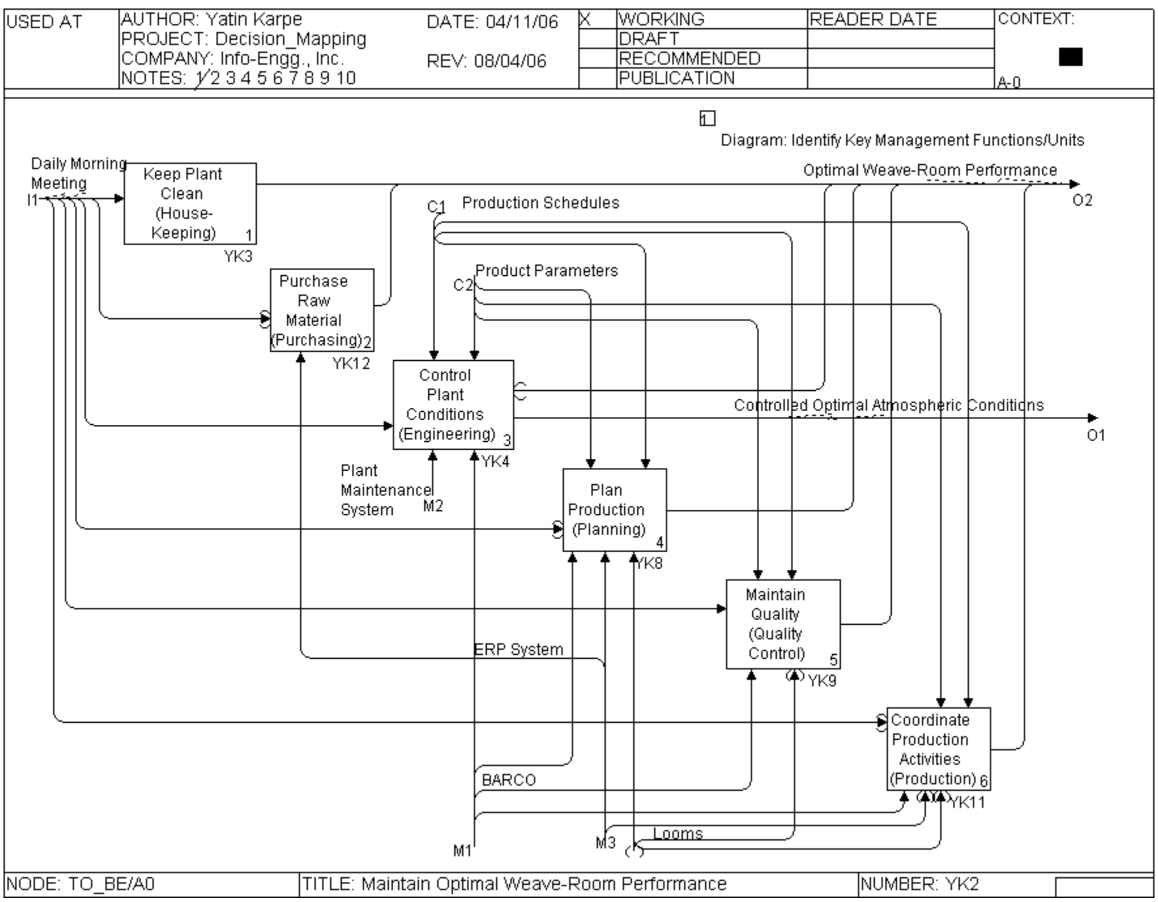

Figure 6.2: Maintain Optimal Weave-Room Performance (A0)

Each of these decision-making units are explained in some detail in the following diagrams, in context of their daily decisions and tasks that they perform.

6.2.4 Level A1

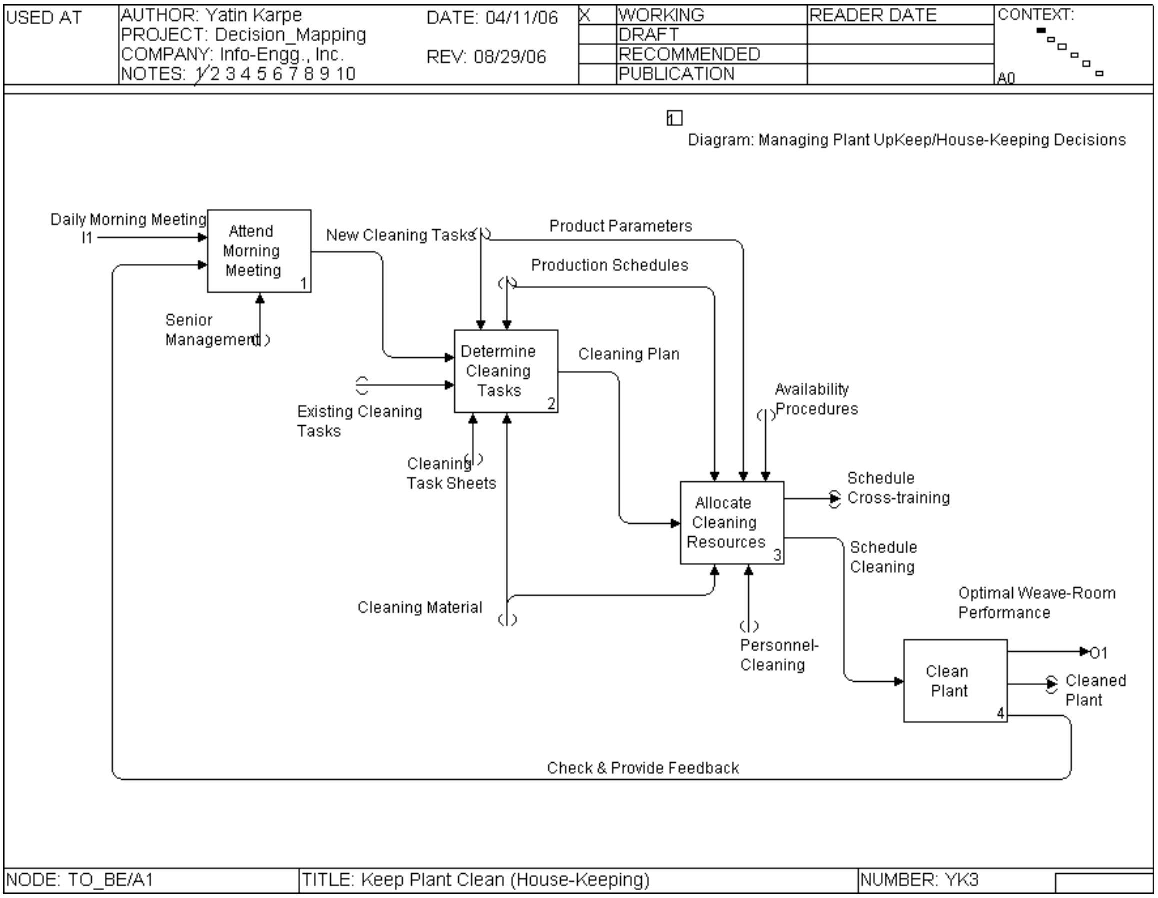

Figure 6.3: Keep Plant Clean (A1)

In this process, the decision-maker is the House-Keeping Manager (HKM2). The kind of decisions and tasks that should be carried out by HKM2 are shown in figure 6.3 and described as follows:

1. Attend Morning Meeting: The HKM2 should attend the morning meeting and get feedback on any new cleaning tasks from the senior management, or get updated with any tasks that need special attention. The HKM2 in turn, also provides a feedback or discusses concerns with the relevant senior management personnel.

2. Determine Cleaning Tasks: Based on this input, the HKM2 should determine the daily cleaning tasks, taking into consideration the existing daily cleaning routines that need to be followed by the cleaning personnel. Standard operating procedures of the various cleaning tasks involved in maintaining a clean weave-room should be developed and maintained by the HKM2. Cleaning in the weave-room area is dependent on the production schedules, as well as product parameters.
3. Allocate Cleaning Resources: Based on the cleaning plan and availability procedures, the HKM2 should allocate the cleaning resources to schedule cleaning of the weave-room. At the same time, the HKM2 must coordinate and schedule cross-training of the cleaning personnel, especially due the uncertain nature of their attendance at work.
4. Clean Plant: Once cleaning resources are allocated and tasks scheduled, the plant should be cleaned. Feedback should be provided to the senior management, either at a daily morning meeting or by personal contact.

6.2.5 Level A2

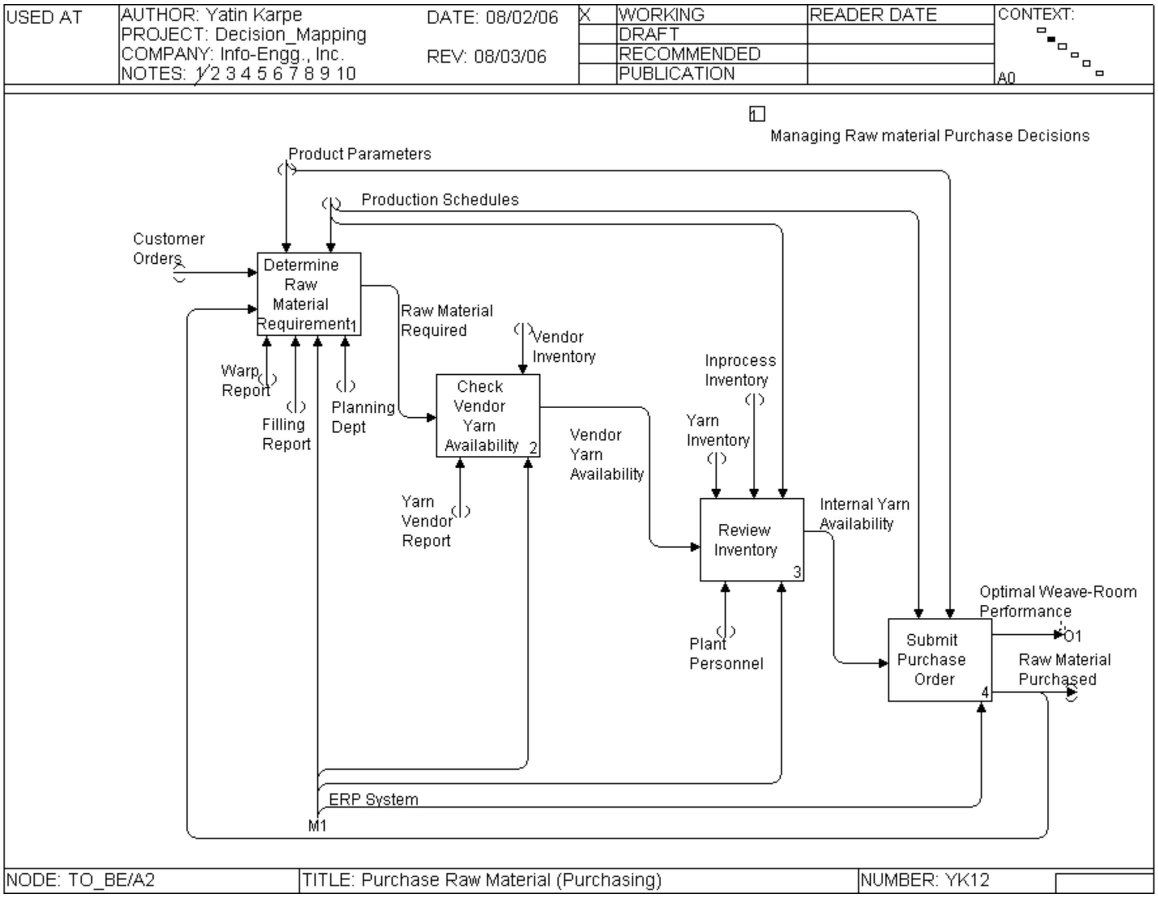

Figure 6.4: Purchase Raw Material (A2)

In this process, the decision-maker is the Purchasing Manager (PM2), who is responsible for making decisions related to purchasing and sourcing the appropriate amounts of yarn, based on the customer order requirements as determined by the planning unit and the ERP system, as well as inventory levels. His decisions are influenced or constrained by the product parameters and production schedules. The kind of decisions and tasks carried out by the PM2 are shown in figure 6.4 and are described as follows:

1. <u>Determine Raw Material Requirements</u>: Based on the customer orders received and the production planning figures generated by the ERP system, the PM2 should generate and review the Filling and the Warp

Reports to determine the raw material required for manufacturing the styles.

2. Check Yarn Availability: The PM2 should then review the Yarn Vendor Report to check for yarn availability.

3. Review Inventory: In this step, the PM2 should check for yarn inventory using the ERP system, as well sometimes by interacting with the various plant personnel (Weaving, planning, supply-room, etc.) to locate any material that maybe en-route to be restocked and hence not entered into the ERP system. Every effort should be made to keep the ERP system updated.

4. Submit Purchase Order: Once all the background information is reviewed, the PM2 should make the decision to either purchase or not purchase the relevant raw material.

A process identical to the one described above should be used for purchasing both, the filling yarn and the warp yarn. The role of the PM2 is vital, since the availability or delivery of yarn from the vendors has been a growing problem faced by the weaving plants, especially with the decline of the yarn manufacturers in the domestic market and growing dependence on foreign yarn vendors, which poses greater challenges in acquiring raw material.

6.2.6 Level A3

In this process, the decision-maker is the Plant Engineer (PE2), who is mainly responsible for two functions: Facility Maintenance Management, as well as the Atmospheric Conditions Management within the plant (figure 6.5). For the Facility Maintenance component, there should be a unique, customizable Plant Maintenance System (PMS) that could be used as a repository of historical information, as well as, used for inputting the most current maintenance work requests and information on the facility maintenance needs. In this way, the system could be used for multiple purposes of facility maintenance and along with BARCO, could assist in understanding and trouble-shooting any maintenance issues, by comparing with any historical patterns of similar problems. The PMS would also be responsible for the Atmospheric Conditions management component that monitors the temperature and humidity conditions at various points within the weave-room and allows for system-based modifications of conditions from one central computer of the plant maintenance system. For both these functions to be carried out successfully, there should be constant interaction with the plant personnel to address any problems and determine the best possible solutions for each.

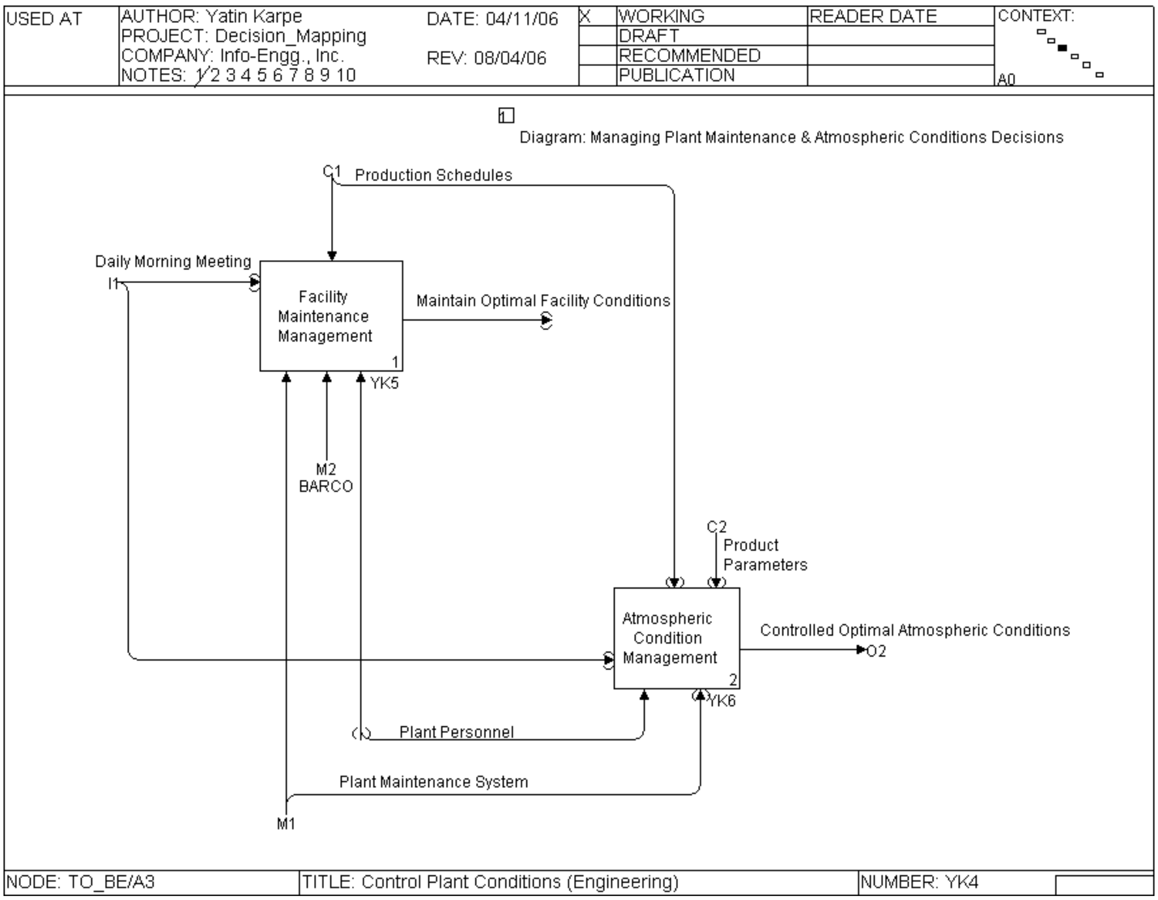

Figure 6.5: Control Plant conditions (A3)

Figure 6.6 further explains the Facility Maintenance Management decision tasks and figure 6.7 shows the Atmospheric Conditions Management decision tasks.

6.2.6.1 Level A31

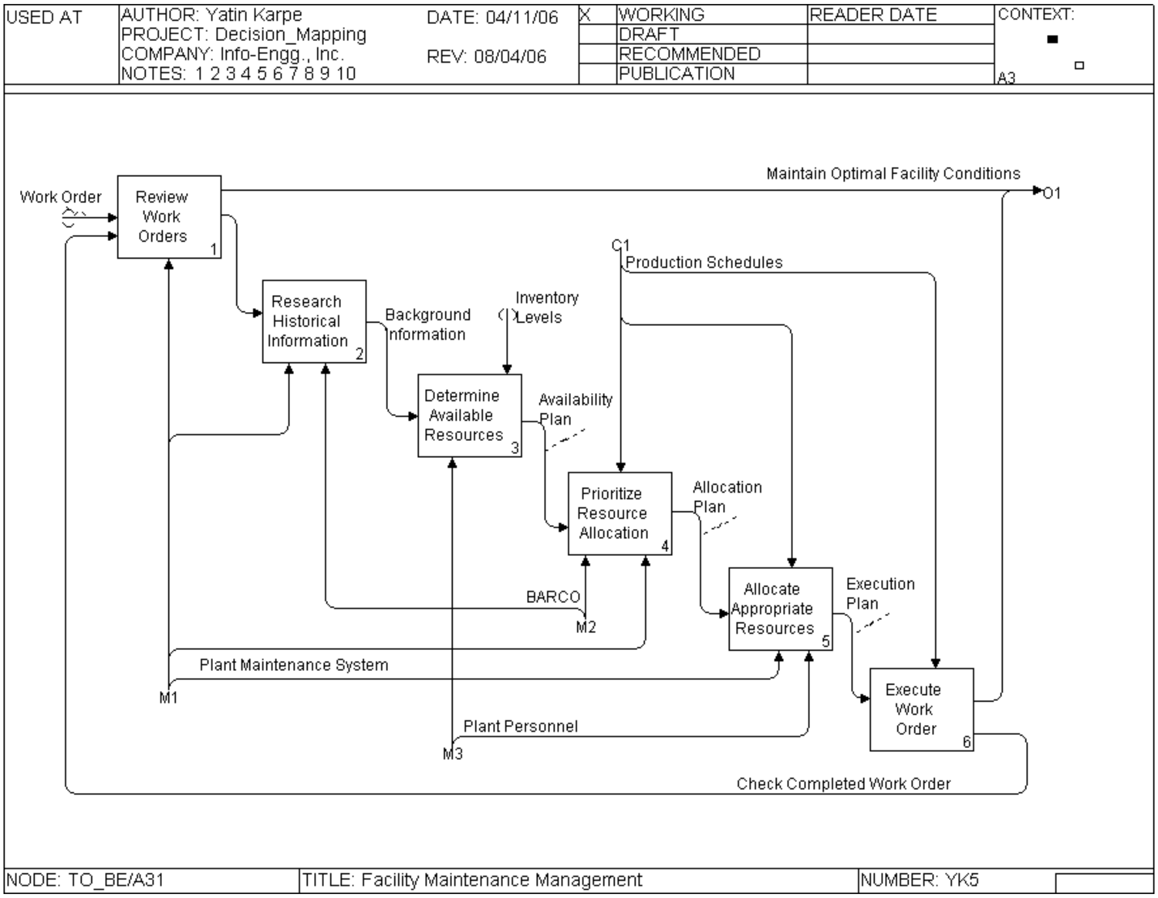

Figure 6.6: Facility Maintenance Management (A31)

1. Review Work Orders: Whenever there is a maintenance work order request, it should be entered into the PMS and the PE2 should review all new and old orders every morning.
2. Research Historical Information: In this step, the PE2 must review historical information for that particular work order, in order to research the problem further, along with BARCO, if necessary. Several options could be used from the PMS system based on the requirement for researching the problem. The PMS listing will give the PE2 information on the specific problem, its time of occurrence and the steps taken to resolve the same in the past, in the form of notes in that work order listing. It would also specify the location and how long the

problem persisted during its last occurrence. This information should be used as background information to move to the next step.

3. Determine Available Resources: At this step, based on the historical research and the inventory levels, the PE2 should determine the availability plan in terms of available resources and plant personnel.
4. Prioritize Resource Allocation: Based on the production schedules and the need or urgency of the work order, the PE2 must prioritize the orders that need to be attended and determine an allocation plan.
5. Allocate Appropriate Resources: The PE2 should then allocate the resources for attending to the Work Order and discusses the execution plan along with his staff.
6. Execute Work Order: Based on all the previous steps, the appropriate plan should be executed to complete the work order. Entering the information in the PMS would provide a feedback, so that the same information can be used in the future as historical data for researching similar problems.

6.2.6.2 Level A32

1. Monitor Atmospheric Conditions: The PE2 should monitor the atmospheric conditions using a PMS control central computer system.
2. Regulate Conditions As Needed: Based on the requirements of the production schedules and product parameters, the PE2 in consultation with the plant personnel, must regulate the temperature and humidity conditions as needed, resulting in controlled conditions.
3. Maintain Optimal Condition: The previous steps lead to maintaining optimal atmospheric conditions needed for the efficient running of the weave-room plant.

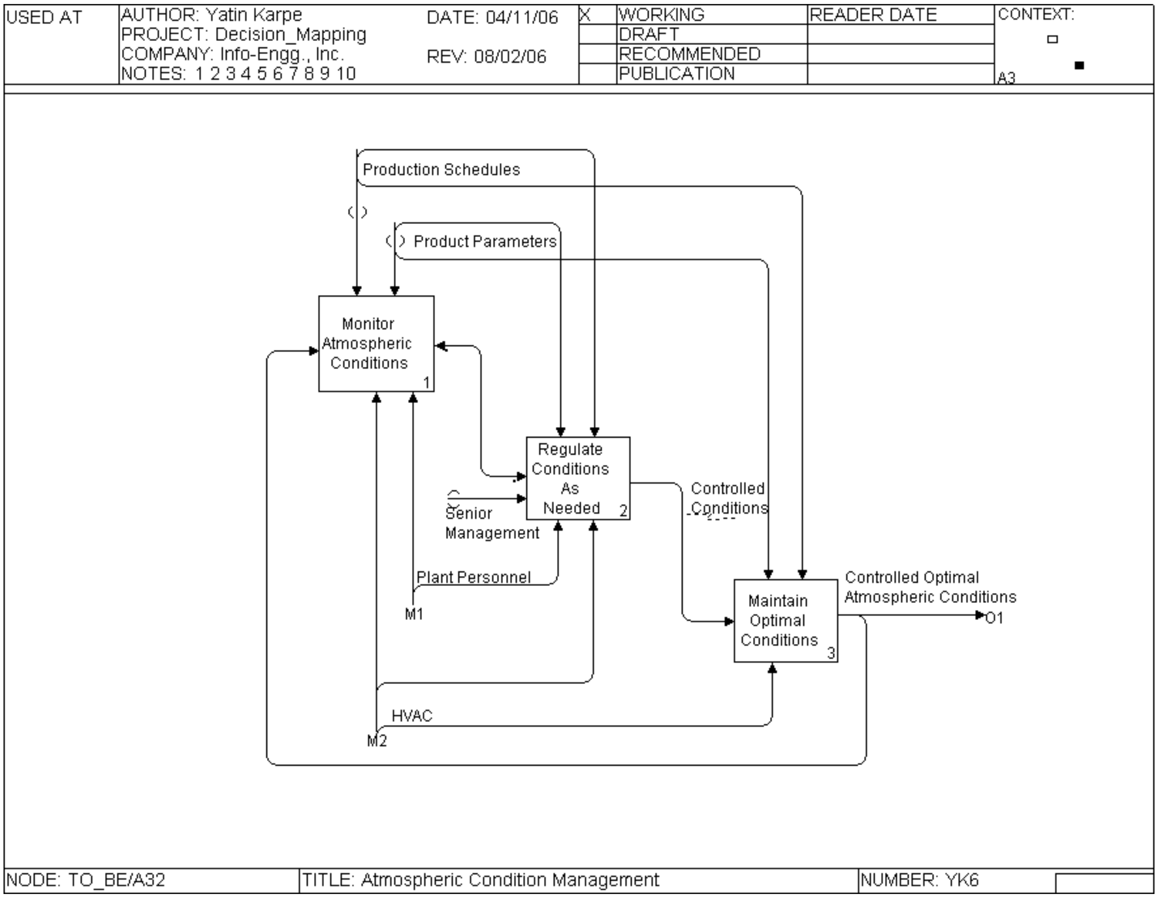

Figure 6.7: Atmospheric Conditions Management (A32)

6.2.7 Level A4

In this process, the decision-maker is the Planning Scheduling Manager (PSM2), who is responsible for planning and scheduling looms, based on the orders received from the customer service department in the corporate office. The kind of decisions and tasks performed by the PSM2 are shown in figure 6.8 and described as follows:

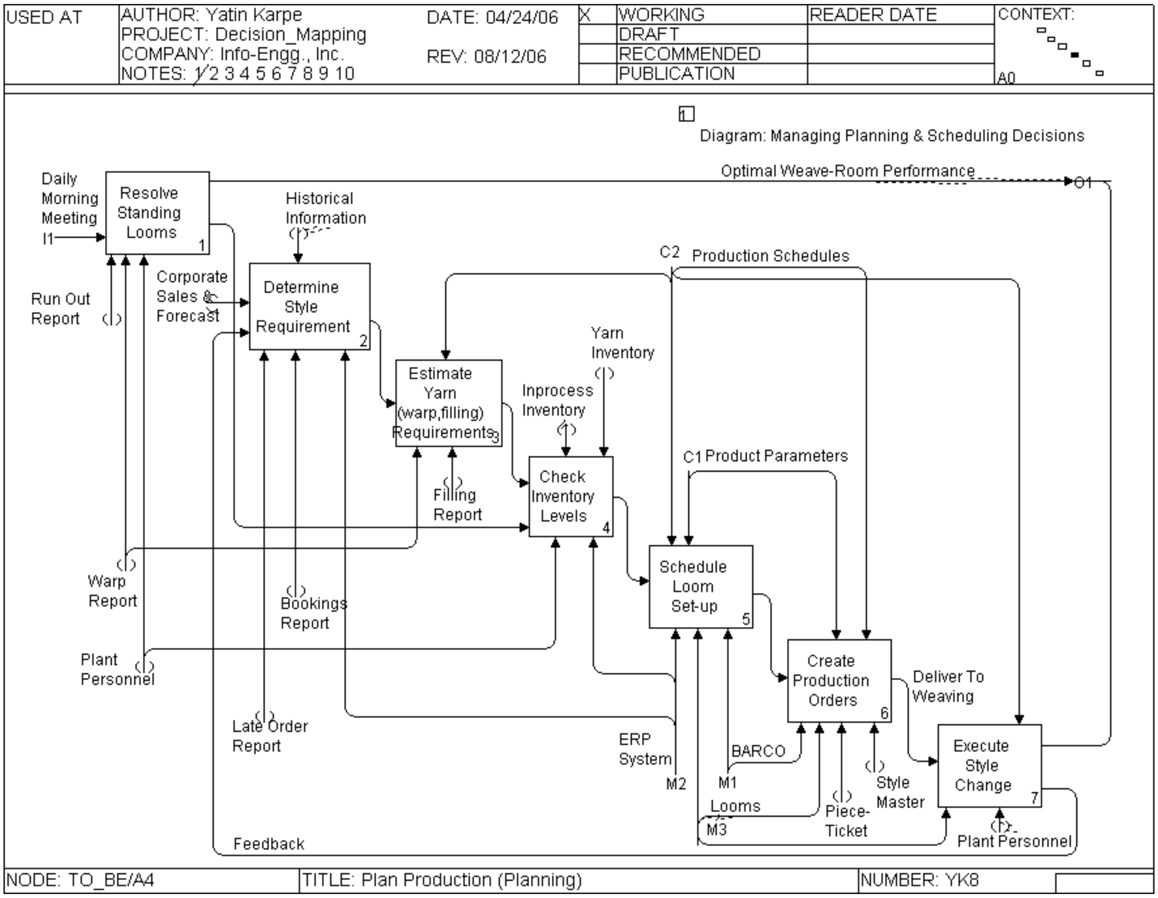

Figure 6.8: **Plan Production (A4)**

1. <u>Resolve Standing Looms</u>: The first task of the PSM2 should be to review the Run Out Report to check for any non-operating looms due to lack of work/production orders and interact with production personnel to do the needful to get them operational. As an example, the looms could be waiting for yarn availability issues, at which point the PSM2 needs to coordinate with the appropriate plant personnel to resolve that matter.

2. <u>Determine Style Requirement:</u> The PSM2 should then review the Late Order Report and the Bookings Report to determine the style requirements for new orders received from the corporate sales team. The PSM2 should also check if the late orders are in process or if there is any potential to meet the late orders with in-process production orders or if there is a need to schedule them on an urgent basis. Historical

customer information is an important consideration at this stage, in order to determine the style requirements for the new orders.

3. Estimate Yarn (warp, filling) Requirements: At this stage, the PSM2 should review information obtained from the Warp Report and the Filling Yarn Report to estimate the raw material that is being used at that moment, so that it can be compared to the requirements of the new styles that need to be produced and estimate the final raw material requirements.

4. Check Inventory Levels: At this step, it is important to crosscheck with the purchasing department to check on the potential availability of the raw material, as well as to check to see if there is any in-process or in-stock yarn inventory.

5. Schedule Loom Set-up: Once the inventory levels and the raw material requirements are reviewed, the PSM2 should schedule the loom for the particular style item number, based on the information gathered from the previous steps. Both the BARCO and the ERP system could be extensively used at this stage to review and schedule the appropriate loom, based on the product parameters of the item that is to be woven, as well as the production schedules of the looms in the weave-room.

6. Create Production orders: Once the looms are scheduled, Production Orders should be created for particular looms. Piece Tickets and Style Masters are generated as a result. Again, this step is constrained by the current production schedules and the product parameters, as well as ever-changing customer demands to obtain their orders earlier than scheduled.

7. Execute Style Change: At this point, the personnel from the planning department can take the Piece Ticket and the Style Master to the weave room area and that would then trigger the production plant personnel to execute the style change for weaving the new styles.

6.2.8 Level A5

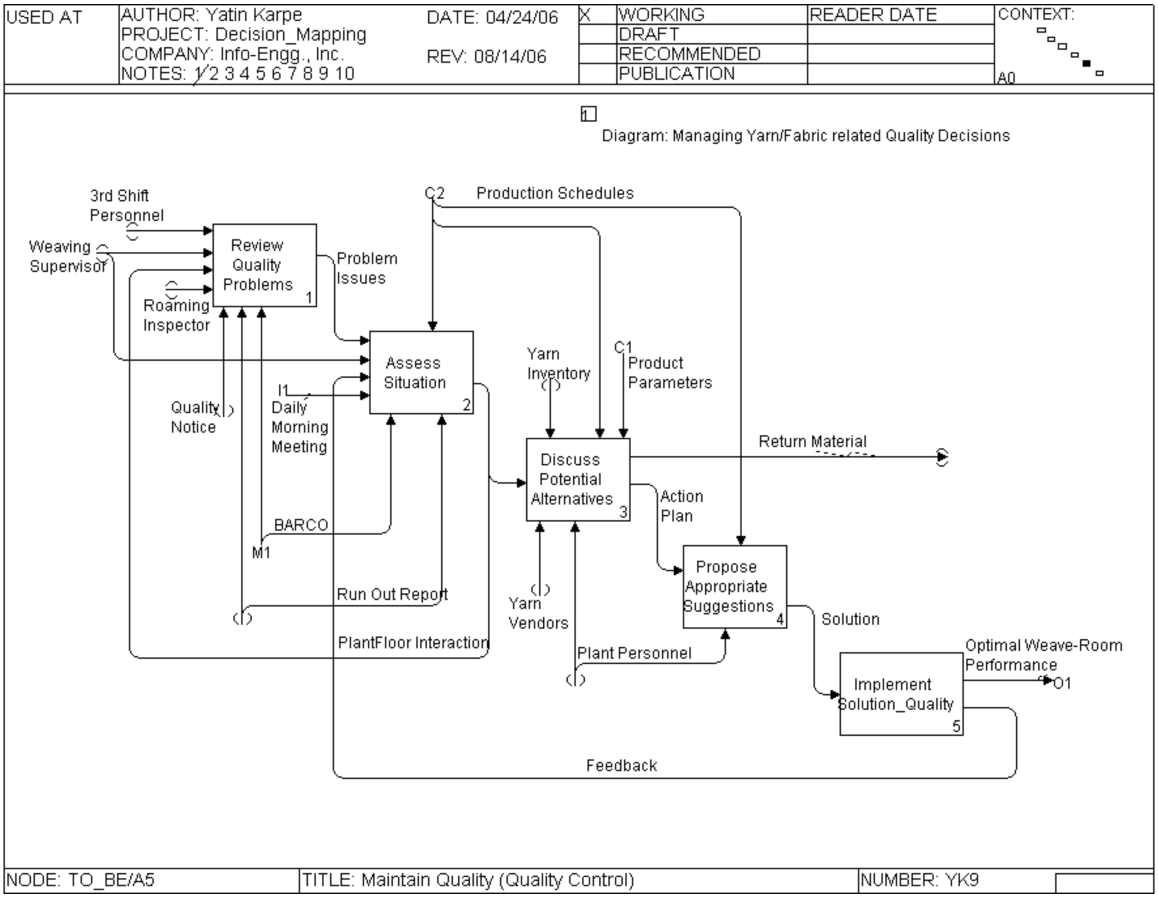

Figure 6.9: Maintain Quality (A5)

In process level A5, the decision-maker is the Quality Control Manager (QCM2), who is responsible for all quality related issues of yarn and greige fabric. The QCM2 should constantly interact with the yarn vendors, as well as the production personnel to resolve any quality issues that arise during production. The decisions and tasks performed by the QCM2 are shown in figure 6.9 and described as follows:

1. <u>Review Quality Problems:</u> The QCM2 should review all quality related problems that are brought to his notice by the Weaving Supervisor, Roaming Inspector or any other production personnel from any shift. A Quality Notice, wherein all the relevant information about the quality related problem, is provided for the reference of the QCM2. If needed,

yarn samples or swatches of fabric with quality problems should be provided to the QCM2 for evaluation. The Run Out Report should also be reviewed by the QCM2 in order to check for quality related problems.

2. Assess Situation: The QCM2 must then assess and evaluate the situation, by reviewing any relevant historical information on similar quality problems and discuss with the senior management during the daily morning meeting. The QCM2 must make the best efforts to try and isolate the problem, so as to better understand the extent or cause of that problem. This would also speed up the process to resolve the quality issue at hand.

3. Discuss Potential Solutions: Based on his assessment and interactions with the senior management, the QCM2 should discuss potential alternatives with the Purchasing unit and yarn vendors, which may lead to more quality testing in the labs, or return the material to the vendor for exchange or replacement. Potential solution might also dependent on the yarn inventory and product parameters and the urgency of the situation so that production schedules are not affected. Similar efforts should be carried out to discuss potential greige fabric quality problems.

4. Propose Appropriate Suggestions: The QCM2 may propose to find a different supplier for that yarn if repeated problem persists with that specific yarn or could potentially propose other solutions, based on his findings and causes of the quality problems. Similarly, appropriate solutions maybe proposed for resolving fabric quality problems.

5. Implement Solution_Quality: Based on all the previous steps, the QCM2 must implement the most optimal solution.

6.2.9 Level A6

In this phase, the Weaving Manager (WM2) is the decision-maker, who is mainly responsible for the weave-room production and technical related decisions. The decisions and tasks performed by the WM2 are shown in the figure 6.10 and described as follows:

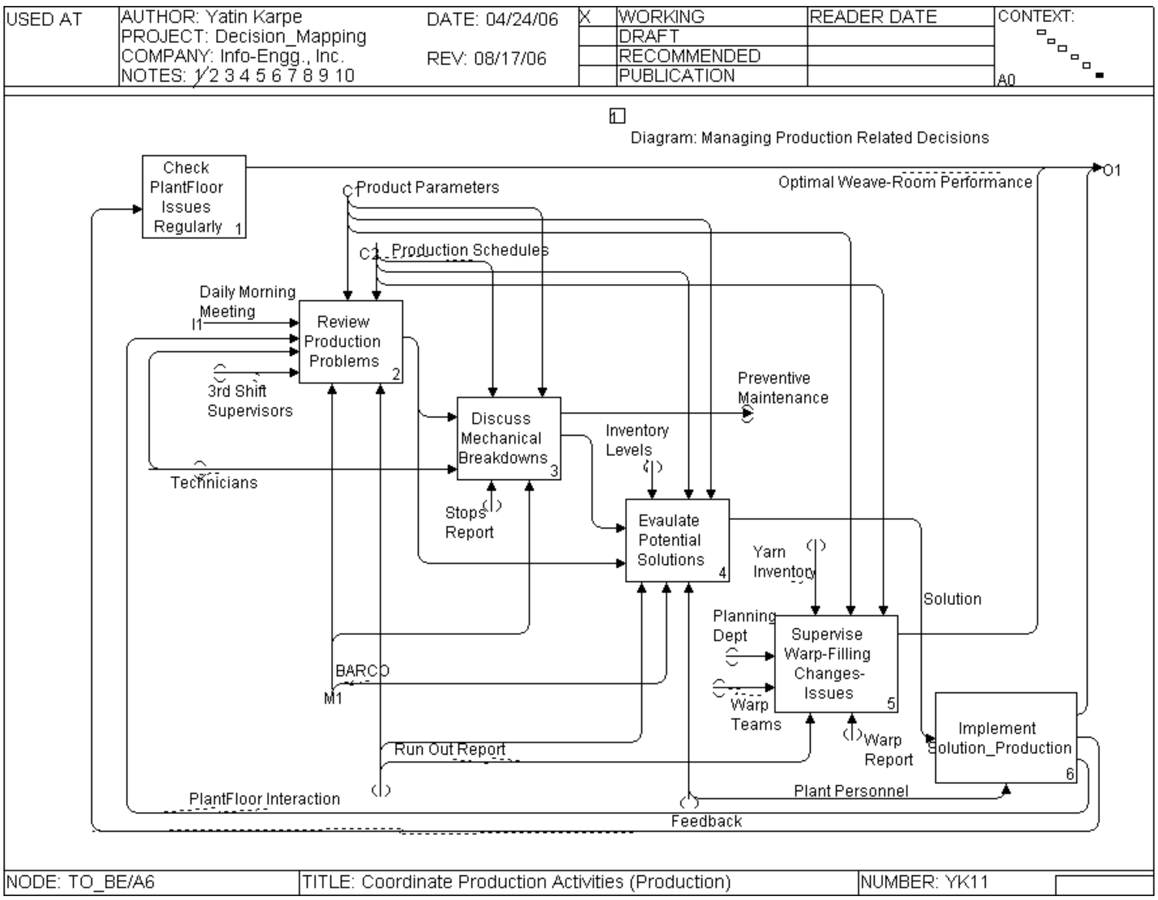

Figure 6.10: Coordinate Production Activities (Production) (A6)

1. <u>Check Plant Floor Issues Regularly:</u> The WM2 should constantly patrol the weave-room to keep a watch on various aspects of production, safety, housekeeping and working conditions in general and keep a good watch on the different people that are working in the weave-room area.
2. <u>Review Production problems</u>: The primary task performed by the WM2 in the morning should be to review the Run Out Report for any production issues along with the 3rd shift supervisors and the technicians

team. Problems could not be covered in the prior days' 3rd shift, should be given first priority, since they would affect the production schedules for that particular day and further.

3. Discuss Mechanical Breakdowns: The WM2 must constantly interact with the technicians to discuss the mechanical breakdowns in order to keep the production schedules on target and provide any assistance to the technicians' team so that the production is not affected. The WM2 must use the BARCO system to review stop reports, in particular, since they could be due to specific product parameters in use and which could definitely affect the production schedules. The WM2 and the technician's team should complement each other to reduce mechanical breakdowns.

4. Evaluate Potential Solutions: All matters that need attention within the Run Out Report should be addressed first and potential solutions sought, in consultation with the Plant Manager and other plant personnel as needed. Inventory levels (both yarn and parts), as an example, would definitely be a constraint around which potential solutions for the stopped looms need to be addressed.

5. Supervise Warp-Filling Change Issues: The WM2 should also be responsible for supervising the warp-filling change issues. Here again, the Run Out Report would assist the WM2 to keep an eye on the latest status of the looms with reference to the warp-outs and the filling yarns; Also, there should be constant interaction with the Planning Department to keep an eye on style changes that will be implemented. The WM2 should continuously evaluate the yarn inventory levels and interact with his warp teams with regards to keeping a close watch on warp-outs and style changes.

6. Implement Solution_Production: Based on all the interactions and discussions between the WM2 and the supervisors, warp teams, planning unit, technician's, etc., to address the production problems at

hand, the best possible solution must be implemented for maintaining optimal weave-room performance.

In this way, the key decision units and key decision-makers should work cohesively towards attaining the overall top-level objective of maintaining the most optimal weave-room performance levels. It is the interaction of these units and the management personnel, as well as the daily decisions/tasks that they perform that would lead to a successful weaving operation. Additionally, after studying, reviewing and developing the best practices TO-Be model, certain performance improving tasks/options are presented below that would help overcome the limitations that were observed and documented for each of the three case studies conducted.

6.3 Performance Improving Tasks -

Based on the literature reviewed, findings of the case studies and results obtained in the form of the best practices TO-BE model, following key performance improving tasks are recommended, as a solution for the limitations observed during the case studies, which in turn could assist in enhancing the efficiency of the weave-room decision-making process.

1. Make Daily Morning Meetings Mandatory: At the A0 level, there should be a daily, mandatory meeting in the morning, that is coordinated by the Plant Manager, wherein all the key decision-makers come together to discuss the day-to-day production problems and issues and collectively brainstorm for the best possible alternatives to resolve them. At this stage, the collective implicit knowledge of the decision-makers could assist in collaboratively attending and resolving the daily production problems.
2. Develop Clearly Defined House-Keeping Tasks: House-Keeping is one of the most important functions, without which a clean weave-room cannot be maintained, which in turn would affect the production schedules, equipment efficiency and product quality. The manager in-charge of this function needs to maintain clear and precise cleaning instruction task sheets for all the relevant

duties that need to be performed in order to maintain a clean weave-room plant. If the information of the cleaning tasks and duties are clearly presented, along with a clear definition and significance of the same, it would translate into meaningful knowledge for the cleaning personnel.

3. Customize Plant Maintenance System: It is important to have a customizable computer system that maintains information on plant-wide maintenance work. Such a system allows for plant personnel to enter work requests from any part of the plant, while also allowing for researching historical information on similar tasks performed in the past and reviewing that information along with other resources to expedite new work requests that are submitted through the system. The inherent characteristic of the information quality provides the correct data needed to enhance the pragmatic information quality, which enhances the usefulness of the data. It also allows for all the senior management to keep a watch on the updated status of the work requests and obtain other relevant corresponding information as per their needs.
4. Coordinate Yarn Availability Issues: One constant problem faced by weaving plants is the issue of yarn availability. For example, the purchasing department needs to constantly keep in touch with the yarn vendors to push them to meet the promised delivery schedules for the yarn. Additionally, the purchasing department should constantly evaluate and find new vendors to source yarn, especially due to the uncertainty of the mere existence of the yarn manufacturing companies in today's' competitive atmosphere. Several yarn companies are either consolidating or moving offshore, which makes the yarn sourcing and availability a very delicate issue. Communication and timeliness of information is of vital importance for this task.
5. Maintain Quality Control: It is imperative that the weaving plants manage to weave cloth of the best possible, first quality. For this to happen, the quality of the raw materials that constitute the cloth, as well as the equipment and plant atmospheric conditions need to be maintained. It is important to have the quality control functionality as part of the weaving plant, so that a close vigil could be maintained on the raw material that is being purchased from yarn vendors, as well

as on the woven cloth at the inspection stage. Technical know-how and cognitive attributes, which are the main components of implicit knowledge form a vital part of the quality control functionality.

6. Improve Run Out Report Format: The Run Out report or the shift-end report (as it is called at some weaving plants) is one of the most important reports that are being used in weaving plants and discussed at the daily morning meeting. This report contains all information with regards to each shift happenings within the weave-room, such as warp-outs, style changes, filling or warp problems, mechanical problems, etc., and is filled out mainly by the production floor personnel and circulated among all the senior managers. Since this is a hand-filled report, it consists of the latest updated information on the weave-room. The importance of this report needs to be highlighted to the plant personnel on a regular basis, and care should be exercised to include all the information on matters that need attention. Some form of standardization, such as color-coding the issues that are needed to be addressed by the different plant personnel (technicians, supervisor, etc.) could help in reducing the need for each of them to review all the problems on that report. Similar coding could potentially be used on the loom monitoring system (such as BARCO) for the corresponding problems listed on the Run Out report, so that the personnel are not subjected to information overload of sorting through other irrelevant data to get to their specific information. In short, although the report takes the form of explicit information, it has a very important implicit angle to its characteristic and hence needs to be given constant, regular attention.

7. Provide Information Feedback: It is important to provide feedback on problems that are being resolved or decisions that are being taken on a regular basis (routine recurring decisions), so as to update everyone on the latest status of the matter. As an example, with the MWRS in Case_1, feedback could be in the form of making notes in the system after work requests are completed, so that the personnel that have requested the work requests are aware of the work completed. Another example is when customer service or corporate sales team take customer orders and promise delivery dates and enter that information into the ERP system, the

purchasing or planning personnel need to verify the possibility of that order completion and confirm the promised delivery date, or notify the sales or customer service team of the inability to meet the due date, along with a reason and/or a new updated delivery due date. This prevents for any information or communication gap from being developed in the knowledge cycle.

8. Maintain Continuous Plant Interaction: There is a continuous need to have plant interaction, at least among the senior management, so that each of the units is kept updated of any developments that could possibly affect their operating schedules. After the daily morning meeting, the senior management should try and meet up at least once during the shift with other, relevant peers and discuss any matters that may need special attention. These meetings could also lead to some innovative solutions or suggestions for the decision-makers, since they could have the benefit of getting a newer perspective to their problem.
9. Use a Comprehensive ERP System: For successful information management, a customizable enterprise resource planning management system could definitely assist in smooth functioning of the plant. Different weaving plants have various types of limitations on resources, as well as units and decision-makers that are performing multiple roles. In such cases, customizing the use of the information system to better suit their needs would definitely benefit the functioning of the weaving operations.
10. Generate Regular Performance Reports: Plant performance reports are a good tool to review the overall performance of the plant with different parameters on a daily, weekly, monthly or yearly basis. They assist the plant manager and the senior management to maintain a good perspective of their performance and helps indicate what needs to be done to enhance that performance. Such reports should be generated by the plant manager and discussed on a regular basis (weekly, monthly or as needed) with the key decision-makers of the plant. A copy of these reports could be provided to the corporate office for their review and comments. Again, although this information has an explicit angle, the manner in which it is interpreted for understanding the performance of a particular functioning department, results from the implicit nature and knowledge of the decision-maker,

and thus allows the decision-maker to make a wise decision, which in turn is a function of the data, definition, understanding, presentation, significance and actions taken by the knowledge worker or decision-maker.

If sufficient attention were focused on these ‘top 10’ performance improving tasks, it would definitely enhance the efficiency and effectiveness of the overall weave-room performance decision-making process. The IDEF methodology helped in the process of identifying these performance enhancers with respect to their roles in the weave-room decision-making process. Hence, section 6.4 presents the finding of the usability or functionality of IDEF0 for understanding, mapping and analyzing plant specific manufacturing decision-making process.

6.4 IDEF0 SWOT Analysis -

Process maps or models offer a systematic, well-defined way of representing the structure of manufacturing operations or processes. They record the activities that are performed, in order to achieve a well-defined purpose of some kind, together with the activities’ inter-dependencies. IDEF0 is one such process method designed to model the decisions, actions and activities of an organization, a system or a process. Effective IDEF0 technique helps to organize the analysis of a system and to promote good communication between the analyst and the user. As a communication tool, it enhances domain expert involvement and consensus decision-making through simplified graphical images. As an analysis tool, IDEF0 assists the modeler in identifying what functions are performed, what is needed to perform those functions, what the current system does right or wrong and potentially what could be done better with the current system or process. Thus IDEF0 models are created as one of the first tasks of a procedural and methodical development effort. The IDEF0 model is used to record the understanding of the current system operations or processes (AS-IS), and to express the structure of these operations as they wish to see them in the future (TO-BE). Keeping these concepts in mind, the AS-IS and TO-BE models were created for the weave-room decision-making process as part of this research. But it needs to be noted that IDEF0 has predominantly been used in developing manufacturing process maps This research approach at modeling the manufacturing decision-making process using IDEF0 is a rather new and novel approach.

Based on the manner in which the IDEF0 technique has been used in this study, a SWOT analysis of the overall usability of IDEF0 for modeling or mapping manufacturing related decision-making processes is presented below.

6.4.1 Strengths

IDEF0's main strength is in its effectiveness of detailing the system or process activities, in the ICOM format. Additionally, the activities can be easily refined into greater detail, until the model is as descriptive as required for the decision-making task at hand. This process helps identify the various data and information inputs, the resources that assist in converting them into outputs and the constraints under which the conversions take place. More specifically in decision process modeling, it helps identify the various decisions or tasks that need to be performed, who performs them, the inter-relation and inter-dependency between them, as well as the factors that control or influence the decisions and the mechanisms that are used to make those decisions. Each of the ICOM's, as well as the activities and decision tasks can be defined and the terms and their definitions become part of a comprehensive glossary for reference. The IDEF0 software used in this research provides for document attachment, in the form of reports or screen-shots, which in turn could assist in further understanding the decision activity or task. Applying the IDEF0 method results in an organized representation of the activities and the important relations between these activities.

6.4.2 Weaknesses

The efficacy of detailed expression of IDEF0 on the other hand is also one of its main weaknesses. The IDEF0 models get so concise, that many a times they are understood or readable only with a domain-expert reader or someone who has participated in the model creation. Unless specific principles of IDEF0 are known, it is difficult to develop a perfect IDEF0 model. Another weakness of IDEF0 is the tendency of the model to be represented as a sequence of activities, causing it to be more of a static model rather than a dynamic one. Due to its principles of placing activities from left to right and in an ascending number format, activity sequencing seems to unintentionally and automatically get embedded in the IDEF0 model. In case where activity sequences are not part of the developed model, readers and users of the model can be tempted to add such an interpretation to their analysis. This is true in case of the decision modeling. Decision tasks are carried out with a greater degree of concurrency and the decision-maker, in addition to using the resources and inputs for decision-making, also has to depend upon the cognitive element of decision-making. Such attributes are not well captured by IDEF0. One cannot say on the basis of an IDEF0 model that a decision activity or a task will behave in the same way on successive occasions. This is certainly true in case of human activities of decision-making, since people have moods and memory, which very often would produce different outputs when given the same inputs at different times. IDEF0 is not a plainly quantitative model, and hence it makes it harder for it to be used by anyone as a compelling case for change. The subjectiveness of the IDEF0 process modeling method is a very significant weakness. There are various reasons for the IDEF0 model to be subjective. When an analyst re-expresses information that he receives during interviews, he needs to make some kind of interpretation. The translation between the notes gathered during an interview with the operating staff, and a process map, is by no means only an issue of grammatical interpretation. Meaning must be attributed to an interviewee's words in order to determine, for instance, what is an IDEF0 control and what is an IDEF0 input. The problem is compounded, especially in decision process modeling, when raw data is ambiguous and inconsistent, which definitely happens when two people with similar designations from different plants, or within the same plant are asked about the same decision task. It is not uncommon, for instance, for a person in one department to believe that an activity is scheduled on a computer, and that the computer provides legitimacy to conduct a certain operation or process or task, while another person with a similar designation in a different plant (or same plant) may believe that a manual system does exactly the same thing. Another problem related to subjectivity is that the information that is revealed in the interview process by the interviewee is dependent upon the analyst's line of enquiry. The questions that the analyst asks, and the terms in which he formulates them, plainly have an influence on the answers that the analyst gets. The main problem with this lack of strict objectivity is that subjective analyses are rarely convincing enough to justify substantial changes in a company's mode of operations or processes. This particular problem is not only related to IDEF0 process modeling, but to process modeling on an overall basis. But care should be taken to see that the objective should not be to ignore the subjective information, since it may be highly valuable, but just to know its limitations. One other common weakness is the instant aversion shown by some reviewers or customers/users when first presented with and IDEF0 diagram. The network of boxes and arrows, along with the size of some models, can cause many users to reject the model.

6.4.3 Opportunities

IDEF0 provides an opportunity to create AS-IS models, based on which TO-BE models can be replicated for system or process enhancements. IDEF0 assists in capturing redundancy or duplication of activities, as well as data/information resources utilized. IDEF0 is a widely used and accepted model, which also provides an opportunity to integrate the use of the model with several automated tools that are available to support the development of the IDEF0 models. These tools include those, which run on popular platforms including both Macintosh and DOS-based personal computers. This support provided an unique opportunity and proved valuable in the development and conversion of the IDEF0 maps into the dissertation. The text and diagrams developed could be easily copied into the word processing and other applications. Likewise, text and diagrams from other applications could also be inserted into the IDEF0 model. The IDEF0 technique provides an opportunity to develop a comprehensive deliverable, which consists of the graphical images, text in the form of the ICOM's, activities and the glossary, as well as provides an opportunity to add attachments to specific tasks. In this way, a "complete" document in the form of a manual can be provided to the customer by the analyst and used for internal reference.

6.4.4 Threats

One of the biggest threats of IDEF0 is using the technique all by itself for modeling decision processes. Due to the explicit and implicit nature exhibited by the decision-making process, it might be useful to use the IDEF suite of techniques as a whole, meaning a combination of all or most of its types (IDEF0, IDEF1, IDEF2, etc.), although the static nature of the IDEF technique would continue to be an obstacle. Additionally, other competing methods that are commercially available for business process reengineering could prove to be competitive and advantageous over IDEF0, depending upon the potential end-use of IDEF0.

Thus, it can be seen that IDEF0 as a process modeling technique has its own sets of strengths, weaknesses, opportunities and threats. The IDEF0 model is strictly a static model, which could be useful in communicating a general understanding of the system. Instances in which it is especially helpful include complex methodologies that can be decomposed into smaller tasks. The fact that it generates graphical images, glossary of terms and text, along with attachments, could definitely prove useful in modeling manufacturing processes and activities. It yields a hierarchy of pictures, so that one can look at the system at any of a number of levels of abstraction. It is possible to capture the whole system without being bogged down in an excess of detail. Unfortunately, real problems and decisions are complex, not just as a result of the fact that they are concerned with a large number of activities within the manufacturing process, but also are complex because they cannot be solved by examining their natures along a single dimension, such as looking simply at activities and their mechanisms only. Especially when it comes to modeling the decision-making process, one has to factor in the use of cognition and its related attributes that are hard to capture and portray in the model. The abstraction away from timing, sequencing and decision logic leads to comprehension difficulties for the people outside the domain. Hence, based on the overall discussion and points presented, IDEF0 could fit well to be used for drawing the big picture mapping of an overall decision-making process and the top few levels of detailing, but is not the best possible modeling technique for the purpose of mapping specific, individual manufacturing decision-making processes that need to exhibit greater degree of dynamic details and complex , interactive components. A pilot study needs to be conducted before modeling any specific decision to determine the appropriate fit.

6.5 Information Engineering Methodology -

The Information Engineering methodology has been developed that can be used for decision mapping across different manufacturing units and sectors. In order to use the approach adopted in this research for future similar studies, a generic Information Engineering methodology has been described in the following paragraphs; and since IDEF0 technique has been used in this study, the same is being used to sketch out the Information Engineering process map. It should be noted at this point that IDEF0 mapping technique is used for this purpose, only because of its availability and understanding developed during this research process. Similarly, other tools could also be utilized in the actual development of the AS-IS and TO-BE models that are part of this Information Engineering methodology.

6.5.1 IDEF0 Information Engineering Glossary

The IDEF0 Information Engineering glossary consists of the terms (input, controls, outputs, mechanisms) that are used in the development of the Information Engineering methodology. It should be noted that unlike the glossary that was presented in chapter five, this glossary consists of only those terms that need further clarification and description. The self-explanatory terms are not defined in this glossary listing.

AS-IS Models	Current status or method of the decision-making process
Budget	Monetary resource available for purchasing resources needed for conducting the research study
Collect & Analyze Data	Perform case studies in order to collect and analyze the data gathered
Conduct Pilot Study	Conduct Pilot study
Data	Data in the form of reports, screen-shots, process examples, etc. that help in explaining the decision-process
Develop An Information Engineering Methodology	A Generic Information Engineering Methodology that could be used for mapping decision-making processes across different plant manufacturing decisions
Formulate Research Approach	Develop appropriate steps to conduct research

Information Technology Resources	Computers, Software, recorders, etc.
Introductory Letter	Introductory letter clearly defining the research purpose and providing some background material for the manufacturing company personnel to gauge the scope of the research
Library	Information source to gather relevant literature with reference to the purpose of research study
Literature	Published literature with reference to research topic that is being studied
Manufacturing Companies	Companies that are part of the research study
Pilot Questionnaire	Initial set of questions that are formulated for personal interviews with the manufacturing management personnel
Preliminary Research Approach	Initial research approach that will be utilized for conducting the pilot study
Present Findings & Results	Make conclusion based on the findings & results obtained
Proximity	Manufacturing company's location closeness with reference to distance and time needed for the researcher to go back and forth
Purpose of Research	Purpose for which research is being conducted
Research Outcome	Conclusions and recommendations based on the research study conducted
Scheduling Meetings	Scheduling conflicts with reference to availability of company personnel
Subject Experts	Professors and industry experts
Time	Time available with reference to both, the plant personnel for meetings and interviews, as well as time available for the research study

6.5.2 Level A-0

Figure 6.11 shows the main function or context, which is to develop an Information Engineering methodology. The Information Engineering methodology could be used for mapping decision-making processes across different plant manufacturing decisions. Literature and time constitute potential constraints that influence the extent of research capability of the study, while resources such as subject experts, companies willing to participate and various information technology resources such as software, personal recorder, etc. provide the basic resource infrastructure needed to accomplish the research study.

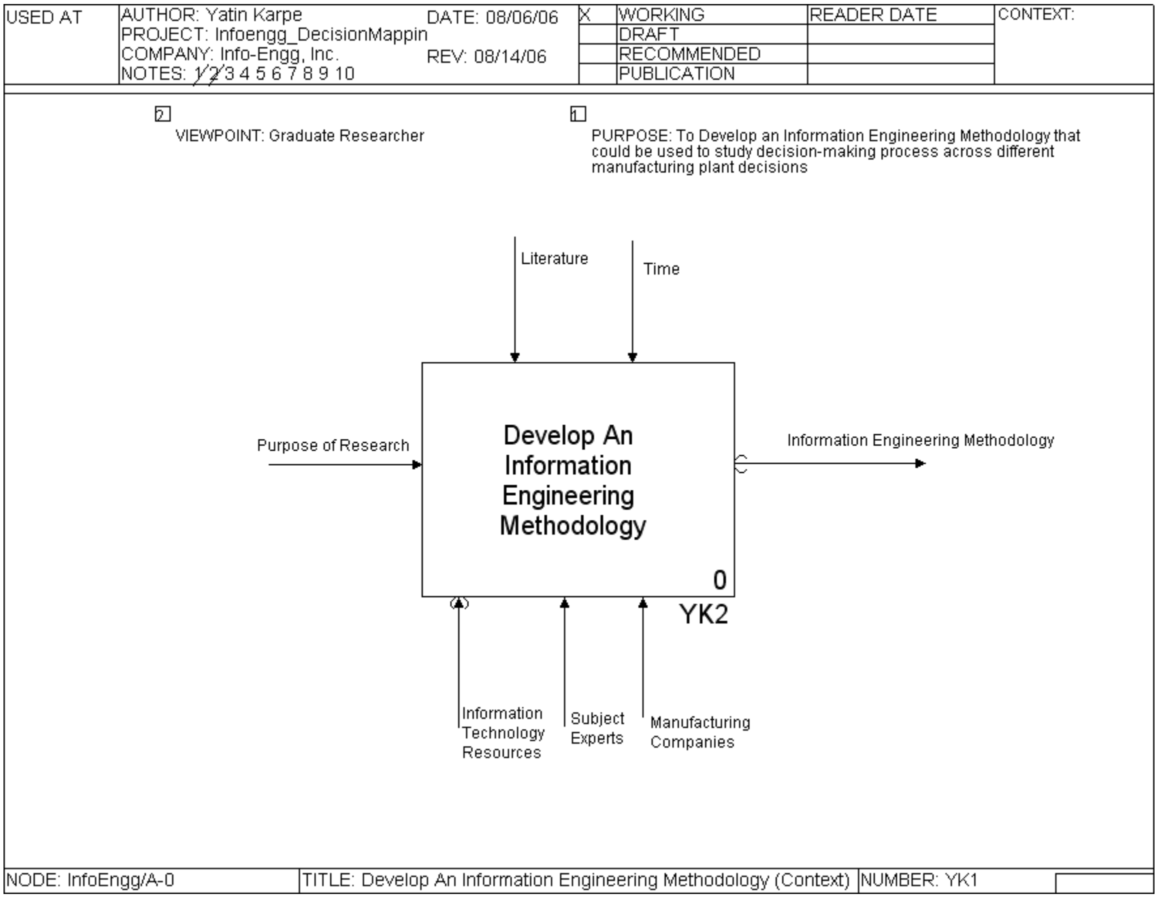

Figure 6.11: Context Diagram – InfoEngg (A-0)

6.5.3 Level A0

Figure 6.12 shows the generic steps involved in developing an Information Engineering methodology. They are as follows:

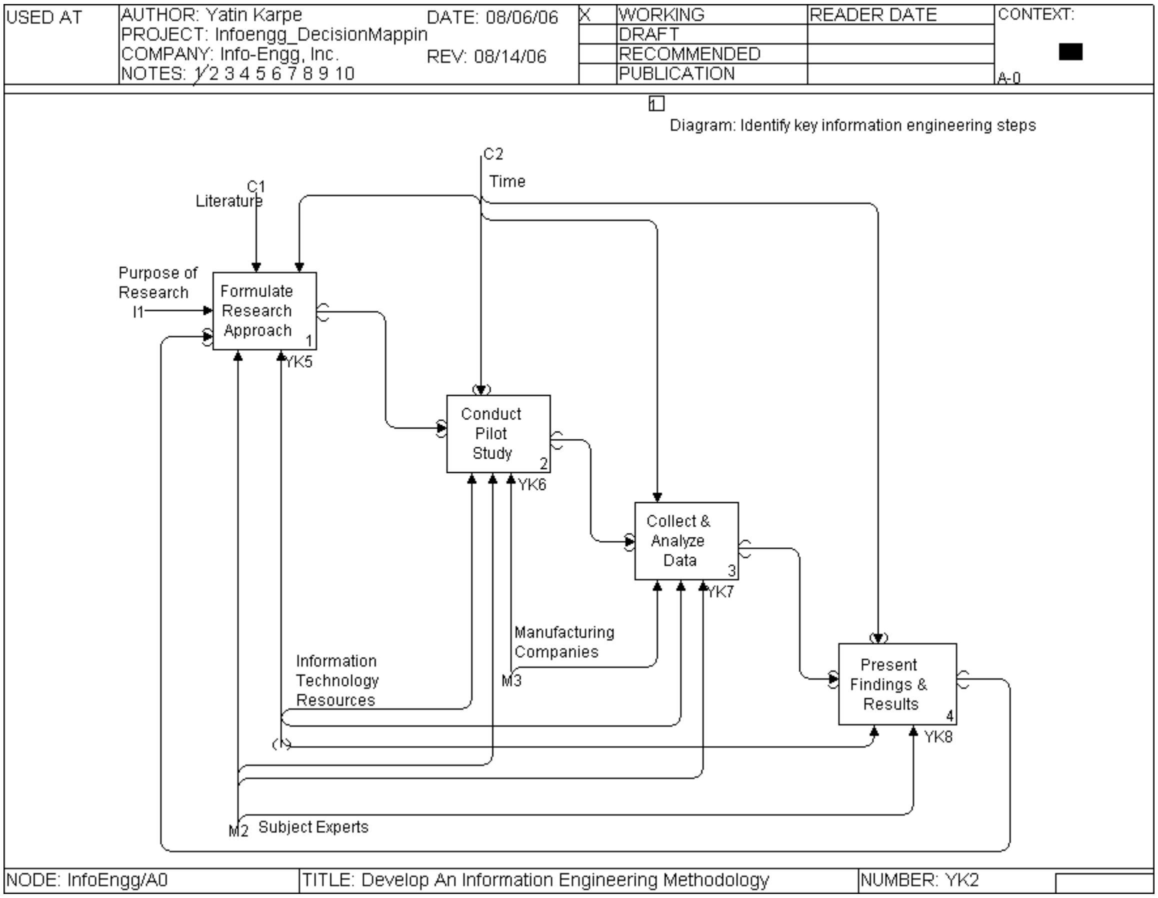

Figure 6.12: Develop An Information Engineering Methodology (A0)

1. Formulate Research Approach – It is important to articulate the overall purpose for which the study is being conducted, as well as to formulate the appropriate research approach which encompasses the defining of the research goals, determining the research unit and size of the study, as well as the approach and tools that will be utilized for the study.
2. Conduct Pilot Study – Once a specific approach has been identified, a pilot study needs to be conducted at one of the manufacturing units to study the feasibility or appropriateness of the study with reference to the research purpose and goals defined, which assists in finalizing the research approach needed to be adopted for the study.
3. Collect & Analyze Data – Once a specific approach has been identified, company plant visits should be conducted for personal interviews and

interactions, and the relevant data needs to be collected for analyzing and drawing the AS-IS models.

4. Present Findings & Results – Based on the AS-IS models, the TO-BE, Best Practices model should be developed, along with any other performance indicators that could help enhance the efficiency of the decision-making process. Additionally, any other relevant findings should be identified and results presented in the most concise manner.

6.5.4 Level A1:

Figure 6.13 illustrates the basic introductory steps involved in formulating the research approach and are described as follows:

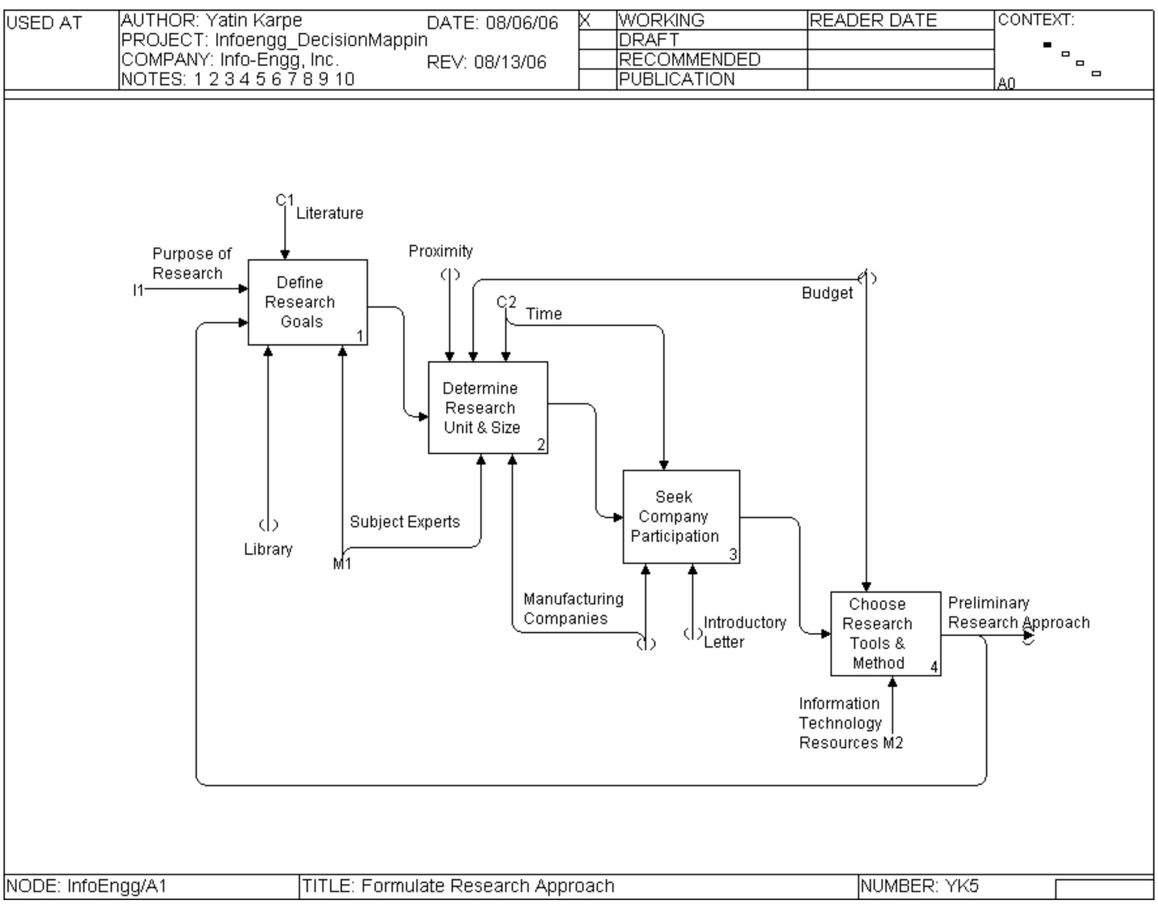

Figure 6.13: Formulate Research Approach (A1)

1. Define Research Goals – Sketch out the overall research goals in as much detail as possible, based on the purpose of research, literature available and interaction with the subject experts from industry and academia.
2. Determine Research Unit & Size – The next step should be to determine the research unit to conduct the study, and also the number of case studies that need to be conducted. This determination is limited by the budgetary constraints, as well as the proximity of the manufacturing units and the time frame needed to complete the study.
3. Seek Company Participation – After deciding on the manufacturing companies for the study, their permissions for participation should be sought, both by contacting them personally, as well as followed with some written documentation of the research study and purpose.
4. Choose Research Tools & Method – At this stage, it is necessary to select the appropriate research tools (such as the Wizdom IDEF software, personal recorders, etc.) and the relevant research method to conduct the research study. Again, like the previous step, this stage is also bound by budgetary constraints.

6.5.5 Level A2

Figure 6.14 explains the steps needed to conduct the pilot study. They are:

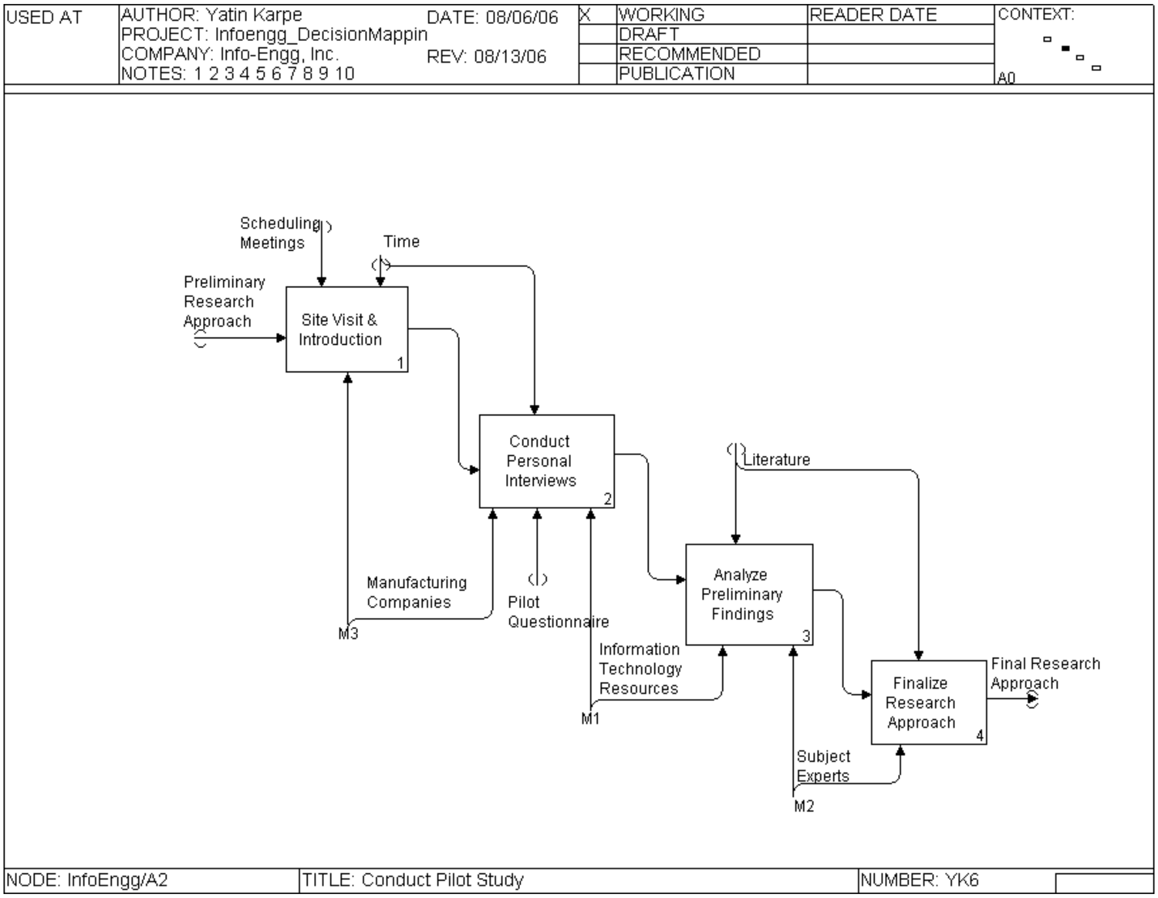

Figure 6.14: Conduct Pilot Study (A2)

1. Site Visit & Introduction – At this stage, the introductory visit should be conducted to the first manufacturing plant wherein the pilot study will be conducted. It is important to schedule meetings well in advance, and have contingency plans in place if meetings with senior management were cancelled due to scheduling conflicts, especially since manufacturing plants could have emergencies that need to be attended by the management at any time.
2. Conduct Personal Interviews – Based on the introduction provided, personal interviews should be conducted with the manufacturing management personnel in order to obtain and collect information using a pilot questionnaire and appropriate information technology resources as needed.

3. Analyze Preliminary Findings - The data obtained should then be reviewed to understand the preliminary findings and compared with the literature, goals and the overall purpose of the research study. At this point, the information gathered should also be discussed with the subject experts and feedback sought from them as to the direction of the research study.
4. Finalize Research Approach - Once sufficient understanding and feedback is obtained in relevance to the appropriateness of the information collected, the research approach should then be finalized, to be used for conducting the final, detailed plant visits and studies.

6.5.6 Level A3

Figure 6.15 shows the steps needed for data collection and analysis. They are:

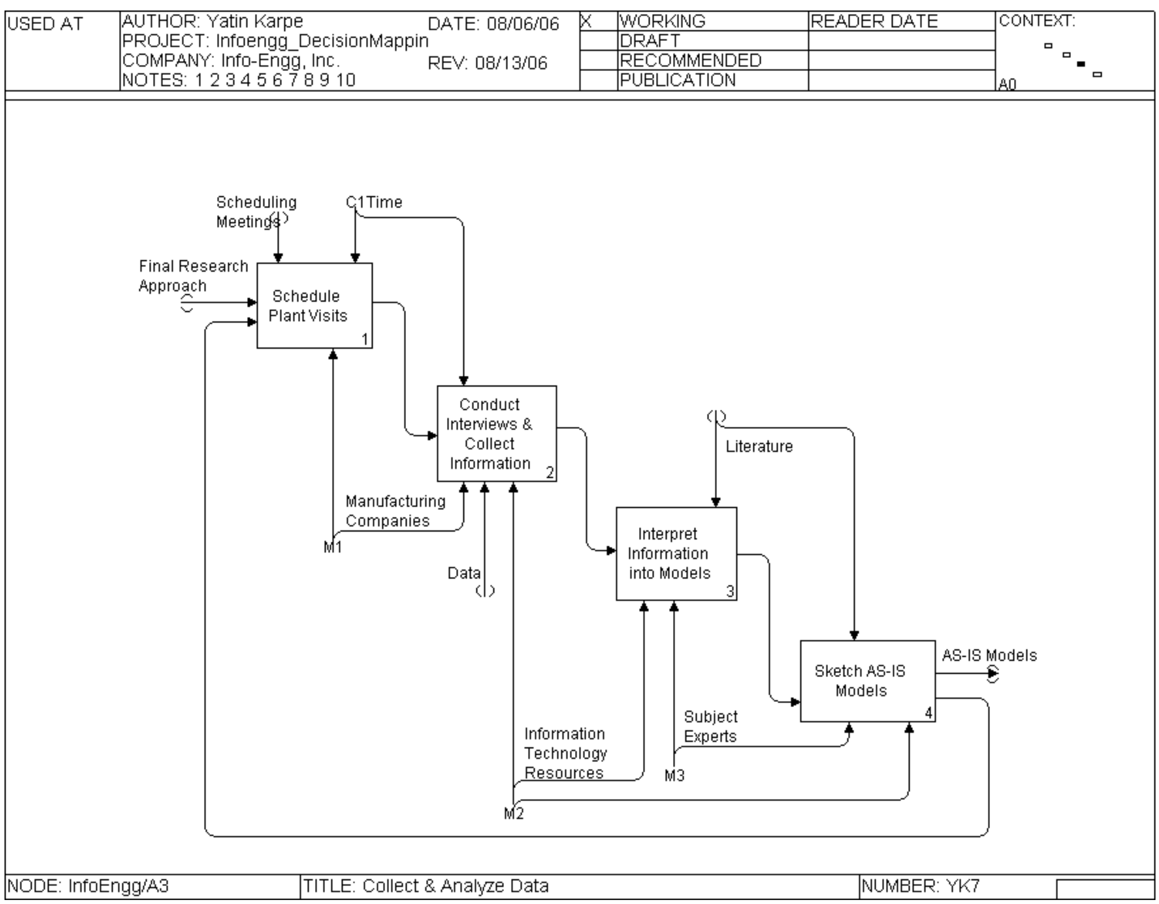

Figure 6.15: Collect & Analyze Data (A3)

1. Schedule Plant Visits – Once the research approach has been finalized, it is necessary to schedule plant visits with the research units that have been selected for the research study. Back-up plans also need to be put into place, in case of any last-minute scheduling conflicts or time issues with the concerned management personnel.
2. Conduct Interviews & Collect Information – Once plant visits are scheduled and conducted, information should be collected by means of personal interviews and one-on-one meetings with the plant personnel. Examples of reports, screen-shots of process examples, etc. need to be collected at this stage, in order to better understand the process and identify the data elements and information processed at various points during the decision-making process. Resources such as personal recorders are important to capture all the information, so that it can be retained for recollection during the next step.
3. Interpret Information into Models – Once sufficient and relevant data is obtained, it should be converted into meaningful, significant and useful information, such as graphical process maps/models that convey the meaning and understanding needed by the reader to interpret that information. Tools such as the IDEF techniques (e.g. Wizdom Software), Action Workflow diagrams, etc. could be used during this process. Additionally, it is important to discuss the interpretations and maps with the subject experts to gain their guidance and advise during this stage.
4. Sketch AS-IS Models – The previous step results in the creation of the AS-IS model, which signifies and portrays the current state of the decision-making process at that particular manufacturing plant unit.

6.5.7 Level A4

Figure 6.16 shows the last stage of the research study, wherein the research findings are presented, results discussed and conclusions drawn. The steps in this stage are:

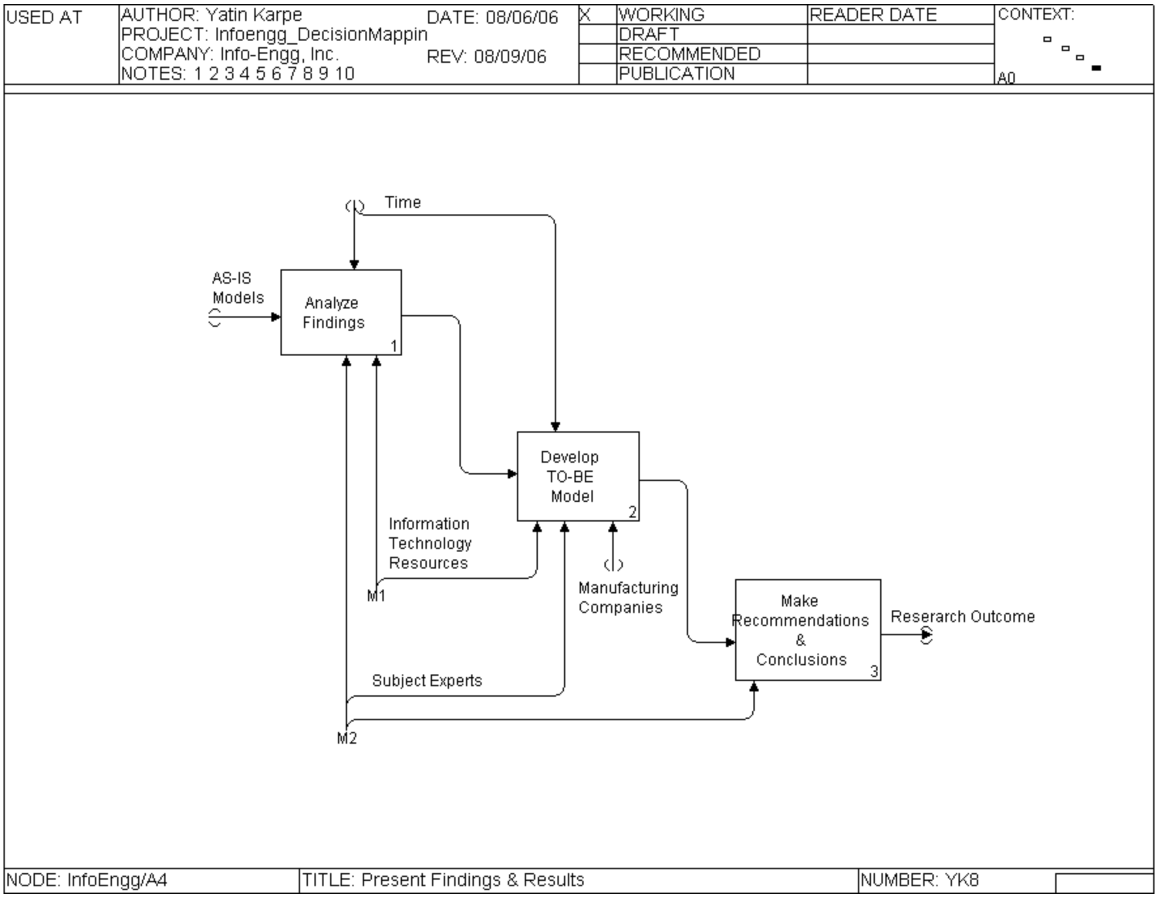

Figure 6.16: Present Findings & Results (A4)

1. Analyze Findings – Based on the AS-IS models, as well as the literature reviewed, the information is analyzed in order to produce findings and outcomes that assist in the development of the TO-BE model.
2. Develop TO-Be Model – The TO-BE model is developed based on the findings resulting from the previous step. This TO-BE or Best Practices model should then be validated with feedback from the manufacturing units wherein the studies were conducted, to gauge their feedback and utility factor. Subject experts also provide their feedback and advise as to the usefulness of such a model.
3. Make Recommendations & Conclusions – The final recommendations and conclusions are drawn based on all the findings till this stage. As an example, the TO-BE model and its data elements could be used by

database software developers to develop a manufacturing plant specific expert system, or decision system, etc. Some other recommendations could be made in the form of performance indicators for enhancing the decision-making process, again based on the TO-BE model.

Hence, it can be seen that the Information Engineering methodology that is illustrated above, could prove to be a useful tool for analyzing, understanding and mapping process maps/models for different decisions across various textile plant units. Some repeating, constant factors such as the involvement of the subject experts during the entire process, as well as the focus on the time constraints of the research study must never be ignored during the research study.

Information Engineering was defined in chapter three, as a technique for extracting the meaning contained in information to allow the understanding needed by the user to make an informed decision. The Information Engineering methodology illustrated above draws a close resemblance to this definition, wherein the case study approach, personal interviews, process modeling tool and the AS-IS and TO-BE models assist in extracting the meaning contained in the information and providing the necessary understanding needed by the decision-maker to make an informed decision. This methodology also contributes to enhancing the quality of the information obtained, both in terms of its inherent as well as pragmatic quality. Additionally, a parallel can be drawn between this methodology and the knowledge management principles and phases, which further highlights the validity and authenticity of the Information Engineering methodology.

7 CONCLUSIONS & RECOMMENDATIONS FOR FUTURE STUDIES

7.1 Conclusions -

The main purpose of this research study was to understand, define and map the weave-room performance decision-making process. In order to achieve this overall main objective, literature was reviewed in the subject areas of information technology, knowledge management, information quality and decision-making. Additionally, a preliminary Decision Cycle Model was developed in order to form the underlying basis against which the literature was reviewed and a research approach was developed. Information Engineering resulted from the development of the Decision Cycle Model and was compared to the well-established and published knowledge management principles and theories. Furthermore, in order to develop the Information Engineering approach, there was a need to adopt a mapping technique for developing the different decision process models. The models were developed using the IDEF0 principles and technique. The case studies conducted at the three weaving plants resulted in the development of three AS-IS models, which provided the framework to compare with and develop the proposed Best Practices TO-BE model of the weave-room performance decision-making process. This method helped in identifying the performance improving tasks that could assist in enhancing the decision-making process in the weave-room. Additionally, it also provided a structure to analyze the utilization and functionality of IDEF0 as a tool for modeling the decision-making process in a manufacturing environment. In summary, the deliverables that have been accomplished as part of this research study are as follows:

1. Structured, well-defined "AS-IS" weave-room performance decision-making process maps for each of the three weaving plants, along with a comprehensive glossary.
2. Proposed "TO-BE" Best Practices map that could be used by any weave-room plant in order to maintain optimal weave-room performance.
3. Key performance improving tasks for enhancing the efficacy of the weave-room decision-making process.

4. A SWOT analysis to understand the usability and functionality of the IDEF0 technique as an appropriate tool for mapping manufacturing plant-specific decision-making processes.

5. A generic Information Engineering methodology that could potentially be used for studying and analyzing decision-making processes for manufacturing related decisions across different textile and other manufacturing departments and units.

The Information Engineering methodology developed seems to be well suited for routine, repetitive type of decision-making, as compared to the non-routine, uncertain decision-making. This methodology, when used along with IDEF0 as the process mapping tool, was found to be a good technique for mapping and capturing an overall decision-process pictorial view, especially in the context of obtaining information related to explicit knowledge (components such as documents, reports an so on). But if a detailed analysis of the decision-process were to be conducted which would entail capturing the tacit and explicit knowledge components together, especially in a dynamic context, IDEF0 would not be a suitable tool. This type of knowledge capture would again fall under the non-routine, uncertain decisions, which is dynamic in nature. Additionally, capturing this information and interpreting it into the IDEF0 models is difficult. Hence, there is a need for careful evaluation with reference to the research purpose and further analysis of IDEF0, before it is used as a process mapping tool.

7.2 Research Contributions -

Based on the findings and results of this research study, the research contributions were:

- *Contribution to published management theory* – Illustrated and demonstrated the conceptual understanding of knowledge management, information engineering and information quality with reference to the decision-making process; the development and use of Information Engineering approach for effective and efficient decision-making and analyzing the use of IDEF0 as a tool for capturing decisions. The Information Engineering methodology developed can be used to study other decisions in different manufacturing environments, as well as analyze in further details, the usability of IDEF0 process modeling technique for capturing and mapping decision processes.

- *Contribution to industry viability* – The resulting AS-IS decision-process models could be used as reference points by each of the textile weaving plants, to understand their respective current decision processes as well as compare them with the Best Practices TO-BE model, and possibly take relevant steps to adopt some of the performance improving tasks that could enhance the efficiency and effectiveness of their decision-making process. Additionally, the benefits of the TO-BE model can be extended to other weaving plants that would be seeking to enhance the decision-making process of their weaving plants.

7.3 Recommendations for Future Studies -

Following are a few recommendations for future studies related to this research.

1. <u>Broaden the use of IDEF techniques</u>: The IDEF0 process models could be expanded into IDEF1 (data/information) models. The AS-IS and Best Practices TO-BE process models that have been sketched for the three weaving plants could be further used to develop and map out the data/information models for either the entire decision-making process as a whole, or possibly just certain specific manufacturing decisions. The Wizdom software that was utilized in this research has the capability to capture and map the data model for each corresponding process model developed. This would assist in understanding the various data and information components of the decision process in weaving, thus allowing for getting in-depth knowledge of the decision-making process in weave-room. Similar efforts could be conducted to develop an IDEF2 decision-making simulation model.

2. Change viewpoint and purpose: Purpose and viewpoint are two key factors in the creation of IDEF0 process models, since they provide a clear focus for the modeler and the reader. By changing these two factors, IDEF0 decision process models should be created in order to determine if the models are similar or different. As an example, the planning manager's viewpoint would result in a more in-depth IDEF0 process model, whereas, if the view point were to be in the context of the Vice-President, the IDEF0 process model would be more broader in its scope.

3. Determine further validation: The IDEF0 TO-BE process model and the Information Engineering methodology needs to be further validated by using it in the development of decision process models for other textile manufacturing plant units, such as spinning, dyeing and finishing decision processes.

4. Develop comprehensive model of decision-making in textiles: The development of the IDEF0 and IDEF1 process and data decision models respectively across different textile manufacturing units could be used to link, model and explain the interaction between the decision-making processes between the textile sectors, in the context of the textile enterprise as a whole.

5. Developing Digital Dashboards: The information that would be obtained from the IDEF0 process and IDEF1 data models would assist in the design of manufacturing plant-specific decision support or expert systems for textiles, which could eventually lead to the creation of the Digital Decision Dashboard (D^3) as mentioned earlier in the study. The D^3 can prove to be an essential tool for decision-making in textiles, capturing and disseminating vital management information for effective and efficient decision-making, thus addressing a critical need presently facing the textile industry. D^3 is the technology that would put the "intelligence" back in "business intelligence" and empower the decision-maker to make timelier and strategic business decisions. The D^3 can be used for developing dashboards for specific independent functional decisions such as for the

maintenance/engineering function, the planning function, etc.; but it could need more complex investigations for developing a dashboard for the plant manager.

In conclusion, the outcome of this study points to different directions that can be adopted to further analyze the results and findings of this research. In particular, if Information Engineering could contribute to the development of D^3, it could have far reaching implications in decision-making for the manufacturing industry, especially the textile supply chain.

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9 APPENDICES

9.1 Appendix A: Attachments of Case_1

Figure A1. Housekeeping Tasks

ADDENDUM: Example of Specific House-Keeping Task

FACILITY SURVEYS

JANITORIAL SURVEY-ROOM COUNTS

CLIENT: [illegible]

LOCATION: [illegible] Plant

BUILDING, AREA	INTER OFFICES	REST ROOMS	CAN-TEENS	STAIR WELLS	TRASH CANS	ENTR-ANCES	WATER FTINS	EYE WASH
Main Office	~~21~~ 15	2				1	~~2~~ 1	
Dornier Weave		~~2~~ 0			2 ~~1~~		~~5~~ 0	
Cloth Room	2	2			20		1	1
Warehouse	2 ~~3~~		1		2		1	1
Shop	3				3			1
Air Jet Weave	4	2		2	5		1	
Sulzer/Ruti Weave #1					4		1	
Sulzer/Ruti Weave #2	1				4		1	
Conference Area	4 ~~5~~	2			2		1	
Weave #4	~~1~~				~~[illegible]~~		~~1~~	~~1~~
Sample	~~3~~	~~2~~			2 ~~1~~		1 ~~2~~	
Technical/DM Office	2							
Cutting	~~1~~							
Training	1 ~~2~~							
TOTAL	~~36~~ ~~48~~ 34	8 ~~12~~	1	2	44 ~~58~~	1	~~16~~ 8	~~5~~ 3

Figure A2. Housekeeping Tasks at the Interplant Offices

[redacted]

FREQUENCY	INTERPLANT OFFICES
ONCE PER 24 HOURS	1. Empty trash containers, maintaining clean liners / empty recyclable containers
Once per week	2. Dust furniture, files, ledges, etc.
	3. Clean door glass and partition glass
	4. Sweep and/or dust mop floors
	5. Vacuum walk-off mats
	6. Spot mop floors for spillages and heavy traffic
ONCE PER MONTH	1. Damp mop tiles floors
	2. Spot wax heavy traffic areas
	3. Spray buff tiled floors
TWICE PER YEAR	1. Strip, reseal and rewax tiled floors

Figure A3. Housekeeping Tasks at the Plant restrooms

FREQUENCY	PLANT RESTROOMS
1st & 2nd only ONCE ~~PER EIGHT HOURS~~ (Monday through Friday)	1. Clean restrooms as per the following specifications: a. Empty trash containers b. Empty and clean sanitary napkin waste containers c. Clean and dry polish mirrors d. Damp wipe dispensers e. Clean and disinfect sinks, commodes and urinals f. Spot clean walls and partitions g. Damp wipe outside of trash containers h. Restock tissue, towels and handsoaps i. Sweep floors j. Mop floors with germicidal cleaner k. Report malfunctions in restrooms to maintenance personnel 2. Police restrooms as per the following specifications: a. Check tissues, towels and handsoaps b. Pick up trash from floor c. Check trash containers d. Spot mop floor e. Spot wipe fixture surfaces
TWICE PER YEAR	1. "G.I." clean restrooms

Figure A4. Maintenance Work Request System (MWRS)-screen shot

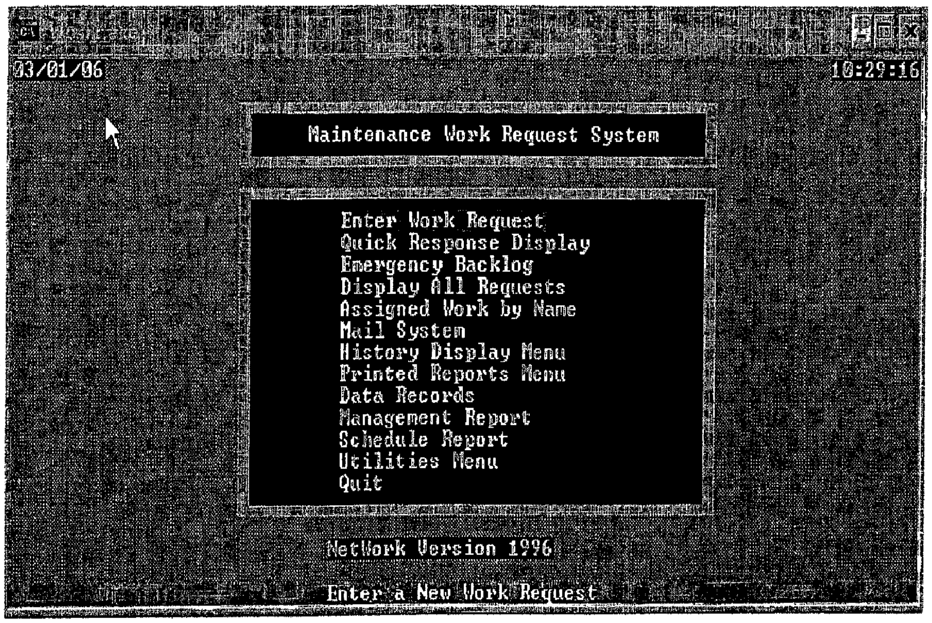
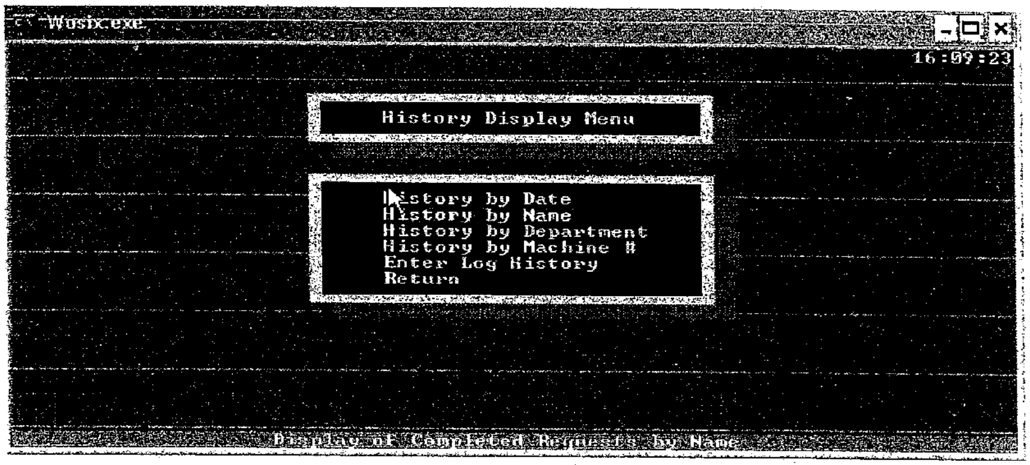
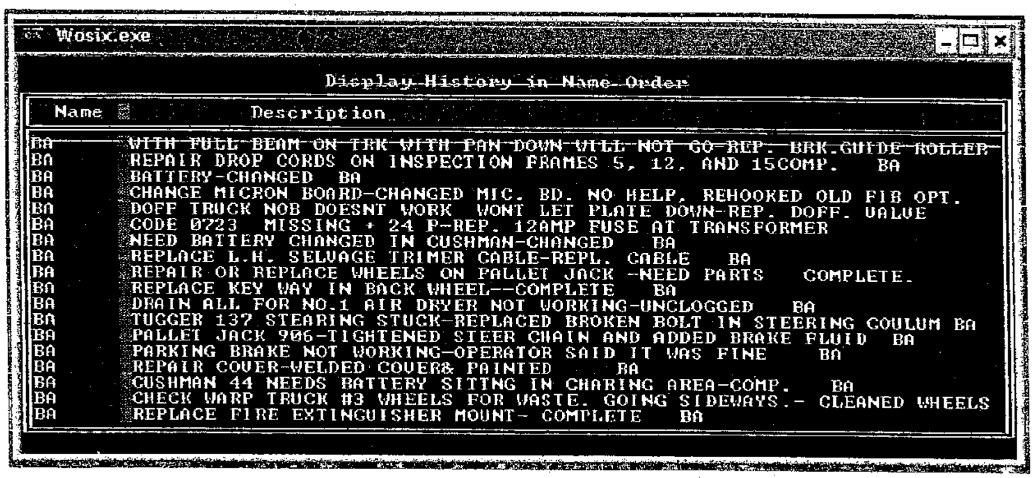


Figure A5. History Display Menu- screen shot





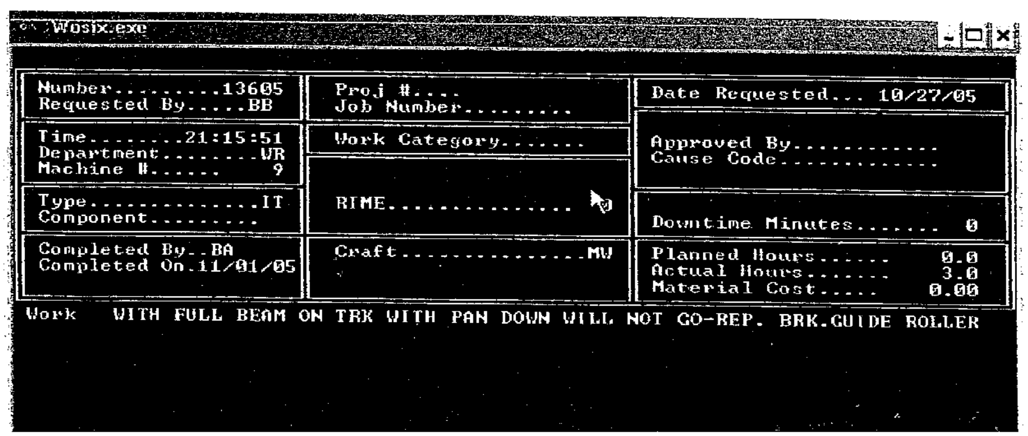


Figure A6. Late Order Report

DATE 26APR06 TIME 05:16 MATTRESS TICKING NEW ORDERS/TOTAL ORDERS DUE WITH INVENTORY SHORTAGES ZBH0402 STEP BHJ0110I

STYLE	WTH	COLR	FIN	PUT UP	GRP	NAME	WTD BKNGS	04/25/06 NEW ORDERS NOT ALLOC	TOTAL ORDERS DUE NOT ALLOC	INVENTORY AVAILABLE	INVENTORY SHORTAGE	PRODUCTION 04/28	PRODUCTION 05/05
INTERNAL													
51026	088	0460	000	02	01	OPEN LINE	0	0	1,150	0	-1,150	0	0
51109	088	1223	000	02	01	OPEN LINE	0	0	2,617	0	-2,617	0	7,094
51775	088	4210	000	02	01	OPEN LINE	0	0	1,000	0	-1,000	2,342	3,254
53035	088	8217	000	02	01	OPEN LINE	0	0	200	0	-200	0	804
53060	088	3665	000	02	01	OPEN LINE	1,000	0	500	0	-500	0	743
53065	088	0009	000	02	01	OPEN LINE	0	0	1,624	0	-1,624	0	6,484
53139	088	8581	000	02	22	SERTA INTERNAT	500	200	993	0	-993	0	4,942
53238	088	4973	000	02	22	SERTA INTERNAT	0	0	1,813	0	-1,813	0	5,697
53267	088	1553	000	02	22	SERTA INTERNAT	0	0	963	0	-963	0	2,321
53334	088	3765	000	02	64	KING KOIL	0	0	43	0	-43	0	792
53590	088	3969	000	02	01	OPEN LINE	0	0	300	0	-300	1,041	3,822
53819	088	4719	000	02	01	OPEN LINE	1,001	750	750	0	-750	404	395
54921	091	1593	OLS	02	01	OPEN LINE	0	0	600	0	-600	1	597
55209	088	6394	OLS	02	01	OPEN LINE	0	0	1,415	0	-1,415	0	1,592
55241	088	0893	OLS	02	01	OPEN LINE	0	0	882	0	-882	802	405
55396	088	7536	OLS	02	01	OPEN LINE	0	0	1,612	0	-1,612	400	2,800
55666	088	0085	OLS	02	20	SEALY	1,100	550	1,053	100	-953	4,819	5,412
55687	088	2099	OLS	02	01	OPEN LINE	0	0	100	0	-100	0	400
55886	088	5221	OLS	02	01	OPEN LINE	200	0	2,080	0	-2,080	398	2,067
55904	088	2192	OLS	02	01	OPEN LINE	200	0	318	0	-318	817	683
55920	088	5163	OLS	02	22	SERTA INTERNAT	100	100	454	0	-454	1,254	742
55960	088	8154	OLS	02	01	OPEN LINE	150	0	100	0	-100	1,806	1,763
56898	091	0036	000	02	20	SEALY	250	200	200	0	-200	0	853
57274	090	1280	000	02	43	SIMMONS CANADA	0	0	200	0	-200	0	393
58823	088	1824	000	02	01	OPEN LINE	0	0	1,522	0	-1,522	0	7,455
TOTAL INTERNAL							4,501	1,800	22,489	100	-22,389	14,084	61,510

Figure A7. Bookings report

DATE 25APR06 TIME 18:34 TICKING WTD FORECAST BOOKINGS ZBH0223 STEP BHJ0115F

GRP CODE	STYLE	WTH	COLR	NAME	FIN	PUT UP	REST CODE	S T	SPEC DMD NUMBER	------BOOKINGS------ TUESDAY	WTD	--------FORECAST-------- CURRENT	ERROR	SHIPMENTS WTD
01	50317	88	12	WHITE	000	02		A		0	0	329.23	329.23	585
	50318	88	8584	1/08511	000	02		A		0	0	91.29	91.29	110
	50348	88	8508	307/08503	000	02		A		150	150	199.89	49.89	248
	50351	88	8516	306/08503	000	02		A		0	500	173.48	-326.52	505
	50354	88	8515	302/08503	000	02		A		167	467	125.75	-341.25	468
	50361	88	8608	70/8000	000	02		A		0	650	713.43	63.43	718
	50362	88	8508	307/08503	000	02		A		100	100	231.92	131.92	121
	50365	88	8612	76/08503	000	02		A		100	100	149.39	49.39	92
	50384	88	8650	76/302/08503	000	02		A		300	300	327.46	27.46	315
	50385	88	8616	72-307/08503	000	02		A		0	0	1.07	1.07	499
	50389	88	8574	303/08503	000	02		A		88	88	118.84	30.84	0
	50409	88	8521	77/08503	000	02		A		100	100	78.98	-21.02	100
	50510	88	12	WHITE	000	02		A		0	0	759.70	759.70	743
	50520	88	8794	501-70/08511	000	02		A		0	0	1020.74	1020.74	3030
	50569	88	8515	302/08503	000	02		A		500	500	23.39	-476.61	0
	51022	88	50	LINEN	000	02		A		2000	2000	1050.27	-949.73	0
	51022	88	78	NATURAL	000	02		A		1000	1000	1949.78	949.78	1021
	51022	88	192	AZURE	000	02		M		0	0	3.75	3.75	193
	51023	88	1478	CARAMEL	000	02		A		0	600	523.43	-76.57	0
	51026	88	460	STRAW CLOUD	000	02		A		0	0	39.19	39.19	50
	51060	88	1148	NATURALWHITE	000	02			APR	0	0			200
	51081	88	1359	REGAL	000	02		A		0	500	189.41	-310.59	515
	51109	88	1223	CREAM NAT	000	02		A		0	0	1643.70	1643.70	984
	51209	88	4195	NATWHITESNOW	000	02		A		1500	1500	96.76	-1403.24	0
	51214	88	157	BERMUDA	000	02		A		1000	2500	2298.10	-201.90	3052
	51265	88	6637	CAMELOTMELON	000	02		A		0	0	976.57	976.57	2500
	51332	88	5163	NAT DES BGE	000	02		A		0	0	88.11	88.11	200
	51450	88	1605	CHAMPVANILLA	000	02		A		1000	1000	722.90	-277.10	1025
	51453	88	4076	SESAME VANIL	000	02		A		0	0	151.01	151.01	1039
	51556	88	3727	WINDSOR	000	02		A		0	0	638.55	638.55	234
	51591	88	1615	IRIS	000	02		A		0	1000	459.26	-540.74	1000
	51604	88	2113	LINEN WHTE	000	02		A		0	200	182.37	-17.63	0
	51614	88	2206	FROST HONEY	000	02		A		300	300	100.02	-199.98	312
	51705	88	6531	CAMELT U/MAR	000	02		A		200	200	204.16	4.16	0
	51706	88	2113	LINEN WHTE	000	02		A		2000	2000	395.93	-1604.07	0
	51768	88	6476	PERRIVANILLA	000	02		A		100	100	521.41	421.41	0
	51769	88	144	CELADON	000	02		A		300	300	74.14	-225.86	309
	51810	88	919	CONCORDEHNY	000	02		A		0	0	136.08	136.08	401
	51810	88	6505	LAUREL MELON	000	02		A		0	0	118.09	118.09	646
	51931	88	2271	SESAME	000	02		M		0	0	4.46	4.46	288
	51935	88	2964	CRM MERCURY	000	02		A		0	0	205.26	205.26	517
	51960	88	6867	CELESTIAL	000	02		A		0	0	26.03	26.03	1297
	51972	88	7614	DREAM	000	02		M		698	698	18.69	-679.31	500
	51978	88	4547	PACIFIC	000	02		A		1000	2500	20873.64	18373.64	2121
	52061	88	1488	CHELSEA	000	02		A		0	0	515.05	515.05	1551
	53002	88	7952	OCEAN MINT	000	02		A		200	200	223.79	23.79	0
	53008	88	7917	SUEDROBINEGG	000	02		A		0	0	204.94	204.94	306
	53010	88	8218	OCEANSUNDROP	000	02		A		800	800	348.23	-451.77	806
	53023	88	4001	MOSAIC	000	02		A		1500	1500	381.04	-1118.96	0
	53024	88	5248	CAMEL WHITE	000	02		M		-400	-627	0.00	627.00	0
	53035	88	8217	NAT BREEZE	000	02		A		0	0	301.86	301.86	104
	53044	88	3765	NAT ROB EGG	000	02		M		-77	-77	0.11	77.11	0
	53060	88	3665	CLOUD BLUE	000	02		A		0	1000	312.52	-687.48	558
	53063	88	6827	DENIM	000	02		A		2385	3085	518.83	-2566.17	3087

FileName: \bhf\bhf\bhj0115\2006-04-25\bhj0115f.sj0115f1.zbh0223-2006-04-25__183634.pagemart

Figure A8. Available to Sell Report

```
Page: 1 Document Name: untitled

 P561 04/26 09:11     A V A I L A B L E   T O   S E L L    DISPLAY    PROG C2210501
STYLE WIDTH FIN COLOR NBR / NAME   PU RC    FIRSTS 2ND/SHT INPROC   GREIGE   WK-DMD
53819    088 000 4719 PERRI LTPINK 02              0       0     811        0      253
'ACTIVE'           CWS      251  AP      0
 WK ENDING.: 04/28 05/05 05/12 05/19 05/26 06/02 06/09 06/16 06/23 06/30 FUTUR
 PRODUCTION.:  404   395     0     0     0     0     0     0     0     0     0
 ORDERS.....:    0   750     0     0     0     0     0     0     0     0     0
 NET 2 SELL.:   49    49    49    49    49    49    49    49    49    49    49
                                  PR  2.20              E          GRP: 01
 399101 013037   0   750     0     0     0     0     0     0     0     0     0




 END OF SKU REACHED
 PF3=MENU PF4=FRWD PF5=BACK     INQ KEYS(PF6=STYLE PF7=ACCOUNT PF8=ORDER PF9=SKU)

Date: 4/26/2006 Time: 09:14:16 AM
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Figure A9. Requirements by Style Report

PAGE 191

WARP CONDITION: 28030 2385 262180 PERRI - MORRISON-28030 04/25/06 TPREPORT2

53819 870 4719 - 870 FAMILY: 725 SAPPHIRE PPI: 30.00 GROUP: 01 STAT: A
LOOM GROUPS: FL 90100 700370 .1873 .0000 .0000 .0000 FCST: A

FCST: 253 SS: 116 RESERVED 0 TYPE: 30PK LOOM COMMENT:

	GR-INV	WEAVING	04/28	05/05	05/12	05/19	05/26	06/02	06/09	06/16	06/23	06/30
ORDERS			0	0	0	0	0	0	0	0	0	0
TOTAL REQUIREMENTS			0	0	0	246	259	260	258	255	248	241
LOOM SCHED	0	0	0	0	0	0	0	0	0	0	0	0
NET POSITION ORDERS (YARDS)			0	0	0	0	0	0	0	0	0	0
NET POSITION TOTAL (YARDS)			0	0	0	-246	-505	-765	-1023	-1278	-1526	-1767
NET POSITION TOTAL (WEEKS)			0	0	0	-1	-2	-3	-4	-5	-6	-7

55179 870 6668 - 870 FAMILY: 724 LUXURY PPI: 54.00 GROUP: 01 STAT: A
LOOM GROUPS: FLA 90100 200460 .1124 FLB 90100 800220 .1124 FLC 90100 700320 .1124 .0000 FCST: A

FCST: 84 SS: 0 RESERVED 0 TYPE: 30PK LOOM COMMENT:

	GR-INV	WEAVING	04/28	05/05	05/12	05/19	05/26	06/02	06/09	06/16	06/23	06/30
ORDERS			0	0	0	0	0	0	0	0	0	0
TOTAL REQUIREMENTS			0	0	0	0	0	0	0	0	32	79
LOOM SCHED	0	0	0	0	0	0	0	0	0	0	0	0
NET POSITION ORDERS (YARDS)			0	0	0	0	0	0	0	0	0	0
NET POSITION TOTAL (YARDS)			0	0	0	0	0	0	0	0	-32	-111
NET POSITION TOTAL (WEEKS)			0	0	0	0	0	0	0	0	0	-1

** WARP COLOR 262180

FCST: 5408 SS: 14840 RESERVED 527 TYPE: COMMENT:

ORDERS			1624	0	0	0	0	0	0	0	0	0
TOTAL REQUIREMENTS			6412	3471	3989	5081	5271	5281	5364	5362	5241	5171
LOOM SCHED	0	14097	4397	2100	5700	1900	0	0	0	0	0	0
NET POSITION ORDERS (YARDS)			2773	4873	10573	12473	12473	12473	12473	12473	12473	12473
NET POSITION TOTAL (YARDS)			-2015	-3386	-1675	-4856	-10127	-15408	-20772	-26134	-31375	-36546
NET POSITION TOTAL (WEEKS)			0	-1	0	-1	-2	-3	-4	-5	-6	-7

Figure A10. Warp Report

LOOMS OPEN AT LEAD TIME 05/01/06 DCWPSCH

LOOM	STYLE	VAR	COLOR	PO NBR	MOUNT DATE	RUNOUT DATE	LM GRP	88	BAL. WEAVE	FAM	IN25	PPI	WP YARN	WP STYLE	WP COLOR	COUNTER
356	55960	881	8154	34077	06/05/01	06/05/01	131		-7	796		50	07918	1385	101050	1
359	54925	910	36	32912	06/05/01	06/05/01	131	89	-134	749		36	24154	1384	101054	1
360	57222	920	9999	33152	06/05/01	06/05/01	131		-1293	748		48	24074	1384	101050	1
361	57178	920	9999	34025	06/05/01	06/05/02	131	89	373	746		40	24074	1384	101050	1
OPEN LOOMS 131																4
201	53338	880	13	34260	06/05/08	06/05/16	191		2475	778		32	24508	1385	101053	1
202	55836	882	3765	34518	06/05/09	06/05/22	191		2475	762		44	24508	1385	101053	1
204	53338	880	13	34706	06/05/08	06/05/16	191		2475	778		32	24508	1385	101053	1
205	53338	880	13	34698	06/05/18	06/05/23	191	89	1675	778		32	24508	1385	101053	1
206	53338	880	13	34310	06/05/09	06/05/17	191		2475	778		32	24508	1385	101053	1
207	55888	881	85	34528	06/05/17	06/05/19	191	89	875	776		44	24508	1385	101053	1
208	53338	880	13	34258	06/05/17	06/05/24	191		2475	778		32	24508	1385	101053	1
209	56842	910	165	34047	06/05/16	06/05/17	191	89	600	785		30	24074	2384	960330	1
210	57208	960	9999	34555	06/05/09	06/05/22	191		3100	746		40	24074	1384	101050	1
212	57208	960	9999	34556	06/05/15	06/05/25	191		3100	746		40	24074	1384	101050	1
213	57330	911	9999	34033	06/05/15	06/05/24	191	89	2500	758		40	24074	1384	101050	1
214	57224	920	9999	34143	06/05/02	06/05/17	191	89	2500	748	25	54	24074	1384	101050	1
215	53338	880	13	34564	06/05/17	06/05/24	191		2475	778		32	24508	1385	101053	1
216	53338	880	13	34369	06/05/09	06/05/17	191		2475	778		32	24508	1385	101053	1
217	53338	880	13	34367	06/05/10	06/05/18	191		2475	778		32	24508	1385	101053	1
218	53338	880	13	34208	06/05/11	06/05/19	191		2475	778		32	24508	1385	101053	1
219	53338	880	13	34370	06/05/08	06/05/17	191		2475	778		32	24508	1385	101053	1
220	53338	880	13	34562	06/05/11	06/05/22	191		2475	778		32	24508	1385	101053	1
221	55888	881	29	34696	06/05/19	06/05/25	191	89	1275	776		44	24508	1385	101053	1
222	53338	880	13	34563	06/05/15	06/05/22	191		2475	778		32	24508	1385	101053	1
223	55909	881	8789	34531	06/05/18	06/05/23	191	89	1075	776		44	24508	1385	101053	1
224	55948	880	2860	34524	06/05/10	06/05/22	191		2475	776		44	24508	1385	101053	1
226	53338	880	13	34707	06/05/04	06/05/16	191		2475	778		32	24508	1385	101053	1
228	55968	880	2860	34523	06/05/11	06/05/23	191		2475	776		44	24508	1385	101053	1
229	55910	880	2192	34389	06/05/15	06/05/19	191	89	1275	776		44	24508	1385	101053	1
OPEN LOOMS 191																25
321	55664	880	3581	34560	06/05/10	06/05/19	261		2050	703	25	48	07918	1385	101050	1
329	55665	880	3191	34561	06/05/10	06/05/19	261		2050	703		48	07918	1385	101050	1
OPEN LOOMS 261																2
316	57253	930	9999	34554	06/05/08	06/05/23	271		3100	748	25	54	24074	1384	101050	1

Figure A11. Filling Report

DATE 04/24/06 TIME 23.45.30 L/S 04/22/06 FILLING YARN REQUIREMENTS PROG P30828-A STEP P0711KE PAGE

PLANT-01 [illegible] WV 127 X-WIDE

STYLE/VAR YARN CD	YARN DESCRIPTION	YARN COLOR	YARN COLOR NAME	******REQUIREMENTS BY WEEK ENDING****** 04/29	05/06	05/13	05/20	05/27	06/03	TOTAL REQMTS	INPR INV.	YARN INV.	YARN POSITION
01-036	8.1/1 KP	10102/0	HALF BLEACH	*	*	*	*	*	*	*	*	639*	639
01-036	8.1/1 KP	10103/0	WHITE	*	*	*	*	*	*	*	1181*	14928*	16109
27183/000/9999				1066	1006	215				2287			
51109/892/1223				936	2344	3066	154			6501			
51530/881/0078				348						348			
51775/880/4210				694	360	428				1480			
53038/880/1971				331						331			
53316/880/1971					616					616			
53324/880/8493				273		177				450			
55346/880/1971					12					12			
55395/881/7548				65		163				228			
55396/880/7536				850	533	1112				2495			
55415/882/1971				652	547	707				1904			
55774/874/7782				89						89			
55781/880/7784				182						182			
55798/892/0078					365					365			
55798/892/3413				504						504			
55803/881/3732						730				730			
55822/880/8403				36						36			
55822/882/8388						548				548			
55880/880/3732				1		580	173			753			
58701/883/0078				888	46					935			
01-036	8.1/1 KP	10105/0	NON TINT	6915*	5829*	7726*	327*	*	*	20794*	779*	4124*	-15891
70522/000/1864				6						6			
01-036	8.1/1 KP	13004/1	CREAM	6*	*	*	*	*	*	6*	142*	*	136
01-036	8.1/1 KP	13010/1	CREAM	*	*	*	*	*	*	*	*	870*	870
01-036	8.1/1 KP	13011/1	TALC	*	*	*	*	*	*	*	642*	700*	1342
01-036	8.1/1 KP	13025/1	CREAM	*	*	*	*	*	*	*	*	306*	306
01-036	8.1/1 KP	13028/0	CHAMPAGNE	*	*	*	*	*	*	*	*	225*	225
56842/910/0165						64	65			128			
01-036	8.1/1 KP	13213/1	EGG	*	*	64*	65*	*	*	128*	*	373*	245
01-036	8.1/1 KP	13241/1	EGG	*	*	*	*	*	*	*	*	476*	476
01-036	8.1/1 KP	13250/1	EGG	*	*	*	*	*	*	*	542*	*	542
23200/000/0914				28						28			
01-036	8.1/1 KP	13254/1	CREAM	28*	*	*	*	*	*	28*	*	128*	100
01-036	8.1/1 KP	23041/1	BLUE	*	*	*	*	*	*	*	*	640*	640
01-036	8.1/1 KP	23044/0	PURPLE	*	*	*	*	*	*	*	*	2188*	2188
01-036	8.1/1 KP	23047/0	PEWTER BLUE	*	*	*	*	*	*	*	*	910*	910
01-036	8.1/1 KP	23055/0	FEDERAL	*	*	*	*	*	*	*	*	27*	27
01-036	8.1/1 KP	23120/0	RAISIN	*	*	*	*	*	*	*	*	77*	77
01-036	8.1/1 KP	23248/1	BLUE	*	*	*	*	*	*	*	*	328*	328
01-036	8.1/1 KP	23285/0	BLUE	*	*	*	*	*	*	*	*	1091*	1091
01-036	8.1/1 KP	25016/0	BLUE	*	*	*	*	*	*	*	*	67*	67
01-036	8.1/1 KP	25024/0	PLUM	*	*	*	*	*	*	*	196*	*	196
01-036	8.1/1 KP	25096/0	BLUE	*	*	*	*	*	*	*	*	83*	83
01-036	8.1/1 KP	33219/1	TURQ	*	*	*	*	*	*	*	*	748*	748
01-036	8.1/1 KP	43027/0	WILLOW	*	*	*	*	*	*	*	*	249*	249
01-036	8.1/1 KP	43033/0	SPRING GREEN	*	*	*	*	*	*	*	63*	*	63
01-036	8.1/1 KP	43077/1	GREEN	*	*	*	*	*	*	*	*	983*	983
01-036	8.1/1 KP	43129/0	GREEN	*	*	*	*	*	*	*	*	310*	310
01-036	8.1/1 KP	43132/0	GREEN	*	*	*	*	*	*	*	*	358*	358
01-036	8.1/1 KP	43139/0	GREEN	*	*	*	*	*	*	*	*	106*	106
01-036	8.1/1 KP	43340/1	GREEN	*	*	*	*	*	*	*	*	446*	446*

Figure A12. Piece Ticket

[illegible] WEAVING PIECE TICKET RN-14125

PAT.REPEAT 24.44

LOOM STYLE/VAR COLOR -MADE IN USA-
644 55209/870 6384 [redacted]
STYLE NAME - [redacted]
GR/CD S.CUT WIDTH PPI DATE
9 100 90/ 91 54 DOFF
-SHIP-TO-PLT 0095
CONTENT: POLP 52.00% POLY 48.00%

QUAL | YARDS | WEIGHT | PPI | INSP #/DATE

PT= 4
S.WGT 64 CROSS REF NBR 7676030
34014017 BATCH LS

STYLE/VAR COLOR LOOM 00644 PLT 0163
55209/870 6384 [redacted]
QUAL | YARDS | WEIGHT | DATE | LOCATION

-SHIP-TO-PLT 0095
34014017 BATCH LS C/REF NBR 7676030

STYLE/VAR COLOR LOOM 00644 PLT 0163
55209/870 6384 [redacted]

QUAL | YARDS | WEIGHT | SD RD RDY

-SHIP-TO-PLT 0095
34014017 BATCH LS C/REF NBR 7676030

Figure A13. Style Master

[illegible] WEAVING STYLE MASTER RN-14125

P1[illegible] DRAW______ DOFF YDS______ TIE____

STYL_X_ FILL_X_ CARD_X_ PGEAR_X_ BOX____

REED____ SLEY____ENDS____ OFF PO 33888

LOOM STYLE/VAR P.O. GRP SLEY G-PPI-F

644 55209/870 34014 481 100 54 54

COLOR/NAME REED SPREAD WIDTH

6384 [redacted] [redacted] [redacted] [redacted]

CARD ORDER BOX MOTION GRP SPEED YARDS

T9779/1 [redacted] [redacted]

DOBY-DRAW DOBY-CHAN PATRN HOOKS

[redacted] [redacted]

CDS IN E/D SELVAGE TYPE P/CNT TAKEUP

REPEAT B E D SELVGE BB TB

[redacted] 2 2/E 2/D C CORD 5.00

DOF YD 400 PCUT 778 CONV.FACT .51

BB01 STYLE COLOR/NAME WGT [redacted] ENDS

28030-2385 462250 [redacted] 00-[redacted]00

28030 150/50 SB [redacted] [redacted]

101050 COLOR

NW 124 S/C 4

FILLING COUNT COLOR LBS/YD

A 90100 300/72 [redacted] DURON [redacted]

400360 ATLANTIC GRN

B 90100 300/72 [redacted] DURON [redacted]

600150 COPPER E25

C 90100 300/72 [redacted] DURON [redacted]

700410 [redacted]

Figure A14. Shift End Report

Date 4-26-06 Shift 1st

Shift End Report

Warp Activity		Warps Completed	Efficiency/ Operation	
Section 1	Section 2	523	Section 1	Section2
229-E	538-E	510	T-2	T-7
227-m	503-m	212	T-3	T-9
219-E	512-E	216	T-11	T-10
228-out	552-m		Sect. Total	Sect. Total
	315-m		Break Outs	Draws
	533-E			

Material Issues

No Filling	No Warps	Absent/ Reason – OT Needed
90100 501610 Del Sol		
all yarn at looms		
552 + 524 on out of		
Del Sol		
90100 200490 Deep Sky		
all yarn at loom 217		

Miscellaneous Information

212- Pulling warp over (Running)	
528- fuzzing out ends	
539- [illegible] lost ends	
213. OQW ends crossed on LS	
PMO worked on	
513- Shop worked on not	
starting up	
225- Hand drive - No Part	

Figure A15. Main Menu-screen shot

```
[illegible]          R[illegible]e Loom Monitoring          26-APR-06 10:53:14
                              Main Menu

 1.  Stops & Efficiency Menu                        20. File Maintenance Menu
 2.  Planning Menu                                  21. Utilities Menu
 3.  Texpert                                        22. Printer Status
 4.  Data Entry of Warp Outs/Style Changes
 5.  Safety Numbers                                 Cloth Inspection:
                                                    30. Reports Menu
 7.  Card Cutting Menu                              31. File Maintenance Menu
 8.  Change Current Printer
 9.  Team News                                      Administration:
10.  Machine Startup Data Entry                     40. File Reports Menu
11.  Curtailment Data Entry                         41. File Maint. Inquiries
12.  Scoreboard Data Entry                          42. File Maint. Inputs
13.  Rerun End Of Week History Reports              43. Budgets and Costing
14.  Tie Sheet Menu
15.  Doffing Menu                                   46. Filling Invent. Inputs
16.  Supervisor Doffing Menu                        47. Filling Invent. Rpts.
17.  Print End of Week Reports Williamsburg
                          CURRENT PRINTER: Mail Room Printer
                          89.9 LOOM EFF  0.9 DEF/C YARDS
                          99.  Exit Menu and System
                          Key In Menu Choice [___]
```

Loom #528

Figure A16. Stops and Efficiency Menu-screen shot

[illegible]on [illegible] Loom Monitoring 26-APR-06 10:51:50

1. Stops & Efficiency Menu

Stops & Efficiency By:
1. Machine
2. Machines/Section
3. Work Team
4. Machine Group
5. Shift Section Manager
6. Shift/Section
7. Section Totals
8. Style
10. Designated Machine
12. Style and Machine
13. History Report
14. Work Team Accumulative
17. History Report By Filling
18. History Report By Style
19. History Report By Warp
20. Speed Variation
21. Worst Running Machines
22. Stop and Monitored Report

Color Graphics:
30. Section Layout
31. Current Shift Status

Trend Reporting By:
40. Work Team
41. Shift/Sections
42. Style

43. Weekly Eff./Machine
44. Sample Sheet Menu
45. Show Mach. Eff. Anal.
46. Yarn Search

Other:
50. Warp/Style/Yards Runout
51. Inquiry Yards Woven

99. Exit Menu and System

Key In Menu Choice [___]

Figure A17. Information on Machine 528 –screen shot

[illegible] [illegible] Loom Monitoring 26-APR-06 10:50:19

1. Stops & Efficiency by Machine

Machine Number: 528 Shifts Back: 9 Shift/Day: 1 Sunday

					Total Stops					Loom	Oprnl	
Shift	Style	Std. Speed	Avg. Speed	MPX	Warp	Fill	Mech	Other	Total	Eff	Eff	
1 Wed	53997	440	463	97	6	5	0	0	11	95.8	95.8	
3 Wed	53997	440	466	139	26	12	4	0	42	97.4	66.3	C 1
2 Tue	53997	440	459	65	16	12	9	0	37	95.9	30.8	C 9
1 Tue	53997	505	511	99	28	26	15	2	71	93.4	41.2	C 9
3 Tue	53997	505	518	212	7	10	2	0	19	87.5	87.5	
2 Mon	53997	505	521	186	12	18	0	0	30	76.7	76.7	
1 Mon	53997	505	511	123	33	24	16	0	73	85.5	50.7	C 9
3 Mon	53997	505	497	59	38	17	4	0	59	90.6	24.6	C 1
2 Sun	53997	505	0	2	0	2	0	0	2	100.0	100.0	C10
1 Sun	53997	505	0	0	0	0	0	0	0	0.0	0.0	C10
	Totals		498	982	166	126	50	2	344	88.2	56.7	

P = Print [RETURN] = Continue

9.2 Appendix B: Attachments of Case_2

Figure B1. Cleaning Tasks of a Sweeper

Customer:

Location: 108

Job Schedule

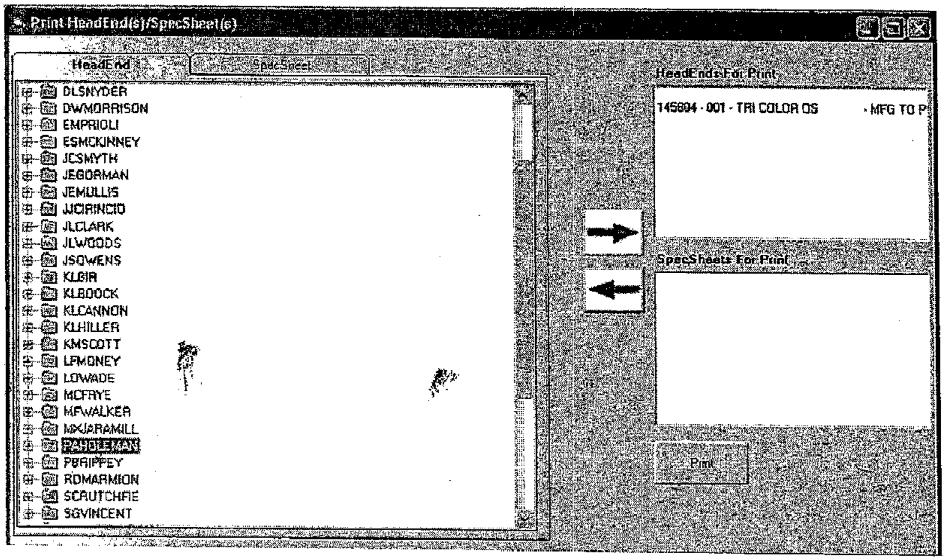
****Schedule Subject To Change Daily**

Position: **Sweeper/Waste Utility** Norman

Schedule: **7am. - 3pm.**

Start	Stop	Assignment
7:00		Get Bobbins & Take Upstairs
		Get Up Waste
		Sweep Weaveroom
	9:30	Run Billy Goat
9:30	10:00	Break
10:00	11:00	Gantry/Overhead Cleaning
11:00		Sweep Weaveroom
	12:30	Run Billy Goat
12:30	1:00	Break
1:00		Pull Trash
		Get Up Waste
		Sweep Weaveroom
	3:00	Run Billy Goat
		**Run Billy Goat in other areas of the plant

Figure B2. Manufacture to Print –screen shot



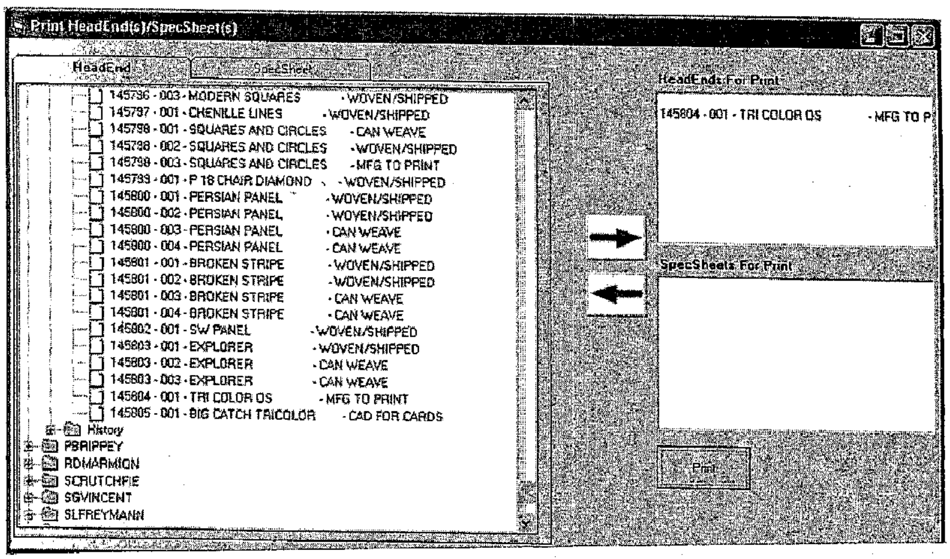


Figure B3. Head End Sheet

[redacted] HEADEND SHEET

1

Rls Date 5/17/06

HeadEnd# 145804-1

Due Date 5/31/06
Patt Desc TRI COLOR OS
Designer [redacted]
Mfg Entity [redacted]
TX/CD# 35263
EPI [redacted]
PPI [redacted]
Weave JACQUARD
Routing RETURN TO DESIGN
Comments COMBOS 6-9 MIX C2.5 AND CSD

Dead Px N
Parallel Px N
MegaHead N
Plain Y
Warp Id1 42028K-1 B
Color BLACK 7710
Warp Id2
Color
Mini Mill N

Card App N
Card App Dsc
Prod Desc RESIDENTIAL
Other
Color Work Y
Special For
Designer Req#
Finish Like UB
Draw

Combo#	Pick Trial	Box 1	Box 2	Box 3	Box 4	Box 5	Box 6	Box 7	Box 8	Yards
1			O4/1AC SYRUP10283	O4/1AC CLART10288		CSD1250P4 TOBACCO		CSD1250P4 RUSSET		1
2			O4/1AC SYRUP10283	O4/1AC DENIM10001		CSD1250P4 TOBACCO		CSD1250P4 SPRUCE		1
3			O4/1AC SYRUP10283	O4/1AC LODEN10041		CSD1250P4 TOBACCO		CSD1250P4 OLIVE		1
4			O4/1AC CLART10288	O4/1AC LODEN10041		CSD1250P4 RUSSET		CSD1250P4 OLIVE		1
6			O4/1AC SYRUP10283	O4/1AC CLART10288		C2.5NMA SENOHAVAN		CSD1250P4 RUSSET		1
7			O4/1AC SYRUP10283	O4/1AC DENIM10001		C2.5NMA SENOHAVAN		CSD1250P4 SPRUCE		1
8			O4/1AC SYRUP10283	O4/1AC LODEN10041		C2.5NMA SENOHAVAN		CSD1250P4 OLIVE		1
9			O4/1AC CLART10288	O4/1AC LODEN10041		C2.5NMA SENOCHIAN		CSD1250P4 OLIVE		1
sh PPB		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Per Repeat		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
d Picks		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
allel Picks										

e Woven
's to Weave
nple Weaver
iability Good ______ Fair ______ Poor ______ Did Not ______
nments

Sam Filling Hauler
Days Delinquent to Weave

Fabric Weight

Figure B4. Main Menu –screen shot

```
05/17/2006 Rel 6.0                          HPB System                        Job: QPADEV0089
11:32:05 WVMANSFIEL      Main Menu for:                                        Sys: HPB

     1. T&A Exception Conversion
     2. CWG Raw Material Menu
     3. CWG Design Flow Menu
     4. CTW CWG Master Menu


     5. T&A Clock Display

    90. Signoff


Selection
===>
 F1=Help          F5=Start Prt    F6=Stop Prt     F7=Work Prt      F8=My Jobq
 F9=My Reports  F10=Change Pwd  F11=Disp Msg     F22=Calculator  F23=Calendar
Function key not allowed.
```

Figure B5. Design Flow Menu –screen shot

```
05/17/2006 Rel 6.0                          HPB System                          Sys: HPB
11:32:22 WVMANSFIEL                     Design Flow Master                      Menu: CWGDSNFMST

     1. CWG Head End Inquiry
     2. CWG Head End Maintenance
     3. CWG Head End Number Maint

    90. Signoff




Selection
===> ___
 F1=Help          F3=Exit          F5=Start Prt     F6=Stop Prt      F7=Work Prt
 F8=My Jobq       F9=My Reports    F10=Change Pwd   F11=Disp Msg     F24=More Keys
```

Figure B6. List of 3 Manufacture to Print samples –screen shot

HEAD END SHEET
INQUIRY AND MAINTENANCE

5/17/06
11:30:07

DSN001C1

STATUS

OPTIONS: **1=DETAILS** **3=COMBOS**
5=PICK LIST

Opt	HEAD END #	WARP ID	PATTERN	DUE DATE	STATUS
_	145798 003	10210A-2	SQUARES AND CIRCLES	5/31/06	20 MFG TO PRINT
_ →	145804 001	42028K-1	TRI COLOR OS	5/31/06	20 MFG TO PRINT
_	157563 023	42028K-1	2 BOXES YARN TRIAL	5/31/06	20 MFG TO PRINT
_	156398 005	SR8452 TAP	EP441 PARLL H/BONE	4/13/06	25 WARP NOT IN
_	185746 001	SR8659	MONTEL	5/10/06	25 WARP NOT IN
_	185749 001	SR8705	FRAMEUP	5/11/06	25 WARP NOT IN
_	187348 001	10210A-13	APPETIZER	5/29/06	25 WARP NOT IN
_	187354 001	10210A-13	CAHOOTS	5/30/06	25 WARP NOT IN
_	187347 001	10210A-27	APPETIZER	5/29/06	25 WARP NOT IN
_	187353 001	10210A-27	CAHOOTS	5/30/06	25 WARP NOT IN

More...

F3=EXIT F4=PROMPT F5=REFRESH F6=SORT F7=ACTIVE ONLY F8=ADDITIONAL INFO

Figure B7. Head End Pick List

SN016R1

DESIGN FLOW
HEAD END PICK LIST
HEAD END#: 145804 SEQ#: 1

PAGE: 1
RUN DATE: 5/17/2006
RUN TIME: 11:30:38

arn ID 1	Yarn ID 2	Location	Cones	Half Cones	Pieces
SD1250P4	OLIVE				
SD1250P4	RUSSET				
SD1250P4	SPRUCE				
SD1250P4	TOBACCO				
'2.5NMA	SENOCHIAN				
!2.5NMA	SENOHAVAN				
4/1AC	CLART10288	19-013	13.00		1.00
		52-037	7.00	1.00	1.00
)4/1AC	DENIM10001	53-047	7.00	12.00	10.00
)4/1AC	LODEN10041	59-058	3.00	15.00	20.00
)4/1AC	SYRUP10283	59-006	1.00		

========================
E N D O F R E P O R T
========================

Figure B8. Daily Sample Report

Daily Sample Report

[redacted]

Tue
5/16/06

Contract

Des.	PL	HE#	No.	Wove	Comb	Yds	S.W
Chris	Contract	187330	1	05/16/06	40	12.5	dr
Chris	Contract	187333	1	05/16/06	3	9	cw
Chris	Contract	187342	1	05/16/06	2	6	cw
				Total	45	27.5	3

Textures

Des.	PL	HE#	No.	Wove	Comb	Yds	S.W
Phillip	Textures	145767	11	05/16/06	1	11	gr
Phillip	Textures	145768	11	05/16/06	1	11	gr
Phillip	Textures	145775	17	05/16/06	3	16	gr
Phillip	Textures	145775	19	05/16/06	1	6	gr
Tammy	Textures	177100	14	05/16/06	1	11	gr
Tammy	Textures	177101	4	05/16/06	1	11	gr
				Total	8	66	6

Tue	Comb	Yds	T/R
Contract	45	27.5	3
P/Dev.	0	0	0
Textures	8	66	6
Total	53	93.5	9

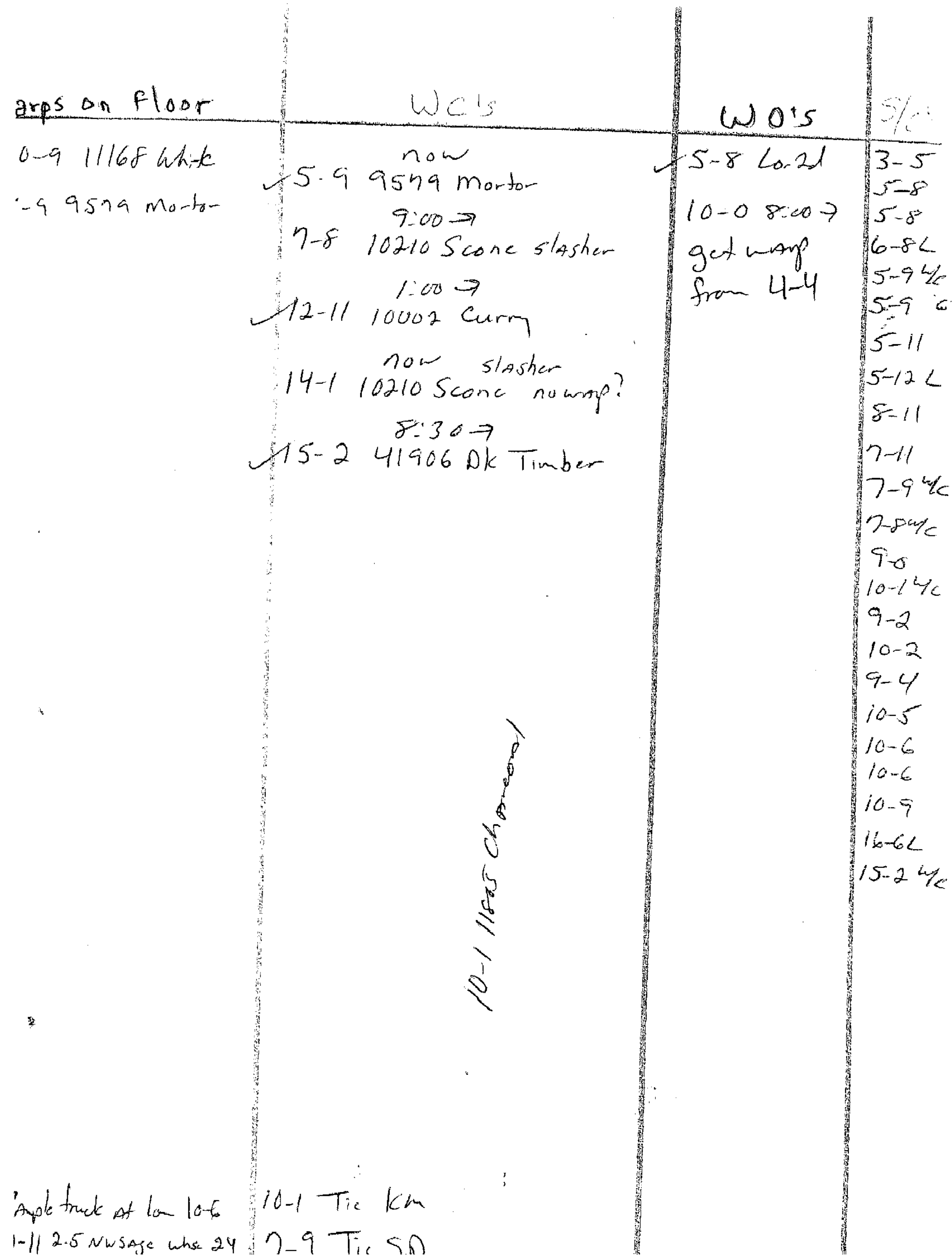
Woven	M-05/15	T-05/16	W-05/17	T-05/18	F-05/19	S-05/20	S-05/21	Total
Contract	5	3			x	x	x	8
P/Dev.	0	0			x	x	x	0
Textures	3	6			x	x	x	9
Total	8	9	0	0	0	0	0	17

O/Weave	M-05/15	T-05/16	W-05/17	T-05/18	F-05/19	S-05/20	S-05/21	
Contract	42	45			x	x	x	
P/Dev.	4	4			x	x	x	
Textures	37	31			x	x	x	
Total	83	80	0	0	0	0	0	

Received	M-05/15	T-05/16	W-05/17	T-05/18	F-05/19	S-05/20	S-05/21	Total
Contract	18	6			x	x	x	24
P/Dev.	0	0			x	x	x	0
Textures	9	0			x	x	x	9
Total	27	6	0	0	0	0	0	33

Can-Rev.	M-05/15	T-05/16	W-05/17	T-05/18	F-05/19	S-05/20	S-05/21	Total
Contract	1	0			x	x	x	1
P/Dev.	0	0			x	x	x	0
Textures	1	0			x	x	x	1
Total	2	0	0	0	0	0	0	2

Figure B9. Warp Status Report



arps on Floor	WC's	WO's	S/C
0-9 11168 White	now ✓5-9 9579 Morton	✓5-8 Loral	3-5
-9 9579 Morton	9:00 → 7-8 10210 Scone slasher	10-0 8:00 →	5-8
	1:00 → ✓12-11 10002 Curry	get warp from 4-4	5-8
	now slasher 14-1 10210 Scone no warp?		6-8L
	8:30 → ✓15-2 41906 Dk Timber		5-9 W/c
	10-1 11825 Charcoal		5-9 c
			5-11
			5-12 L
			8-11
			7-11
			7-9 W/c
			7-8 W/c
			9-0
			10-1 W/c
			9-2
			10-2
			9-4
			10-5
			10-6
			10-6
			10-9
			16-6L
			15-2 W/c
Apple truck at loom 10-6	10-1 Tic Km		
1-11 2.5 NwSage whse 24	7-9 Tic SD		

Figure B10. Run Out Report

PRODUCTION RUN OUT FORM

TE 5-18-06 SHIFT 1st

ARPS OUT FOR NEXT SHIFT

PRODUCTION / PICKS

OUT	1ST SHIFT	SMASH	STYLE CH.
10-9			7-11
8-9			
2-11			
9-2			
14-1			
12-9			
16-2			
10-1			

UPPER	LOWER
70.4%	127

SAMPLES

1-5, 2-5, 5-12, 9-1, 9-8, 12-10, 13-1

STANDING FOR:

NO WARPS

14-1 102105 Score Hacobat#7 (ok)

NO FILLING

9-2 T12069 C0229 7/A pulled 5/c
1-5 6/1A Charco 8000 7/A pulled 5/c
7-10 C1350A1 Sunrs 0263 7/A pulled 5/c
6-10 3/1C 7321 7/A pulled 5/c
15-2 6/1A Prck14045 7/A pulled 4/c
16-5 C1250A35TX Dune04650 7/A pulled 5/c

Break Outs

MECHANICAL DT / MISC. NOTES

12-10 Reed
4-10 Head (Running)

DRAWS

Figure B11. Late Order Report

HRP305R1

CAPACITY REQUIREMENTS PLANNING — BASED ON MFG WORKORDERS
SUMMARY REPORT
AS OF 2006/05/19

JOB: HRP301CL
USER: 85YSIHR
NUMBER: 125661

PAGE: 1
DATE: 5/19/06
TIME: 4:10:17

TOTALS

SCHEDULED YARDS

		LATE 2+	LATE 1	5/19	5/26	6/02	6/09	6/16	6/23	6/30	7/07	7/14	7/21	7/28	FUTURE	TOTALS
LOOM GROUP TOTALS:	GA - 144 DORNIER JACQ SB	6,294	11,048	8,740	7,710	14,288	15,348	18,152	15,290	27,489		8,745			6,060	139,164
	GF - 144 DORNIER DP JACQ SB		104	55	55	495	55	385	110	385						1,644
	GS - 144 DORN MEGA JACQUARD	378	737	624	3,202	6,215	4,015	1,980	1,485	5,335					334	24,305
	GX - 144 DORNIER JACQ HP	440			55				55							550
	JA - DORNIER DOBBY SB		805													805
	MA - 144 MINIMILL AIRJET SB	5,631	6,354	11,794	8,166	13,990	5,225	31,120	17,207	32,230		10,285		550	1,265	143,817
	MX - 144 MINIMILL AIRJET HP	55	110	1,373	578	1,155	165	715	1,155	330		165				5,801
	SA - 22 DORNIER 22/E SB	15,742	9,351	1,925	10,632	4,753	2,637	11,165	7,428	2,695		660				66,989
	TA - 44 DORNIER TRUE JACQ	55,025	27,206	69,150	50,753	47,472	31,182	69,438	72,007	56,430		4,510	4,730	1,155	2,562	491,620
	TC - 44 DORNIER TRUE JACQ	5,846			4,675	6,748	19,096	7,918	1,375	1,760						47,418
	UN - 88 DORNIER RAPIER	12,442	5,595	10,141	15,450	10,919	6,520	18,651	8,030	33,472		6,215	5,555	55	22,000	155,053
	VC - 144 DORNIER JACQ SB									1,304						1,304
	VP - 144 DORNIER AIR JET					509	3,607			3,080		4,180				11,376
	WH - 88 DORNIER RAPIER/WD		402	54	-931	875	888	1,705	110	220						5,257
	WI - 88 DORNIER RAPIER	550	1,587	2,937	-5,276	1,980	55	1,590	1,210	330				55		15,570
	XA - 44 DORNIER RAPIER	596	401	389	186	3,085	1,859	1,210	729	990		110				9,555
	YA - 22 DORNIER RAPIER						1,195		8,148	5,500		894	11,000			26,737
	1A - DORNIER DOB S 17									1,100						1,100
	3B - DORNIER DOB S 503	433	60	5,486	11,227	10,266	10,890	11,495	23,518	165						75,540
		103,432	63,840	112,668	120,905	122,750	102,729	175,524	157,857	172,815		35,764	21,285	1,815	32,221	1,223,605
SUB-GROUP TOTALS:	DOBBY	433	865	5,486	13,227	10,266	12,085	11,495	31,666	6,765		894	11,000			104,182
	22 ENDS	17,590	11,030	3,190	10,688	4,808	2,637	15,015	7,428	2,695		660				75,741
	PUCKER UP WASHED	3,317														3,317
	88 END JACQUARD	12,255	5,595	10,031	15,348	11,794	6,300	18,376	7,315	33,197		6,215	5,555	55	22,000	154,036
	88 END WIDE	550	2,069	2,991	6,207	1,980	935	3,295	1,540	825				55		20,447
	44 END JACQUARD	59,751	25,928	68,384	55,476	57,250	52,357	74,991	74,606	59,180		4,620	4,730	1,155	2,562	541,010
	144 END DAMASK	9,481	18,353	22,586	19,271	36,102	27,865	52,352	35,302	70,153		23,375		550	7,659	323,049
	133 END DAMASK				495	550	550									1,595
	44 ENDS	55			173											228
		103,432	63,840	112,668	120,905	122,750	102,729	175,524	157,857	172,815		35,764	21,285	1,815	32,221	1,223,605

NUMBER OF LOOMS PER LOOM GROUP (BASED ON FIRST ORDER ON MOST CURRENT LOOM SCHEDULE)

GA - 144 DORNIER JACQ SB	19
GF - 144 DORNIER DP JACQ SB	
GS - 144 DORN MEGA JACQUARD	2
GX - 144 DORNIER JACQ HP	
JA - DORNIER DOBBY SB	1
MA - 144 MINIMILL AIRJET SB	18
MX - 144 MINIMILL AIRJET HP	
SA - 22 DORNIER 22/E SB	10
TA - 44 DORNIER TRUE JACQ	29
TC - 44 DORNIER TRUE JACQ	1
UN - 88 DORNIER RAPIER	11
VC - 144 DORNIER JACQ SB	
VP - 144 DORNIER AIR JET	2
WI - 88 DORNIER RAPIER	5
XA - 44 DORNIER RAPIER	3
YA - 22 DORNIER RAPIER	1
1A - DORNIER DOB S 17	1
3B - DORNIER DOB S 503	6
	109

Figure B12. Open Order Report

```
WP0116                          OPEN ORDER LISTING BY WARP I. D.                                  DATE:  5/19/06
  WEAVING                                                                                         TIME:  5:00:09
                                                                                                  PAGE:     66
                                                    ORD ORD    ORDER      YARDS               BAL  CUSTOMER
   DUE DATE   ORD  DATE    WORK ORD     LOOM  SEQ#  CLS TYP   QTY +10%    WOVEN    BALANCE    PRT    NAME
   ========== ==========  ========     ====  ====  =======   ========    =====    =======    ===  ==============
   2006/06/16 2006/05/04   87588   5                REG REG    500.00               550.00     10

                                          COLOR TOTALS:       2000.00     107.00   2093.00     38

PATTERN: P-AT-LARGE MINT          STYLE #: 11311    DRAW:                LOOM GROUP: TA
   2006/04/28 2006/03/16   87275  35                REG REG    200.00      49.00    171.00      3
   2006/05/12 2006/03/28   87346  22                REG REG    250.00               275.00      5

                                          COLOR TOTALS:        450.00      49.00    446.00      8

PATTERN: P-AT-LARGE SUEDE         STYLE #: 11311    DRAW:                LOOM GROUP: TC
   2006/05/05 2006/03/16   87275  37                REG REG    550.00     255.00    350.00      6
   2006/06/02 2006/04/22   87508  49                REG REG    600.00               660.00     12

                                          COLOR TOTALS:       1150.00     255.00   1010.00     18
                                        PATTERN TOTALS:       1600.00     304.00   1456.00     26

                                           WARP TOTALS:       3600.00     411.00   3549.00     64

WARP ID  42028K-1  B          44 EPI 1/300/720     BLACK 7710          CUST CONFIRM DATE          CUTOFF DATE

PATTERN: BAR NONE   AEGEAN        STYLE #: 12924    DRAW:                LOOM GROUP: TA
   2006/06/02 2006/04/11   87438   4    10-02  5.00 REG REG    500.00      54.00    496.00      6
   2006/06/23 2006/05/09   87617   6                REG REG    250.00               275.00      5
   2006/06/30 2006/05/18   87666   6                REG REG     50.00                55.00      1

                                          COLOR TOTALS:        800.00      54.00    826.00     12

PATTERN: BAR NONE   CHOCOLATE     STYLE #: 12924    DRAW:                LOOM GROUP: TA
   2006/06/09 2006/04/26   87528   9                REG REG    200.00               220.00      4
   2006/06/30 2006/05/18   87666   7                REG REG     50.00                55.00      1

                                          COLOR TOTALS:        250.00               275.00      5
                                        PATTERN TOTALS:       1050.00      54.00   1101.00     17

PATTERN: BASKET CAS BLACK PEAR    STYLE #: 13111    DRAW: PARALLEL       LOOM GROUP: TA
   2006/06/02 2006/05/11   87630  16     3-05  6.50 REG FLR    500.00               550.00     10
   2006/06/23 2006/05/18   87666   8                REG RSH    200.00               220.00      4

                                          COLOR TOTALS:        700.00               770.00     14

PATTERN: BASKET CAS BRASS         STYLE #: 13111    DRAW: PARALLEL       LOOM GROUP: TA
   2006/06/23 2006/05/09   87617   7 302            REG REG    300.00               330.00      6
   2006/06/30 2006/05/18   87666   7 302            REG REG    500.00               550.00     10
   2006/06/30 2006/05/19   87671   8                REG REG    100.00               110.00      2

                                          COLOR TOTALS:        900.00               990.00     18

PATTERN: BASKET CAS SAGE          STYLE #: 13111    DRAW: PARALLEL       LOOM GROUP: TA
   2006/05/19 2006/05/18   87652   7                REG FLR     50.00                55.00      1
                                        PATTERN TOTALS:       1650.00              1815.00     33

PATTERN: BONEFISH   SAGE          STYLE #: 13113    DRAW:                LOOM GROUP: TA
   2006/06/23 2006/05/09   87617   9 FL3            REG REG    300.00               330.00      6
```

Figure B13. Master Menu –screen shot

```
5/19/2006 Rel 6.0                              HPB System                      Sys: HPB
2:15:17 MECRAFT                   CTW          Master Menu                   Menu: CTWCWGMSTR

    1. CWG Work Order Menu
    2. CWG Raw Material Menu
    3. CWG Planning Menu
    4. CTW Engineering Menu
    5. CWG Restricted Maintenance

   90. Signoff




election
==> 4
F1=Help         F3=Exit         F5=Start Prt    F6=Stop Prt     F7=Work Prt
F8=My Jobq      F9=My Reports   F10=Change Pwd  F11=Disp Msg    F24=More Keys
```

Bill of material

Figure B14. Engineering Menu –screen shot

```
5/19/2006 Rel 6.0                    HPB System                   Sys: HPB
2:15:20 MECRAFT                 CTW Engineering Menu             Menu: CTWENGMNU

    1. CWP Designflow-Feed Eng.


    2. CTW Engineering Inquiry Menu
    3. CWP Yarn BOM I.D.s
    4. CWG Yarn BOM I.D.s
    5. CTW Designer's Eng. Cost Aid
    6. CWP Cost Group Maintenance
    7. CWP Dup. Patt. of Diff. Style

   90. Signoff



election
==> 02
F1=Help          F3=Exit         F5=Start Prt    F6=Stop Prt     F7=Work Prt
F8=My Jobq       F9=My Reports  F10=Change Pwd  F11=Disp Msg    F24=More Keys
```

Figure B15. Engineering Enquiry Menu –screen shot

```
5/19/2006 Rel 6.0                      HPB System                       Sys: HPB
2:15:23 MECRAFT              CTW Engineering Inquiry Menu              Menu: CTWENGINQ

     1. CWP Raw Mat Where Used (Sel)
     2. Raw Mat Where Used (Sel)
     3. CWP BOM Explosion
     4. CWG BOM Explosion
     5. Engineering Inquiry
     6. Raw Material Inquiry
     7. CTW Pattern/Color Fbr Content

    90. Signoff




election
==> 4
F1=Help          F3=Exit         F5=Start Prt     F6=Stop Prt     F7=Work Prt
F8=My Jobq       F9=My Reports  F10=Change Pwd   F11=Disp Msg    F24=More Keys
```

Figure B16. Material Handling System –screen shot

```
MHS360FM                MATERIAL HANDLING SYSTEM                         DATE:  5/19/06
                     MATERIAL REQUIREMENTS INQUIRY                      TIME: 12:15:38


      ENTER PATTERN INFORMATION:

                   STYLE NUMBER:   13223
                   COLOR NAME:     BEACH
                   YARDS:            250




STYLE / COLOR NOT FOUND
CMD-1: END-JOB
```

Figure B17. Material Handling System –screen shot 2

```
MHS361C1            MATERIAL HANDLING SYSTEM                          5/19/06
                  MATERIAL REQUIREMENTS INQUIRY                       12:15:51

  250 YARDS      PATTERN:  13223  SHIFTING SANDS           BEACH

YPE              RAW MATERIAL ID                        QUANTITY   CUMULATIVE
=== ========================================== =========== ===========
RP  10210A-37  B                                       271.74000
RN     1/150D36P  LINEN19321                            83.93777
RN     2/150D34P  REDSL03416                              .08967
RN        2/150D36P  NATURAL                              .09439
RN     2/150D36P  NATURAL                                 .08967      .18406
RN     O12/2P     NATURAL                                1.39131
RN  O6/1A       SIREN5015                               39.27500
RN  O6/1A       CHAMS0590                               16.00500
RN  O6/1A       WHEAT0538                               30.55250
RN  O6/1A       CHAMS0590                               11.64000    27.64500
RN  O6/1A       ACORN0608                               11.64000
RN  O6/1A       WHEAT0538                               18.91250    49.46500


MD-1: END-JOB     CMD-5: % TOTAL      CMD-7: PRINT
```

Figure B18. Material Handling System –screen shot 3

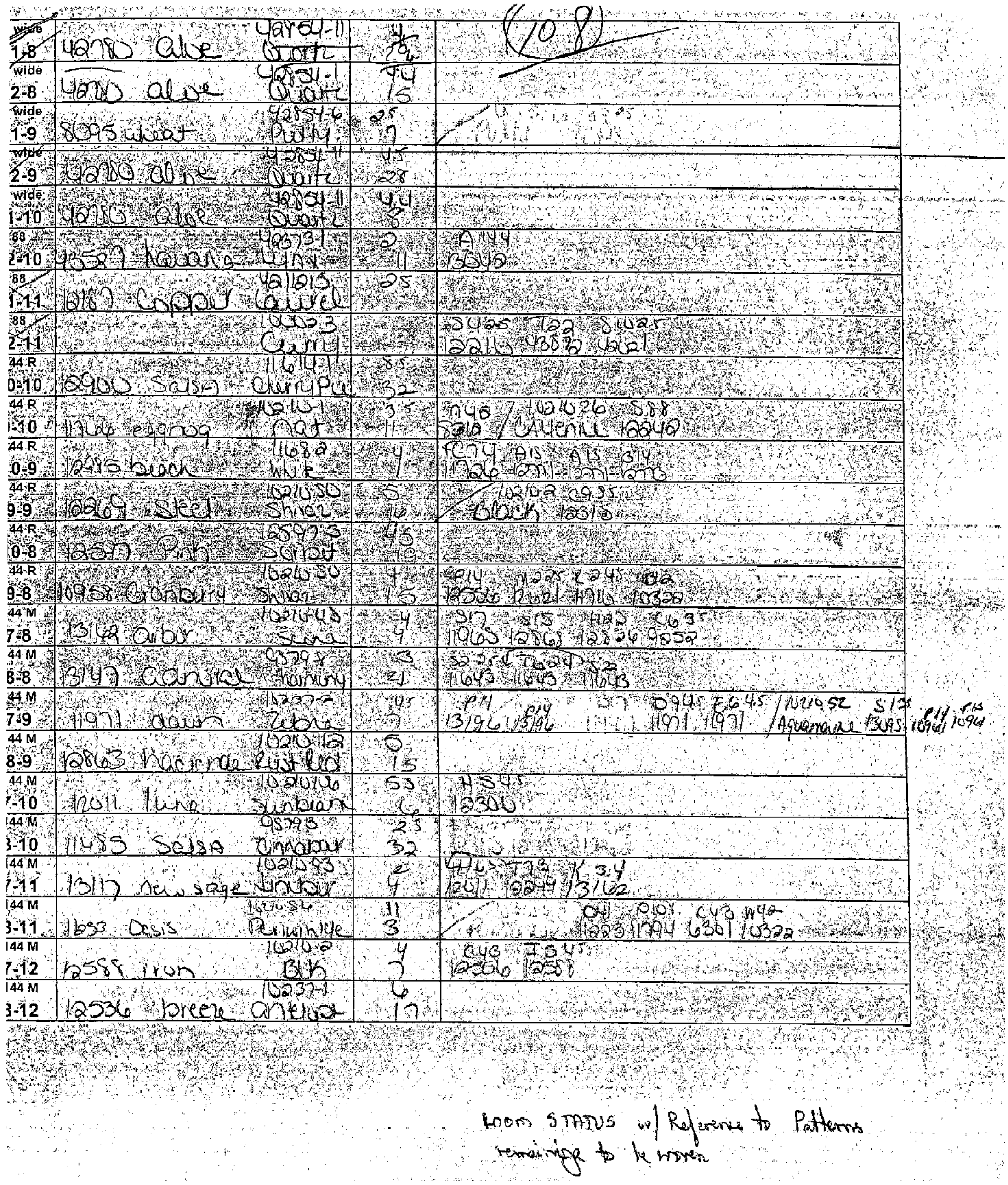
MHS361C2 **MATERIAL HANDLING SYSTEM** 5/19/06
MATERIAL REQUIREMENTS INQUIRY 12:16:23

250 YARDS **PATTERN: 13223 SHIFTING SANDS** **BEACH**
TOTAL = 213.53342

MATERIAL ID/COLOR		PATT REQ	CURRENT REQ	TOTAL INVENT	% OF TOTAL
/150D36P	LINEN19321	83.93	3.00	1867.50	39.30
/150D34P	REDSL03416	.08	189.00	82.96	.04
/150D36P	NATURAL	.18	594.00	382.85	.08
12/2P	NATURAL	1.39	5424.00	3201.37	.65
6/1A	SIREN5015	39.27	10.00	443.70	18.39
6/1A	CHAMS0590	27.64		4.70	12.94
6/1A	WHEAT0538	49.46		31.45	23.16
6/1A	ACORN0608	11.64			5.45

MD-2: RETURN TO PREVIOUS DISPLAY

Figure B19. Loom Status Report



wide 1-8	42780 olive	42854-11 Quartz	4 / 28	(10 8)
wide 2-8	42780 olive	42854-1 Quartz	44 / 15	
wide 1-9	8095 wheat	42854-6 Putty	25 / 17	
wide 2-9	42780 olive	42854-11 Quartz	45 / 28	
wide 1-10	42780 olive	42854-11 Quartz	44 / 8	
88 2-10	43587 havana	42673-1 Linx	2 / 11	A 144 13640
88 1-11	12187 Copper	421613 Laurel	25	
88 2-11		102023 Curry		S 425 T 22 S 425 12216 43872 40621
44 R 0-10	12900 Salsa	116141 CherryPie	85 / 32	
44 R 1-10	11726 eggnog	102101 Nat	35 / 11	N 48 / 102026 S 88 5216 / CAYENNE 12642
44 R 0-9	12495 black	11682 Wht	4	FC 74 A 15 A 15 G 14 11726 12271 12271 12273
44 R 9-9	12269 steel	102650 Shiraz	5 / 16	102102 C 935 Black 12315
44 R 0-8	12257 Pink	125973 Sorbet	45 / 19	
44 R 9-8	10958 Cranberry	102650 Shiraz	4 / 15	P 14 N 225 L 245 12556 12021 11916 10328
44 M 7-8	13148 Arbor	102643 Sierra	4 / 4	S 17 S 15 H 83 C 635 11965 12863 12826 9852
44 M 8-8	13147 canvas	9379-8 hominy	3 / 21	S 225 T 624 S 22 11643 11643 11643
44 M 7-9	11971 dawn	102372 Zebra	45 / 7	P 14 P 14 S 17 D 94 F 645 / 102652 S 135 13196 13196 11971 11971 11971 / Aquamarine 13095
44 M 8-9	12863 hacienda	102612 Rustred	6 / 15	
44 M 7-10	12011 luna	102496 Sunbeam	53 / 6	H 545 12300
44 M 8-10	11485 Salsa	95793 Cinnabar	25 / 32	
44 M 7-11	13117 new sage	102693 Linden	2 / 4	Q 465 T 23 K 3.4 12011 10299 13162
44 M 8-11	11653 Oasis	102654 Periwinkle	11 / 3	041 P 101 C 43 W 42 11223 11794 6301 10322
44 M 7-12	12588 iron	102102 Blk	4 / 7	C 48 I 545 12556 12588
44 M 8-12	12536 breeze	102371 antique	6 / 17	

Loom STATUS w/ Reference to Patterns remaining to be woven

Figure B20. Warp Patrol Sheet

WARPS IN BOLD LETTERS WILL RERACK. ALL OTHERS ARE WRAP OUTS

5/19/2006

1	5-0	sample								
2	5-1	EMPTY								
3	5-2	sample								
4	1-3	sample								
5	1-4	sample								
6	1-5	10210 bronze	2500	10130472						
7	1-6	10210 natural	2700	10130148						
8	2-6	10210 black	1000	10129175						
9	3-6	41906 café	500	9597703		2000	10076976			
10	2-5	10237 snickers	3000	10129042	10814 bullion	3000	10129301			
11	3-5	42028 black	500	10129194		3000	10130450			
12	2-4	10210 black	2500	10129550						
13	3-4	42164 penny	5000	10129075						
14	2-3	sample								
15	3-3	43461 polo	200	10130334						
16	5-3	EMPTY								
17	4-3	EMPTY								
18	5-4	EMPTY								
19	4-4	EMPTY								
20	5-5	42028 black	4800	10077122						
21	4-5	EMPTY								
22	5-6	EMPTY								
23	4-6	42028 black	5500	10129020						
24	6-6	EMPTY								
25	7-6	EMPTY								
26	6-5	EMPTY								
27	7-5	EMPTY								
28	6-4	EMPTY								
29	7-4	43046 navy	100	10129292						
30	6-3	sample								
31	7-3	EMPTY								
32	6-2	42164 penny	100	10016940						
33	7-2	EMPTY								
34	6-1	EMPTY								
35	7-1	EMPTY								
36	6-0	EMPTY								
37	7-0	EMPTY								
38	8-0	EMPTY								
39	9-0	9386 jewel	400	10129188	43232 cactus	5000	10078074			
40	9-1	41906 new rose	3000	10076926	43404 petunia	400	10130463			
41	8-1	EMPTY								
42	9-2	9386 jewel	2000	10130361						
43	8-2	EMPTY								
44	9-3	42028 black	800	10129196		4000	10130343			
45	8-3	EMPTY								
46	9-4	42028 chocolate	1200	10129507		5300	10130374			
47	8-4	42028 black	2500	10078061						
48	9-5	41906 dk timber	3000	10129160						
49	8-5	EMPTY								
50	9-6	11805 black	1200	10129039		4000	10130035			
51	8-6	EMPTY								
52	10-6	42028 black	4000	10129195						
53	11-6	11805 russet	2500	10076983	9386 sahara	300	10130308	41906 pacific	2000	10130318
54	10-5	42028 black	1000	10129193	11805 black	3300	10130037			
55	11-5	41931 onyx	800	10130342		5000	10077015			
56	10-4	43147 oatmeal	500	10076923	43233k-2	ck box	hacoba 6			
57	11-4	41906 bk olive	1200	10129315		5500	10128965			
58	10-3	41906 café	800	10076978		2000	10176982	43232 cactus	3000	10077009
59	11-3	EMPTY								
60	10-2	42028 black	1500	10129197		5500	10129212			
61	11-2	EMPTY								
62	10-1	11805 charcoal	100	10078206		230	10078204		230	10078205
63	11-1	12688 bisque	1400	10129003						
64	10-0	11805 black	1700	10130036						
65	11-0	10210 timber	1800	10128944						
66	13-0	10210 black	2000	10129172		3450	10129179			
67	12-0	10210 black	3405	10129173						

warp patrol

Figure B21. Piece Ticket

STYLE: 12924 BAR NONE
COLOR: [redacted]
PROC.: 30883623

30883623

STYLE: 12924 BAR NONE
COLOR: [redacted]
PROC.: 30883623

30883623

SYNTHETICS

030883623

30883623

TICKET #	: 30883623 5/19/06 11:28:39	WORK ORDER	: 874798/ 500-87528- 9
STYLE	: 12924 [redacted]	WEAVE DUE DATE	: 2006/06/09
COLOR	: [redacted] [redacted]	LOOM	: 0305
PICK GEAR	: [redacted]	WEAVE CODE	: 35066
PICKS: LOOM	: [redacted] FINISH: [redacted]	WEAVING REPEAT	: [redacted]
REED	: [redacted]	FINISH REPEAT	: [redacted]
SETUP	: DRAW:	WARP ID	: [redacted]
DOFF LENGTH	: [redacted]	WARP COLOR	: BLACK 7710
EST RUN TIME	: 1:23:00	2ND WARP ID	:
CONTENT	: [redacted]	WARP COLOR	:
FINISH CODE	: [redacted]	TOTAL ENDS	: 2464 (WITH SELVAGE)
LATEX CODE	: 1401 OYSTER	ENDS/DENT	: 2B 2S
LATEX OZ	: 3.93	PROCESS	:
NEEDLE CD	: MBA2011	HYDRO RECIPE	:

BOX	NDL	YARN ID	COLOR	LOCATION	LBS REQ
2		T3307Q	[redacted]	ROW1	[redacted]
4		T3307Q	[redacted]	ROW1	[redacted]
6		C1350A1	[redacted]		[redacted]
8		C1350A1	[redacted]		[redacted]

SEQ: 1 OF 4

WOVEN YARDS:________ BURL YARDS:________

[redacted] [redacted]

30883623

STYLE: 12924 COLOR: CHOCO
LOOM: 0305 EST RUN TIME: 1:23:00
WEAVER:________ CLOCK PICKS:________
YARDS:________ DOFF LENGTH: 55

[redacted] [redacted]

30883623

STYLE: 12924 COLOR: CHOCO
LOOM: 0305 EST RUN TIME: 1:23:00
WEAVER:________ CLOCK PICKS:________
YARDS:________ DOFF LENGTH: 55

Figure B22. Quality Notice

HOLD

Log #

Quality Notice
Non Conforming Material

Date 4-17-06 Time 7:45

	Material I.D.	
yarn I.d.	warp I.d. 419061R-21	style
color	color New Men	color
lot #	ticket # Turn off	loom # 12-5

1. What process has been stopped? Weaving

2. Who stopped the process ?

3. Description of problem. Rissen on 1 side 53 3/8 RS. 56 1/2 LS

4. Where is the material now? Sent to Leave Pick

5. Is Quality Control support needed? yes No

7.What temporary corrective action will be taken?

8. Who is responsible for corrective action? 1 2

9. Non Conformance form required ? Yes No

10. Vendor problem Form required? Yes No

Final Disposition

- Rework
- Waste
- Regrade
- Return to Vendor
- Seconds
- Use as is
- Other

Authorized by:

Disposition Completed By:

Date

Check Appropriate

cc: Quality Control — Original
- Copy with each material location
- Bin Stock
- Warehouse
- Dye House
- Yarn Prep
- Weaving
- Planning
- Purchasing
- Other

Figure B23. Inspection Report

WEAVE ROOM

O.T.E.T.

Date: 05/15/06

1- [redacted] [redacted] 14
2- [redacted] 0
3- [redacted] 99
Unknown 0
TOTAL 113

Repeat Looms: 11-09

Date	Loom #	Style	Style #	Color	Ticket #	W#	1	W#	2	W#	3	UNK	Reason For Second
05/11/06	11-09	Montel	6872	Blush	30805097					31	59		Mspx
05/11/06	11-09	Montel	6872	Blush	30854426	48	14						Bf
05/11/06	11-09	Montel	6872	Blush	30854434					31	12		Bf
05/11/06	11-09	Montel	6872	Blush	30854418					31	28		Bf
				Totals			14		0		99	0	113

[redacted]

Figure B24. High Stop Loom Report

Barco Sycotex Reports: Filling and Warp Stops Report

Printed At: 6/15/2006 6:04:05 AM

Selection: Default **From:** 6/14/2006 11:00:00 PM **To:** 6/15/2006 7:00:00 AM

Machine	CMPX	# Fill	Fill CMPx	Fill Time	# Warp	Warp CMPX	Warp Time
0103	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0104	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0105	1.05	7	6.65	0:03:47	3	2.85	0:01:07
0106	1.52	69	45.42	0:18:23	9	5.92	0:17:01
0203	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0204	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0205	1.72	16	9.30	0:16:50	7	4.07	0:10:59
0206	1.75	9	5.14	0:04:55	3	1.71	0:06:48
0208	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0209	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0210	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0211	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0212	1.13	33	29.23	0:32:15	1	0.89	0:00:10
0303	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0304	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0305	0.81	18	22.30	0:16:04	0	0.00	0:00:00
0306	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0308	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0309	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0310	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0311	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0312	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0403	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0404	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0405	1.39	33	23.79	0:15:55	25	18.02	0:40:26
0406	1.61	21	13.08	0:13:17	2	1.25	0:04:25
0408	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0409	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0410	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0411	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0412	0.83	80	96.50	2:45:50	2	2.41	0:05:37
0500	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0501	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0502	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0503	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0504	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0505	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0506	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0508	1.49	15	10.08	0:12:42	17	11.42	0:30:14
0509	1.60	11	6.88	0:16:20	3	1.87	0:12:04
0510	1.74	7	4.03	0:11:56	1	0.58	0:00:35
0511	1.67	10	5.98	0:05:52	1	0.60	0:10:24
0512	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0600	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0601	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0602	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0603	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0604	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0605	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0606	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0608	1.56	4	2.56	0:03:22	5	3.20	0:15:43
0609	1.36	44	32.28	0:44:48	6	4.40	0:18:32
0610	1.38	7	5.09	0:14:28	5	3.64	0:09:46
0611	1.71	8	4.68	0:03:59	2	1.17	0:02:03
0612	1.50	23	15.31	0:18:10	2	1.33	0:06:44
0700	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0701	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0702	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0703	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0704	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0705	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0706	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0708	1.05	21	20.02	0:49:24	39	37.18	0:57:19
0709	1.00	0	0.00	0:00:00	4	4.02	0:03:25
0710	1.49	19	12.75	0:39:49	0	0.00	0:00:00
0711	1.64	3	1.83	0:05:19	3	1.83	0:25:41
0712	1.62	12	7.39	0:15:01	2	1.23	0:05:58
0800	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0801	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0802	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0803	0.00	0	0.00	0:00:00	0	0.00	0:00:00
0804	0.00	0	0.00	0:00:00	0	0.00	0:00:00

BARCO

Figure B25. Quality Control Stop Ticket

Do It Right The First Time

QUALITY CONTROL ORDER

STOP LOOM

DATE 6-12-06 GRADE 2nd

TIME 10:30 PM BY VM

LOOM NO 11-9 STYLE 6738

SET NO. ______ CUT NO. ______

DEFECTS First 3 yds see with light on

SHIFT 1 ______

SHIFT (2) Bad Filling

SHIFT (3) ______

CORRECTIVE ACTION [illegible]

BY ______

QUALITY CHECK BY

SHIFT	WEAVER	FIXER	O'SEER
1			
2			
3			

Comments: See Back CW-135-P

Figure B26. Regular Report 1

Daily Reports						
[redacted] Daily Status		5/14	5/21	5/28	6/4	6/11
Subject:	[redacted] Daily Status					
E-Mail To:	[redacted]					

Weekly Reports						
[redacted] Weekly Labor Trend		5/14	5/21	5/28	6/4	6/11
Subject:	[redacted] Weekly Labor Trend Report					
E-Mail To:	[redacted]					
Barco Reports		5/14	5/21	5/28	6/4	6/11
Subject:	Mach Hours by Machine Type 1 Week Time Frame					
	Downtime Losses 1 Week Time Frame					
	Efficiency Report 1 Week Time Frame					
	Warpout Downtime Min Weekly (Summary by Shift)1 Week Time Frame					
	Downtime Losses All Weeks to date (except 1st Week on list)					
	Percent By Product Type					
	Warpout Downtime Minutes (Weekly Trend) All Weeks to date (except 1st Week on list)					
Hard Copy To:	[redacted]					
Hacoba, Warping & Slashing Productivity (H drive)		5/14	5/21	5/28	6/4	6/11
Subject:	Hacoba, Warping & Slashing Productivity Reports for W/E					
E-Mail To:	[redacted]					
[redacted] Weekly Production Report - Monday (Telephone)		5/14	5/21	5/28	6/4	6/11
Subject:	Weekly Production Report for W/E					
E-Mail To:	[redacted]					
[redacted] Report		5/14	5/21	5/28	6/4	6/11
Subject:	La-Z-Boy Weekly Textures for Week Ending					
E-Mail To:	[redacted]					
OTET		5/14	5/21	5/28	6/4	6/11
Subject:	OTET Report for W/E					
E-mail To:	[redacted]					

Figure B27. Regular Report 2

[redacted] abor Cost & Manning Report		5/14	5/21	5/28	6/4	6/11
Subject:	[redacted] abor Cost & Manning Report for Week Ending					
E-mail To:	[redacted]					

Seconds, PPI & Waste Report		5/14	5/21	5/28	6/4	6/11
Subject:	Seconds, PPI & Waste Report for W/E					
E-mail To:	[redacted]					
Hard Copy To:						

Weekly Weavers Efficiency Report [redacted] ***NOT READY***		5/14	5/21	5/28	6/4	6/11
Subject:	Daily Weavers Report Culmination					
Hard Copy to:	[redacted]					

Manning Table [redacted]		5/14	5/21	5/28	6/4	6/11
Subject:	Senority listing by job title & shift					
Hard Copy to:	[redacted]					

Manning Table Extrusion		5/14	5/21	5/28	6/4	6/11
Subject:	Senority listing by job title & shift					
Hard Copy to:	[redacted], [redacted]					

Progression Report		5/14	5/21	5/28	6/4	6/11
Subject:						
Hard Copy to:						

Figure B28. Regular Report 3

weekly charts		5/14	5/21	5/28	6/4	6/11
Subject:	Weave room performance charts					
Hard Copy to:	post in plant [redacted]					

[redacted] WEEKLY PERFORMANCE CHARTS		5/14	5/21	5/28	6/4	6/11
Subject:	Plant performance charts					
Hard Copy to:	[redacted]					

[redacted] WEEKLY SHIFT EFFICIENCY		5/14	5/21	5/28	6/4	6/11
Hard Copy to:	[redacted]					

[redacted] WEEKLY TOP PERFORMING WEAVERS		5/14	5/21	5/28	6/4	6/11
Subject:	Top weavers by set					
Hard Copy to:	[redacted]					

Figure B29. Weekly Production Report

Actual # Days Oper	Week Ending	Tick Ship Yards	Tick Book Yards	Tick Backlog	Uph Prod Yards	Uph Ship Yards	Uph Book Yards	Uph Backlog	Mill Seconds	Down Grades	Total Seconds	% Off Quality	Uph Fin Yards	Avg Looms Oper	Plant Eff
6	5/8/05	6,830	43,060	129,834	434,425	438,678	384,093	2,822,417	2,319	4,837	11,514	3.78%	304,651		
6	5/15/05	12,895	15,100	123,406	465,464	471,239	372,885	2,688,610	2,961	9,972	18,663	4.87%	383,032		
6	5/22/05	14,838	40,150	144,971	444,697	454,161	326,265	2,610,038	2,119	11,693	19,985	4.86%	411,466		
5	5/29/05	4,558	35,000	171,112	365,813	361,255	788,090	2,480,404	3,709	12,804	20,630	5.53%	373,175		
5	6/5/05	5,769	700	23,073	374,215	374,773	405,325	2,497,064	3,678	9,054	19,503	5.90%	330,839		
5	6/12/05	5,060	2,500	16,102	364,637	363,991	304,942	2,391,142	1,922	6,771	12,463	3.81%	327,146		
5	6/19/05	2,340	550	9,710	367,135	361,474	425,460	2,427,788	1,947	7,782	14,614	4.33%	337,280		
5	6/26/05	2,142	940	7,604	370,580	369,184	302,482	2,345,254	3,775	9,531	19,661	5.42%	362,954		
5	7/3/05	2,735	1,000	4,351	398,130	398,730	237,195	2,127,706	4,208	9,958	21,413	5.68%	376,693		
0	7/10/05	0	0	0	0	0	0	0	0	0	0	0.00%	0		
5	7/17/05	2,865	0	0	365,856	366,252	283,000	2,123,380	3,150	4,030	12,387	3.88%	319,502		
6P	7/24/05	0	0	0	401,217	401,467	264,530	1,976,476	3,020	4,376	10,704	3.19%	335,981	125	
5P	7/31/05	0	0	0	313,582	313,971	270,640	1,936,811	3,217	10,405	13,622	4.46%	305,179	96.7	53
7P	8/7/05	0	0	0	294,706	295,006	353,719	1,975,150	1,634	4,260	5,894	1.95%	301,667	103.4	53.4
7P	8/14/05	0	0	0	299,151	299,794	231,114	1,899,632	1,295	5,602	6,897	2.48%	278,146	99.9	57.6
7P	8/21/05	0	0	0	338,975	339,839	187,520	1,759,792	2,747	6,866	9,613	3.81%	252,140	111.6	57.8
7P	8/28/05	0	0	0	368,905	369,143	244,369	1,587,882	1,677	5,840	7,517	2.34%	320,679	110.9	59
6	9/4/05	0	0	0	343,307	343,790	282,928	1,554,994	1,671	4,941	6,612	2.13%	310,753	136.2	56.8
5	9/11/05	0	0	0	305,199	305,501	256,828	1,542,104	4,288	2,263	6,551	2.63%	248,819	139.2	55.6
5	9/18/05	0	0	0	307,787	308,157	370,965	1,609,454	3,487	8,183	11,670	4.53%	257,563	143	52.1
5	9/25/05	0	0	0	287,798	317,134	347,463	1,686,726	3,629	3,573	7,202	2.49%	288,809	122.3	54.5
6	10/2/05	0	0	0	331,939	332,373	326,735	1,703,673	3,959	6,542	10,501	3.36%	312,119	125.5	52.8
6	10/9/05	0	0	0	367,354	367,528	254,550	1,574,581	4,644	10,857	15,501	4.44%	349,169	135.5	54.6
6	10/16/05	0	0	0	334,201	334,748	251,323	1,518,251	4,166	6,950	11,116	3.26%	340,670	122.5	55.5
6	10/23/05	0	0	0	346,399	346,789	368,610	1,573,860	5,345	10,979	16,324	4.32%	377,736	124.7	51.9
5	10/30/05	0	0	0	307,360	306,204	237,330	1,527,378	4,119	12,912	17,031	5.44%	312,793	128.8	57.4
6	11/6/05	0	0	0	346,697	350,294	248,595	1,448,874	3,369	6,293	9,662	3.78%	255,447	132	57.4
6	11/13/05	0	0	0	339,473	342,561	307,730	1,355,229	3,937	7,531	11,468	4.29%	267,110	112	58.3
6	11/20/05	0	0	0	293,613	302,614	330,805	1,434,711	1,497	5,084	6,581	2.57%	256,372	98.5	56.7
3	11/27/05	0	0	0	155,373	154,837	211,150	1,468,788	3,214	3,406	6,620	3.57%	185,282	117.3	59.5
6	12/4/05	0	0	0	308,023	278,480	377,927	1,515,997	3,680	8,829	12,509	3.94%	317,859	118.7	62.9
6	12/11/05	0	0	0	353,529	355,978	272,730	1,474,421	2,699	16,605	19,304	5.99%	322,335	123.3	59.6
6	12/18/05	0	0	0	330,197	340,264	278,440	1,449,701	4,312	10,914	15,226	5.54%	274,942	111.8	60.8
4	12/25/05	0	0	0	237,591	237,712	225,360	1,473,170	3,579	24,447	28,026	10.22%	274,199	122.5	59.8
0	1/1/06	0	0	0	0	0			0	4,293	4,293	10.06%	42,680	0	0
5	1/8/06	0	0	0	311,614	310,078	361,045	1,592,237	2,461	7,864	10,325	4.27%	242,056	103	62
6	1/15/06	0	0	0	337,323	309,087	286,615	1,557,427	5,428	10,044	15,472	4.71%	328,222	114.5	63.6
6	1/22/06	0	0	0	331,896	342,608	287,805	1,527,007	4,132	7,801	11,933	4.21%	283,306	117.3	63.5
5	1/29/06	0	0	0	307,707	323,191	297,281	1,533,565	5,426	5,168	10,594	3.25%	325,892	113.8	64
5	2/5/06	0	0	0	307,464	307,703	284,417	1,536,254	2,618	1,287	3,905	1.41%	277,226	105.6	64.1
5	2/12/06	0	0	0	266,339	266,803	246,451	1,487,764	1,302	12,084	13,386	4.43%	301,863	111.8	61.8
5	2/19/06	0	0	0	286,134	285,538	208,978	1,401,677	4,898	7,093	11,991	4.19%	286,289	114.2	65
5	2/26/06	0	0	0	305,194	305,604	248,960	1,378,743	4,457	4,965	9,422	3.65%	257,849	118	67.3
4	3/5/06	0	0	0	230,827	231,394	219,085	1,357,444	4,392	6,096	10,488	4.24%	247 395	112.8	68.1
5	3/12/06	0	0	0	246,084	246 444	213,836	1,318,806	2,461	4,644	7,105	3.14%	226,402	94.4	67.6
5	3/19/06	0	0	0	210,115	210,377	177,840	1,301,432	332	2,455	2,787	1.53%	182,158	88	66.3
5	3/26/06	0	0	0	231,468	232,267	234,170	1,268,490	4,455	4,050	8,505	3.51%	242,221	87	65.8
5	4/2/06	0	0	0	241,404	241,560	228,840	1,239,753	2,892	3,522	6,414	2.88%	222,479	80.8	67.5
5	4/9/06	0	0	0	233,952	234,123	354,480	1,385,735	2,985	3,954	6,939	3.50%	198,411	80	68.3
4	4/16/06	0	0	0	187,494	184,273	138,940	1,311,290	2,227	2,151	4,378	2.89%	151,230	77.8	65
5	4/23/06	0	0	0	247,741	236,853	159,200	1,190,826	405	2,526	2,931	1.74%	168,933	83	68.2
4	4/30/06	0	0	0	210,953	203,827	224,445	1,231,668	2,317	3,025	5,342	2.23%	239,491	83	67.2
	TOTALS		139,000	630,163	15,757,038	15,775,651	14,503,686	85,181,576	158,161	367,112	583,194	3.70%	14,496,810	108.4463415	

Figure B30. Plant Efficiency Report

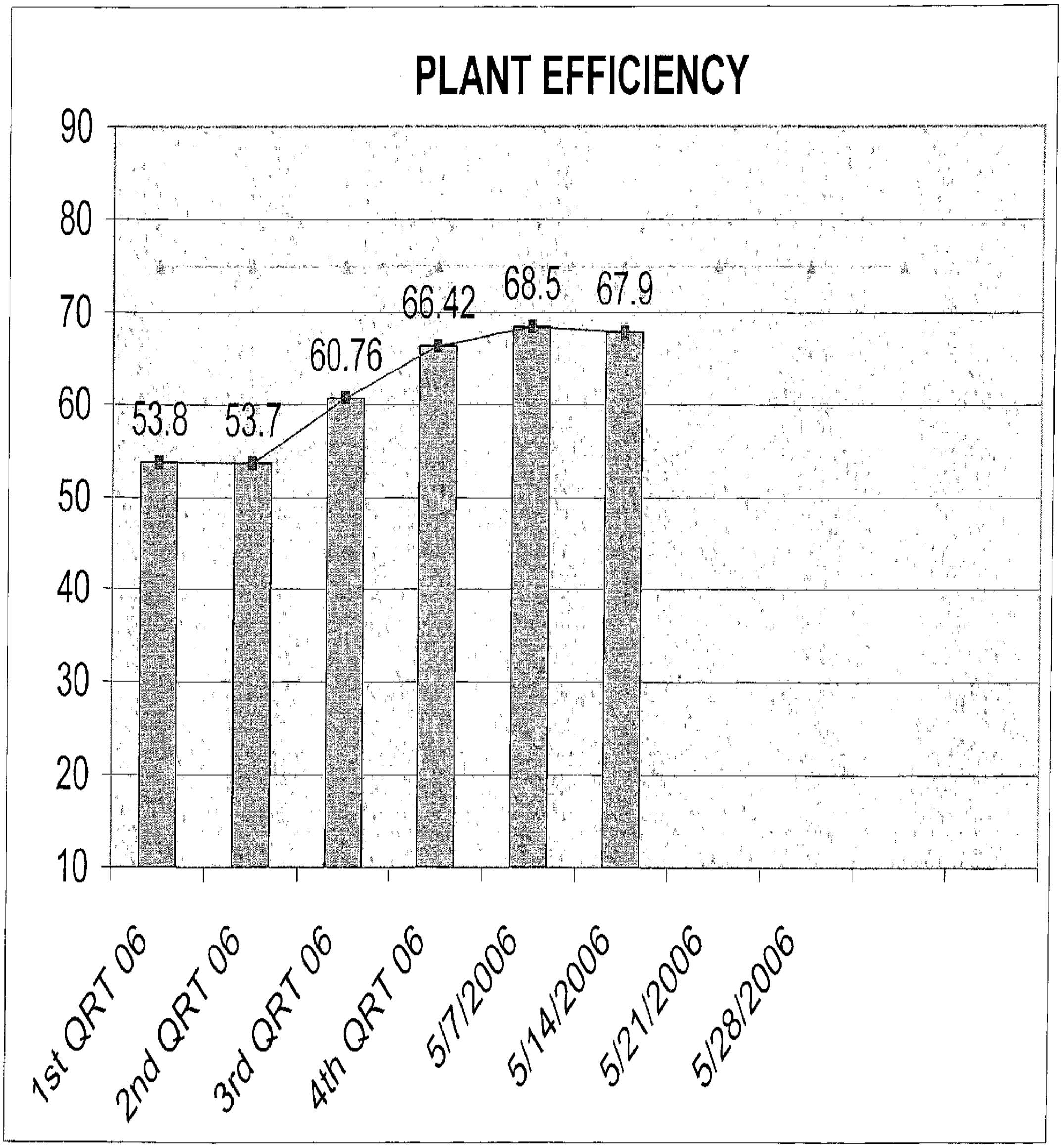


Figure B31. Air Jet Technician Sheet 1

JOB AIR JET TECHNICIAN

TRAINEE ____________________

DATE TRAINING STARTED ______

DATE TRAINING COMPLETED ______

DID TRAINEE COMPLETE? ______

EXERCISE COMPLETION CHART

The following exercises have been completed. Understanding and skill were demonstrated by the trainee.

Job Part	Date	Instructor Signature	Trainee Signature	Comments
SETTING AIR - CONTROL PRESSURE ADJUSTMENT				
ADJUSTMENT OF MAIN NOZZLE				
ADJUSTMENT OF RELAY NOZZLE				
FEEDERS				
ADJUSTMENT OF SHED MOTION				
ADJUSTMENT OF BACK REST ROLLER				
ADJUSTMENT OF WARP STOP MOTION				
DORNIER DOTRONIC WARP LET OFF MOTION				
TAKE UP MOTION				
DISCO LENO				
SINGLE - DISK CLUTCH BRAKE COMBINATION				
WEFT SCISSORS				

Figure B32. Air Jet Technician Sheet 2

JOB AIR JET TECHNICIAN

TRAINEE ______________

DATE TRAINING STARTED ______

DATE TRAINING COMPLETED ______

DID TRAINEE COMPLETE? ______

EXERCISE COMPLETION CHART

The following exercises have been completed. Understanding and skill were demonstrated by the trainee.

Job Part	Date	Instructor Signature	Trainee Signature	Comments
AFR - ADJUSTMENT - AUTO FILLING REPAIR				
ELECTRONIC WEFT STOP MOTION				
TEMPLE SCISSORS				
DORNIER RAPID CROSS LENO DEVICE				
AUXILIARY SELVAGE, CLOTH WIND UP				
ALLOCATION OF WEFT - INSERTION ANGLE				
PROGRAMMING OF WEFT INSERTION				
REGULATION				
VALVE MEASUREMENTS				
WEAVING - REED SUPPORT				
DORNIER PROFILE REED				
TIE HARNESS TO HEDDLE EYE				

Figure B33. Air Jet Technician Sheet 3

JOB AIR JET TECHNICIAN

TRAINEE ____________

DATE TRAINING STARTED ______

DATE TRAINING COMPLETED ______

DID TRAINEE COMPLETE? ______

EXERCISE COMPLETION CHART

The following exercises have been completed. Understanding and skill were demonstrated by the trainee.

Job Part	Date	Instructor Signature	Trainee Signature	Comments
COUNTING CUMBERBOARD				
COUNTING MODULES AND HOOKS				
MODULE COMPOSITION				
MODULE FUNCTION				
REMOVING AND FITTING MODULE				
MODULE TROUBLE SHOOTING				
MAINTENANCE				
HOW TO PROGRAM JC4 TO CHANGE MODULE				
SYNCHRONIZING LOOM AND JACQUARD MACHINE				
COMMUNICATE WITH OTHER SHIFTS				
DIAGNOSE & REPAIR MACHINES				
MAJOR MAINTENANCE FOR BROKEN OR WORN PARTS				

Figure B34. Air Jet Technician Sheet 4

JOB AIR JET TECHNICIAN

TRAINEE ____________

DATE TRAINING STARTED ______

DATE TRAINING COMPLETED ______

DID TRAINEE COMPLETE? ______

EXERCISE COMPLETION CHART

The following exercises have been completed. Understanding and skill were demonstrated by the trainee.

Job Part	Date	Instructor Signature	Trainee Signature	Comments
SETTINGS OR ADJUSTMENTS TO MACHINE, COMPUTER, ETC..				
MAINTAIN CREEL STANDS AND FILLING ACCUMULATORS				
PREVENTIVE MAINTENANCE				
IDENTIFY HIGH STOP LOOMS AND CORRECT CAUSES				
MAKE STYLE CHANGES AS REQUIRED				
APPROVES STYLES BY SWATCHES				
CLEANS REEDS WEEKLY				
WEAVER RESPONSIBILITIES IN THEIR ABSENCE				

9.3 Appendix C: Attachments of Case_3

Figure C1. OTOM Report

USER ID: DWINT

On Time Order Management System
PURCHASING ACTIONS
FOR REQUIRED ACTIONS

7/11/06
8:42:04

.ue: 7/11/06
TIME: 4:15:44 REPORT NAME:

.ility: 01	LOWER ITEM	LOWER PLANNER 1	LOWER VENDOR	LOWER ORDER CLASS	LOWER ORDER TYPE	LOWER ORDER PRIORITY	NEW ORDERS ONLY
	UPPER ITEM 999999999999999	UPPER PLANNER 1	UPPER VENDOR	UPPER ORDER CLASS	UPPER ORDER TYPE	UPPER ORDER PRIORITY	PROTECT ORDERS Y

SEQUENCE: VENDOR / /

ITEM NUMBER	DESCRIPTION	ORD QTY	L/T	SUPPLY ORDER #	SUPPLY QUANTITY	DUE DATE	DATE RQD	060715	060722	060729	060805	060812	060819	060826	060902
VENDOR	KENNETEX INC														
402920	POLY 2800 DEN SPCD C	750.00	28	060711001	20	7/11/06	7/11/06	20							
							# OF ITEMS:	1	0	0	0	0	0	0	0

Figure C2. Warp Report

SFCB920 WSID SFCB92 PRODUCTION - INTERNATIONAL, LTD 7/11/06 Page 2
User DWINT Warp Planning Report 9:02:47

Item: 401230 08448 POLY 150/34 SLASD 166060 Yards per Beam: 2800
Beam Type: LB270

Wk Of:	7/09/06 # Bms	Bm Yards	7/16/06 # Bms	Bm Yards	7/23/06 # Bms	Bm Yards	7/30/06 # Bms	Bm Yards	8/06/06 # Bms	Bm Yards	Date Due	Bm Yds
Demands	5	997	4	331								
Inventory	3	7,787										
Net Total	2-	6,790	6-	6,459	6-	6,459	6-	6,459	6-	6,459		

Item: 401232 08448 POLY 150/34 SLASD 262230 Yards per Beam: 2800
Beam Type: LB270

Wk Of:	7/09/06 # Bms	Bm Yards	7/16/06 # Bms	Bm Yards	7/23/06 # Bms	Bm Yards	7/30/06 # Bms	Bm Yards	8/06/06 # Bms	Bm Yards	Date Due	Bm Yds
Demands					3	398						
Inventory	1	2,053										
Net Total	1	2,053	1	2,053	2-	1,655	2-	1,655	2-	1,655		

Item: 401233 08448 POLY 150/34 SLASD 262260 Yards per Beam: 2800
Beam Type: LB270

Wk Of:	7/09/06 # Bms	Bm Yards	7/16/06 # Bms	Bm Yards	7/23/06 # Bms	Bm Yards	7/30/06 # Bms	Bm Yards	8/06/06 # Bms	Bm Yards	Date Due	Bm Yds
Demands			1	732								
Inventory	2	2,233										
Net Total	2	2,233	1	1,501	1	1,501	1	1,501	1	1,501		

Item: 401234 08448 POLY 150/34 SLASD 262270 Yards per Beam: 2800
Beam Type: LB290

Wk Of:	7/09/06 # Bms	Bm Yards	7/16/06 # Bms	Bm Yards	7/23/06 # Bms	Bm Yards	7/30/06 # Bms	Bm Yards	8/06/06 # Bms	Bm Yards	Date Due	Bm Yds
Inventory	1	725										
Net Total	1	725	1	725	1	725	1	725	1	725		

Item: 401234 08448 POLY 150/34 SLASD 262270 Yards per Beam: 8000
Beam Type: Unassign

Wk Of:	7/09/06 # Bms	Bm Yards	7/16/06 # Bms	Bm Yards	7/23/06 # Bms	Bm Yards	7/30/06 # Bms	Bm Yards	8/06/06 # Bms	Bm Yards	Date Due	Bm Yds
806417											07/13/06	266

Item: 401235 08448 POLY 150/34 SLASD 262290 Yards per Beam: 2800
Beam Type: LB270

Wk Of:	7/09/06 # Bms	Bm Yards	7/16/06 # Bms	Bm Yards	7/23/06 # Bms	Bm Yards	7/30/06 # Bms	Bm Yards	8/06/06 # Bms	Bm Yards	Date Due	Bm Yds
Inventory	1	975										
Net Total	1	975	1	975	1	975	1	975	1	975		

Figure C3. Yarn Vendor Report

Item Nbr	Lot Nbr	Net Wgt	C(	Plant Id		LINE #	Cust Po Nbr	Type Loc
401542	46458	254		00	SHIP		103260	M
401839	45481	301		00	SHIP		102558	M
401945	46910	230		00	SHIP	1	103788	M
401945	46910	366		00	SHIP	1	103788	M
401945	46910	367		00	SHIP	1	103788	M
401951	46021	361		00	SHIP	2	103788	M
401951	46021	361		00	SHIP	2	103788	M
401964	46970	224		00	SHIP	3	103788	M
401964	46970	364		00	SHIP	3	103788	M
402182	45045	312		00	SHIP		102287	M
402823	46359	314		00	SHIP	4	103788	M
402852	46360	319		00	SHIP	5	103788	M
405816	44666	291		00	SHIP		102011	M
405938	46764	261		00	SHIP		103506	M

Figure C4. OTOM Report for yarn 402920

USER ID: DWINT

On Time Order Management System
PURCHASING ACTIONS
FOR REQUIRED ACTIONS

7/11/06 PAGE 12
8:42:04

.ATE: 7/11/06
TIME: 4:15:44 REPORT NAME:

.ility: 01	LOWER ITEM	LOWER PLANNER 1	LOWER VENDOR	LOWER ORDER CLASS	LOWER ORDER TYPE	LOWER ORDER PRIORITY	NEW ORDERS ONLY
	UPPER ITEM 999999999999999	UPPER PLANNER 1	UPPER VENDOR	UPPER ORDER CLASS	UPPER ORDER TYPE	UPPER ORDER PRIORITY	PROTECT ORDERS Y

SEQUENCE: VENDOR / /

ITEM NUMBER	DESCRIPTION	ORD QTY	L/T	SUPPLY ORDER #	SUPPLY QUANTITY	DUE DATE	DATE RQD	060715	060722	060729	060805	060812	060819	060826	060902	060909	060916
VENDOR	KENNETEX INC																
402920	POLY 2800 DEN SPCD C	750.00	28	060711001	20	7/11/06	7/11/06	20									
							# OF ITEMS:	1	0	0	0	0	0	0	0	0	0

Figure C5. Screen shot to check Material Status

```
;SAH00                PRODUCTION - [redacted] INTERNATIONAL, LTD      SBM27B        7/11/06
;1022563                          Purchasing                          DWINT        11:30:59

Requisitions                                    Inquiries
..Requisition Maintenance      (PUR600)         14.Purchasing Inquiry              (PUR300)
!.Requisition Print            (PUR620)         15.Vendor Alpha Look-up            (PUR310)
}.PO Consolidation/Release     (PUR640)         16.Item Alpha Look-up              (INV350)
|.Requisition Release          (PUR650)         17.Warehouse Inquiry               (INV330)
;.Drop Shipment Release        (PUR660)         18.Material Status                 (INV300)
?O Creation                                     Maintenance
;.PO Release/Maint             (PUR500)         19.Vendor Maintenance              (PUR100)
/.Purchase Order Print         (PUR520)         20.Ship-to Maintenance             (PUR130)
}.Bar Code PO Print            (CIM200)         21.Vendor Quote Maintenance        (PUR150)
}.Procurement Authorization    (PUR530)         22.Vendor Notes Maintenance        (ORD140)
).Receipt                                       23.Commodity Code Maint            (PUR180)
).Inventory Transactions       (INV500)         24.Special Charge Maint            (PUR181)
l.Purchase Receipts            (PUR550)         25.Authorization Maint             (PUR170)
                                                Other Options
lose Programs                                   31.Purchasing Reports        (Menu SSAH01)
!.Month End Close              (PUR900)         32.[redacted] Purch. Rpts    (Menu SSAH02)
3.Year End Close               (PUR910)         80.Supplier Schedules        (Menu SSARSS)
Enter Option Number or Product Code: 18          90.Signoff
F1=Help  F3=Exit  F12=Main Menu  F14=Services  F21=Command Line
```

Figure C6. Material Status Inquiry –screen shot

```
INV300-02              PRODUCTION -          INTERNATIONAL, LTD      SBM27B       7/11/06
31022563                    Material Status Inquiry                   DWINT       11:36:05
Item  402920               + POLY 2800 DEN SPCD CAMP 601170 On Hand               1479.974
Fac   01 +   U/M Sales LB  U/M Purch LB  U/M Stock LB   Cust Alloc                .000
Class WY     Group T         Yield %    100.00           Mfg Alloc                564.222
Type  Y  YARN              CLASS CODE          MFG CODE  On Order                 .000
                                                          Available               915.752
                               MTD               YTD      Pickable                .000
Opening Balance           1495.061                  Lot Size Std                  750.000
Issues                        .000                  Std Batch Size                1.000
Receipts                      .000                  Daily L/T Rate
Adjustments                15.087-                  Fixed Lead Time Days          [redacted]
Sales Units                   .000             .000 Var Lead Time
Sales Amt                      .00              .00 Order Policy    I Incremental
List/Catalog                                        Horizon Days
List Price                                          Period Order Days
Std Cost                  [redacted]                MRP/MPS code      Buyer Code 1
Actual Cost               [redacted]        Vendors Vendors Item No
Discount Code                                 70585 KENNETEX INC
Pur U/M Cnv                1.00000                                    Planner Code 1
Sales U/M Cnv              1.00000
Minimum Balance           1500.000
F1=Help F2=Item Note F3=Exit F4=Prompt F12=Cancel  F19=Locations F24=More Keys
```

LT 4 weeks

Lead Time 4 weeks.

Figure C7. Purchasing Inquiry that shows Past History –screen shot

```
'UR732-02                PRODUCTION -          INTERNATIONAL, LTD     SBM27B        7/11/06
;1022563                           Purchasing Inquiry                 DWINT        11:36:31
'urch Orders
:tem 402920                POLY 2800 DEN SPCD CAMP 601170     On Hand           1479.974
3uyer  1                   U/M Stock LB  U/M Pur   LB   Cust Required
/endor 1     70585 KENNETEX INC                             Mfg Required         564.222
/endor 2                                                       On Order

?O No   Wh Vendor                                     Ordered        Received      Due
L02856 WL 70585 [redacted]TEX INC                     700.000         731.000   6/16/06
L02573 WL 70585 [redacted]TEX INC                    1000.000        1614.000   6/01/06
L02366 WL 70585 [redacted]TEX INC                     750.000         762.000   5/19/06
L02117 WL 70585 [redacted]TEX INC                     845.000         845.000   5/15/06
L01868 WL 70585 [redacted]TEX INC                     750.000         824.000   4/28/06
L01494 WL 70585 [redacted]TEX INC                     750.000         847.000   4/15/06
L01343 WL 70585 [redacted]TEX INC                     670.000         670.000   3/31/06
L01226 WL 70585 [redacted]TEX INC                     750.000         848.000   3/31/06
L00788 WL 70585 [redacted]TEX INC                    1500.000        1500.000   3/03/06
 99522 WL 70585 [redacted]TEX INC                    1000.000        1035.000  12/30/05
 98754 WL 70585 [redacted]TEX INC                     750.000         765.000  11/25/05
 97789 WL 70585 [redacted]TEX INC                     731.000         731.000  10/14/ +

F1=Help  F3=Exit  F4=Prompt  F7=Backward  F8=Forward  F11=Fold  F12=Cancel
Query running. 1 records selected, 21 processed.
```

Figure C8. Purchase Order Selection –screen shot

```
PUR500-01             PRODUCTION -        INTERNATIONAL, LTD    SBM27B        7/11/06
S1022563                   Purchase Order Selection             DWINT        11:37:06

Select action and press Enter.  1=Create  2=Revise  3=Copy  4=Delete
5=Display  6=Print  8=Position To  10=Copy and Reprice  11=Revise Lines

Act   PO No     Vendor +  Vendor                                Status

___    1114     40155     HORNWOOD                              Active
___    1464      8032     UNIVAR USA INC                        Active
___    3496      6786     PRYOR ELECTRIC & CONTROLS, INC        Active
___    3579      7151     SHERWIN-WILLIAMS                      Active
___    3586      8127     WELDOR'S SUPPLY HOUSE INC             Active
___    3741      3741     CAROLINA BELTING CO                   Active
___    6711      6711     PRECISION BEARING & MACHINE           Active
___   10025      7764     TEXTILE ARTS & FILM INC               Active
___   10038      7853     LORIS INDUSTRIES                      Active
___   10042      3123     AMERICAN DORNIER MACHINERY            Active
___   10043     33615     VAN DE WIELE GROUP                    Active
                                                                More...

F1=Help  F3=Exit  F4=Prompt  F5=Refresh  F7=Backward  F8=Forward  F12=Cancel
F13=Filters  F14=Purchase Order Inquiry  F24=More Keys
```

Figure C9. Purchase Order Header Maintenance –screen shot

```
'UR750-05           PRODUCTION - [redacted]INTERNATIONAL, LTD    SBM27B        7/11/06
:reate                Purchase Order Header Maintenance          DWINT       11:37:24

'endor Number . . : 70585 +      Vendor Name . : [redacted] INC
'O Number . . . . . 103810       Entry Date  . :  7/11/06 (MDY)
:tatus  . . . . . : 0            Revision Date .  0/00/00
:evision  . . . . .              Ship To . . . . 0 (0,1,2,3,4)  0046   +
:ompany . . . . . : 1            Name  . . . . .
3ill To . . . . . . 0066 +       Attention . . .
'acility  . . . . . 01           Address 1 . . .
Jarehouse . . . . . WL +         Address 2 . . .
3uyer . . . . . . . 1            Address 3 . . .
.ast Change Date  :  0/00/00     State . . . . .      Post              Country
:lose Date  . . . :  0/00/00     Ship Via  . . .
'rint Date/Flag . :  0/00/00 0   Ship Status . .
\ck Request Date  .  0/00/00     FOB Code  . . .
\ck Receive Date  .  0/00/00     FOB Point . . .
/endor Tax Code . .              Destination . .
:erms Code  . . . . 30 +         Comment . . . .

:ountry Code. . . .              Registr. No . .
F1=Help  F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F15=PO Notes
F16=Vendor Notes  F17=PO Inquiry  F22=Clauses
3uyer Code not found
```

Figure C10. Purchase Order Lines Maintenance –screen shot

```
?UR750-06          PRODUCTION -        . INTERNATIONAL, LTD     SBM27B        7/11/06
:reate             Purchase Order Lines Maintenance            DWINT        11:38:00

?.O. 103810 Rev    Vend 70585 [redacted]EX INC                               Lines    1
3ts 0     Ship To 0 0046   [redacted] INTERIORS  (W)           Amount        1762.50
3uyer 1 Bill To   66  Facility 01  Warehouse WL

Type information or actions, and press Enter.  3=Copy  4=Delete
L0=Special Chg  11=Notes  12=Alternates  13=History  14=Ship-To  15=Detail

Act  Line Commodity/Item  +  Due Date      Quantity        Cost/Unit +   UM
_      1 0 402920            8/11/06       750.000         [redacted]    LB
_        _ _____________     0/00/00          .000             .00000    _
_        _ _____________     0/00/00          .000             .00000    _
_        _ _____________     0/00/00          .000             .00000    _
_        _ _____________     0/00/00          .000             .00000    _
_        _ _____________     0/00/00          .000             .00000    _
_        _ _____________     0/00/00          .000             .00000    _
_        _ _____________     0/00/00          .000             .00000    _
_        _ _____________     0/00/00          .000             .00000    _
                                                                 More...
F1=Help  F3=Exit  F4=Prompt  F5=Refresh  F6=Accept  F7=Backward  F8=Forward
F11=Fold  F12=Cancel  F15=PO Notes  F16=Vendor Notes  F24=More Keys
```

Figure C11. Print Purchase Orders –screen shot

```
PUR520-01          PRODUCTION -        INTERNATIONAL, LTD     SBM27B        7/11/06
S1022563                 Print Purchase Orders                DWINT        11:38:35


          Company    to Print (Blank for All)
              -or-  Facility                      01
              -or-  Lower Warehouse               WL
                    Upper Warehouse               WL
          Buyer Code (blank for all)              I
          PO Special Forms Name                   *STD
          Place POs on Hold                       0    (0=No, 1=Yes)
          PO Print OUTQ                           BPCSOUTQ
          OUTQ Library Name                       *LIBL
          Sample PO Print                         0    (0=Print, 1=Sample Print)
          Run Time Parameter                      I    (0=Interactive, 1=Batch)



   F1=Help  F3=Exit  F12=Cancel
```

Figure C12. Purchase Order

PURCHASE ORDER

PO#: 103810
Rev Page 1

Invoice To: [redacted]

[redacted]

PO BOX 616

KENNETT SQUARE PA
19348

Ship To:

[redacted]

USA

Terms NET 30 Currency USD Ship Via FOB

ATTN

Prt Date 7/11/06

Line	Quantity U/M Vendor/[redacted] Item# Due Date Whse Description	Unit Price	Amount Tax
1	750.000 LB 0 402920 8/11/06 WL POLY 2800 DEN SPCD CAMP 601170 601170 CAMPFIRE	[redacted]	[redacted] .00
	Total Tax		.00
	PURCHASE ORDER TOTAL		[redacted]

\-
FAX DELIVERY CONFIRMATION TO [redacted] WITHIN 48 HOURS OF RECEIPT OF PO
FAX BILL OF LADING AND LOAD LIST TO [redacted]
SHIP VIA TERMINAL - NOTE ITEM #49265 SUB 10 ON BILL OF LADING
INCLUDE [redacted] PO NUMBER AND ITEM NUMBERS ON ALL PAPERWORK
\-
FAX NUMBER: [redacted]

[redacted]

NOTICE: ALL PACKAGES AND INVOICES MUST SHOW PURCHASE ORDER NUMBER.
This order is valid only for the amounts entered hereon at the prices stipulated.
No Deviations permitted from specifications and conditions stated on both sides.

AUTHORIZED BY: [redacted]

Figure C13. Run Out Report

Runout Report

Date 7/10/06 Shift 1st

Section I

Warp Outs

210 M T

X.708 - 32h
X. 739. 15h.
X 724 - 33h.
X 722. 16h
X 721 - 3h
X 738 64h.

Warp Outs For Next 24 Hours

734 718
726
205 [redacted]

Breakouts

No Warps

Draws

Warp Out Completed/ In Process

709 c

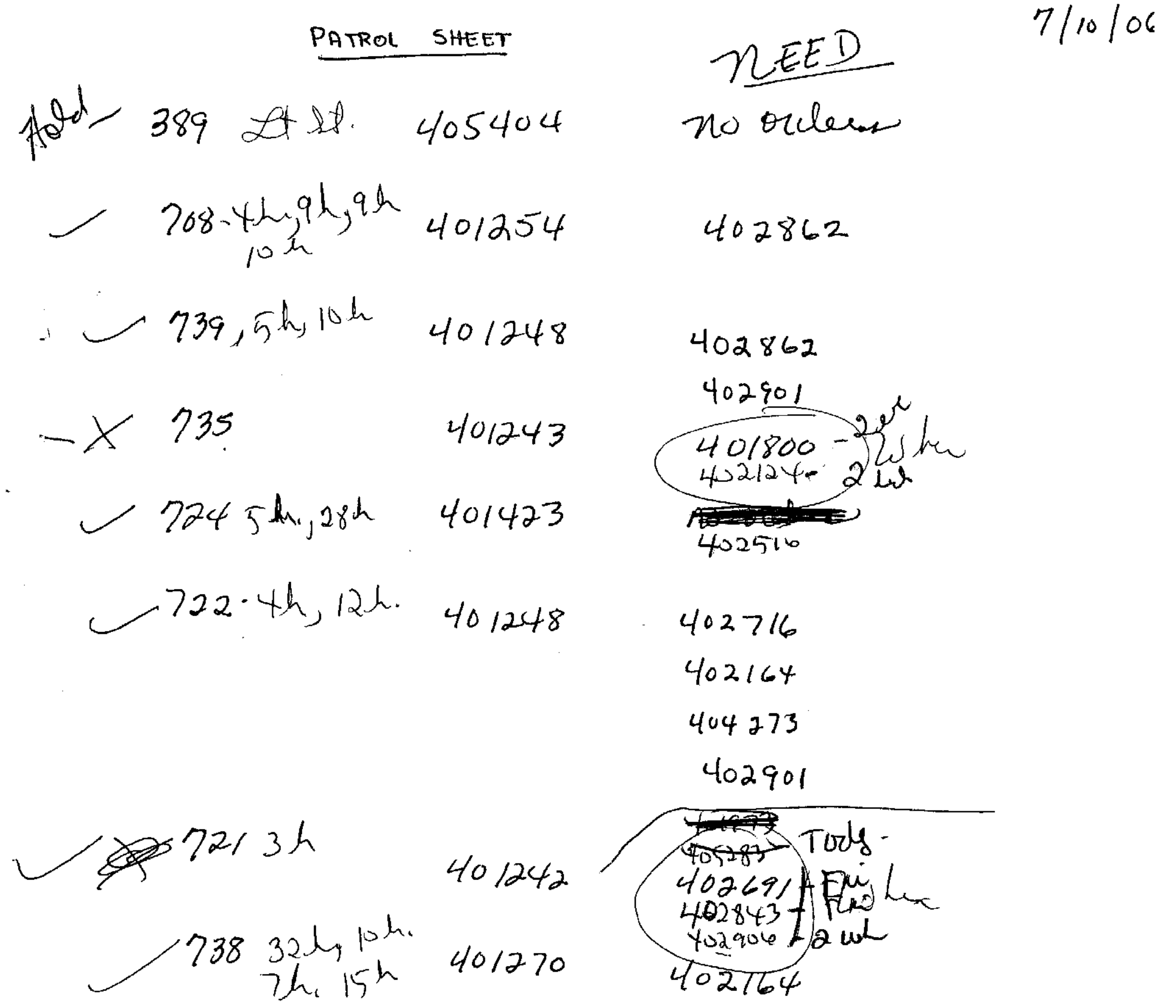
No Filling

Run : 224-211-210-207-205-209-674-668-667

Misc. Notes

No plans: 389-120-708-739-735-724-722-721-[redacted]-738

Figure C14. Warp Patrol Sheet



PATROL SHEET

7/10/06

NEED

Add 389 ... 405404 — no orders

✓ 708-4h, 9h, 9h, 10h 401254 — 402862

✓ 739, 5h, 10h 401248 — 402862, 402901

X 735 401243 — 401800, 402124 — 2 wk

✓ 724 5h, 28h 401423 — [illegible], 402516

✓ 722-4h, 12h. 401248 — 402716, 402164, 404273, 402901

✓ 721 3h 401242 — [illegible], 405283 Today, 402691 Fri, 402843 Tue, 402906 2 wk

✓ 738 32h, 10h, 7h, 15h 401270 — 402164

Figure C15. Loom Report

05/23/06 06:49:11

Production Loom Schedule Printout

PAGE 1

Schd Mach	Weave Item	Item Description	S/O #	S/O Qty	S/O Left	Warp Item	Proc Hrs	End Date	E N	Last Rprtd	Assigned Warp#	Short Comment	MRP Rschd	Orig Due
L119	930537	[redacted] P-SALOON 054 PETAL	685249	55	55	405520	2.55	05/23	E	00/00		20060406	99/99	04/06
	714526	[redacted] P-CABIN 057 CHICKORY	695917	55	55	405520	2.97	05/23	N	00/00		20060522	99/99	05/22
	929706	[redacted] P-CABIN 054 CHICKORY	694197	550	550	405520	29.78	05/24	N	00/00		20060518	99/99	05/18
	929706	[redacted] P-CABIN 054 CHICKORY	694834	1320	1320	405520	71.43	05/30	E	00/00		20060519	99/99	05/19
						TOTAL	106.73							
L205	930534	[redacted] ON CUE 054 BURGUNDY	694825	825	605	405713	34.93	05/24	E	05/23		20060522	99/99	05/22
	929988	[redacted] PITKIN 054 BORDEAUX	685025	1485	1153	405713	33.25	05/26	E	05/19		20060407	99/99	04/07
	930534	[redacted] ON CUE 054 BURGUNDY	694824	220	220	405713	12.69	05/26	E	00/00		20060519	99/99	05/19
	929835	[redacted] MACMILLAN 054 HAZELNUT	685006	1320	1320	405521	45.69	06/01	N	00/00		20060406	99/99	04/06
	929988	[redacted] PITKIN 054 BORDEAUX	685021	990	990	405713	28.55	06/07	N	00/00		20060407	99/99	04/07
	929835	[redacted] MACMILLAN 054 HAZELNUT	687206	1650	1650	405521	57.11	06/13	N	00/00		20060419	99/99	04/19
	929835	[redacted] MACMILLAN 054 HAZELNUT	692274	495	495	405521	17.13	06/14	N	00/00		20060511	99/99	05/11
	929835	[redacted] MACMILLAN 054 HAZELNUT	678061	378	378	405521	13.06	06/14	E	00/00		20060303	99/99	03/03
	929835	[redacted] MACMILLAN 054 HAZELNUT	678061	997	997	405521	34.52	06/16	E	00/00		20060303	99/99	03/03
	929835	[redacted] MACMILLAN 054 HAZELNUT	686054	220	220	405521	7.62	06/16	N	00/00		20060411	99/99	04/11
	929835	[redacted] MACMILLAN 054 HAZELNUT	682925	660	660	405521	22.85	06/19	N	00/00		20060328	99/99	03/28
	929835	[redacted] MACMILLAN 054 HAZELNUT	692273	55	55	405521	1.90	06/19	N	00/00		20060510	99/99	05/10
	929835	[redacted] MACMILLAN 054 HAZELNUT	692272	590	590	405521	20.42	06/20	N	00/00		20060511	99/99	05/11
	929835	[redacted] MACMILLAN 054 HAZELNUT	692272	125	125	405521	4.33	06/20	N	00/00		20060511	99/99	05/11
	929835	[redacted] MACMILLAN 054 HAZELNUT	694836	1650	1650	405521	57.11	06/22	N	00/00		20060522	99/99	05/22
	929835	[redacted] MACMILLAN 054 HAZELNUT	694837	550	550	405521	19.04	06/23	N	00/00		20060522	99/99	05/22
	929735	[redacted] PITKIN 054 LINEN	692333	660	660	405554	19.04	06/26	N	00/00		20060511	99/99	05/11
	929735	[redacted] PITKIN 054 LINEN	694826	1100	1100	405554	31.73	06/28	N	00/00		20060522	99/99	05/22
	930330	[redacted] PITKIN 054 COIN	692332	110	110	405554	3.17	06/28	N	00/00		20060510	99/99	05/10
	929990	[redacted] ON CUE 054 BARLEY	694827	55	55	405554	3.17	06/28	N	00/00		20060519	99/99	05/19
	929990	[redacted] ON CUE 054 BARLEY	694828	55	55	405554	3.17	06/28	N	00/00		20060519	99/99	05/19
						TOTAL	470.48							
L206	929739	[redacted] CLUBHOUSE 054 DESERT	687204	963	563	405567	9.52	05/23	E	05/22	C57012306	20060419	99/99	04/19
	929739	[redacted] CLUBHOUSE 054 DESERT	687204	742	433	405567	27.83	05/24	E	05/22		20060419	99/99	04/19
	929739	[redacted] CLUBHOUSE 054 DESERT	692294	275	275	405567	10.31	05/24	N	00/00		20060510	99/99	05/10
	929548	[redacted] HONDURAS 054 SLATE	690507	495	18	405462	.62	05/30	E	04/29			99/99	05/04
	929739	[redacted] CLUBHOUSE 054 DESERT	692293	110	110	405567	4.12	06/05	N	00/00		20060510	99/99	05/10
						TOTAL	52.40							
L207	929107	[redacted] LAKELURE 054 NAVY	691114	2200	304	405348	20.18	05/23	E	05/22		87474	99/99	05/08
	929357	[redacted] FLOWER PLA 054 NAVY	694829	265	265	405348	12.23	05/24	E	00/00		20060519	99/99	05/19
	929357	[redacted] FLOWER PLA 054 NAVY	694830	165	165	405348	7.61	05/24	E	00/00		20060519	99/99	05/19
	929358	[redacted] FLOWER PLA 054 SKY	695924	165	165	405338	7.61	05/31	N	00/00		20060523	99/99	05/23
	929357	[redacted] FLOWER PLA 054 NAVY	694831	385	385	405348	17.77	06/08	N	00/00		20060522	99/99	05/22
	929107	[redacted] LAKELURE 054 NAVY	694832	1100	1100	405348	72.99	06/13	N	00/00		20060522	99/99	05/22
						TOTAL	138.39							

05/23/06

Figure C16. Planned Orders Report

07/11/06 12:56:25 Planned orders to release PAGE 4

Sorted by Warp

Warp Item #	Weave Item #	Quantity	Planned Release Date	Planner Code
401253	711131	2460	6/07/26	L
	712042	60	6/07/26	L
	712701	60	6/07/26	L
401254	→ 703261	60	6/07/27	L
	707564	60	6/07/31	L
	708456	60	6/07/26	L
	710105	60	6/07/26	L
	710975	60	6/08/01	L
	711713	60	6/07/26	L
	711717	60	6/07/26	L
401258	→ 709306 x	60	6/08/03	L
	709314 m	60	6/08/03	L
	711020 m	60	6/08/03	L
	711719 m	120	6/07/26	L
401262	703457	60	6/08/03	L
	704678	60	6/08/04	L
	708153	240	6/07/28	L
401263	703085	60	6/08/07	L
	703324	60	6/07/26	L
	703793	60	6/07/26	L
	704284	60	6/07/28	L
	705087	120	6/07/26	L
	705140	240	6/08/07	L
	706335	60	6/08/02	L
	707315	60	6/08/03	L
	707494	60	6/07/28	L
	709285	60	6/08/03	L
	711718	120	6/07/26	L
	712712	60	6/07/26	L
	712722	60	6/07/26	L
	712754	60	6/08/02	L
	712783	60	6/08/02	L
	712851	60	6/07/26	L
	712851	240	6/08/04	L
	712876	60	6/08/02	L
	712944	120	6/07/26	L
	712970	60	6/07/26	L
	712970	60	6/08/02	L
401266	702996	60	6/08/04	L
	703000	60	6/08/07	L
	703910	120	6/07/26	L
	703975	60	6/07/31	L
	703975	120	6/08/07	L

Figure C17. Main Menu –screen shot

```
Document Name: untitled

3YS500-05          PRODUCTION [redacted] INTERNATIONAL, LTD     WBBH0106A    7/11/06
                      List of Menus Authorized for User                      13:13:18

 Transfer to Menu ..                    Call Program Directly ..
 Select action and press Enter.   1=Select
                FINISH                  Printing And Finishing Menu
                GMRPT                       Greige Mill Report Menu
                INSP02                     Final Inspection System
     1          LOOMWL  [redacted] Loom Scheduling
                PFNFLR               Printing/Finishing Floor Menu
                PLAN                           Planning Menu
                QUAL                     Quality Reporting Menu
                QUERY                  AS/400 Query Utilities
                SF                        Surface Finishing Menu
                SLSMGT                        Sales Management Menu




F1=Help  F3=Exit  F7=Bkwd  F8=Fwd  F12=Cancel  F13=Functions  F14=SSAZ99
```

ate: 07/11/2006 Time: 1:15:47 PM

Figure C18. Production Scheduling Menu –screen shot

```
Document Name: untitled

SSAK00              PRODUCTION -        INTERNATIONAL, LTD    WBBH0106B   7/11/06
S1022563                   Master Production Scheduling                   13:14:

 MPS Processing                                Reports
 1.Master Sched Generation   (MRP500)  11.Forecast List                (MRP105)
 2.MRP Maintenance           (MRP510)  12.Fac Planning Data List       (MRP145)
 3.Explode PO/FPO Adjustmnts (MRP550)  13.Print MPS Detail             (MRP240)
                                       14.Print MPS Orders             (MRP520)
                                       15.FAS Orders not Released      (MRP530)

 FAS Processing                        Maintenance
 4.Final Assembly Consl/Rel  (FAS500)  16.Forecast Maintenance         (MRP100)
 5.FAS Shop Packet Print     (FAS510)  17.MRP Time Frame Maint         (MRP120)
                                       18.Fac Planning Data Maint      (MRP140)

 MPS Inquiries                         Other Options
 8.Planning/Pegging Inquiry  (MRP300)  20.Material Reqs Plan      (Menu SSAK01)
 9.Available to Promise Inq  (MRP310)  21.MRP/MPS Simulation      (Menu SSAK02)
10.Master Sched Detail Inq   (MRP320)  22.Budget Reports          (Menu SSAKT1)

Enter Option Number or Product Code: 8       90.Signoff
F1=Help   F3=Exit   F12=Main Menu   F14=Services   F21=Command Line

Date: 07/11/2006 Time: 1:16:37 PM
```

Figure C19. Planning Status of Item number 703261 –screen shot

```
Document Name: untitled

MRP300-02
 Item 703261                          Planning/Pegging Inquiry          7/11/06 13:19:22
 Facility 01  +             +  66222 057 CYRANO PEARL           On Hand          56.000
 Order Policy Incremental  Class IW Lead Time   5    0  U/M LY  Alloc Mfg        56.000
 MRP Code M     Activity Y          Lot Size         60.000    Alloc Cus          .000
 JIT Code   Horizon Date  7/31/06   Incr Lot         60.000    On Order           .000
 Method 1 Orders Only               Min Bal            .000    Non Net            .000
 Method 2 Orders Consume Forecast     Batch           1.000
 Type GRE GDS POOL Class Code         Demand Fence Date  9/04/06   Yield  99.70
                                      MFG Code      Red = Blanket Trq = Sample
           -------------Orders------------- -------Requirements-----
 Action    Ref#    Quantity  Rel     Due Fr Wh  Ref#   Quantity    Need     Balance
                                                Planned      55   7/10/06         1
                                                M807264      56   7/11/06       55-
Firm Up   Planned         59   72706   80206    Planned      55   8/02/06       50-
          Planned         59 122006 122806      Planned      55  12/28/06       45-
          Planned         59   31207   31607    Planned      55   3/16/07       41-
          Planned         59   52807   60107    Planned      55   6/01/07       36-
          Planned         59   81307   81707    Planned      55   8/17/07       31-
          Planned         59 102207 102607      Planned      55  10/26/07       26-
          Planned         59   11808   12208    Planned      55   1/22/08       21-
          Planned         59   32108   32508    Planned      55   3/25/08       16-
 F1=Help F2=Itm Note  F3=Exit  F4=Prompt  F5=Refresh  F8=Forward  F9=PO Rlse
 F10=Purchase Orders  F11=Fold  F12=Cancel  F13=Pegging  F24=More Keys

Date: 07/11/2006 Time: 1:21:20 PM
```

Figure C20. Planning Status of Item number 703261 –screen shot 2

```
Document Name: untitled

MRP300-03                      Planning/Pegging Inquiry        7/11/06 13:19:38
 Item 703261            +  66222 057 CYRANO PEARL              On Hand       56.000
 Facility 01  +    Class IW Lead Time   5    0  U/M LY     Alloc Mfg     56.000
 Order Policy Incremental         Lot Size        60.000   Alloc Cus       .000
 MRP Code M     Activity Y        Incr Lot        60.000    On Order       .000
 JIT Code   Horizon Date  7/31/06 Min Bal           .000    Non Net        .000
 Method 1 Orders Only               Batch          1.000
 Method 2 Orders Consume Forecast    Demand Fence Date  9/04/06   Yield  99.70
 Type GRE GDS POOL    Class Code         MFG Code                Red = Blanket
 -------------P E G G I N G-------------                         Trq = Sample
      Qty Req     Need    For       Ref No. Whse  Due   Item/Customer
       55.000   7/10/06 Plnd Req            RM   7/14/06 915984
       56.000   7/11/06 SO           807264 RM   7/17/06 915984
       55.000   8/02/06 Plnd Req            RM   8/10/06 915984
       55.000  12/28/06 Plnd Req            RM   1/08/07 915984
       55.000   3/16/07 Plnd Req            RM   3/26/07 915984
       55.000   6/01/07 Plnd Req            RM   6/11/07 915984
       55.000   8/17/07 Plnd Req            RM   8/27/07 915984
       55.000  10/26/07 Plnd Req            RM 11/05/07 915984
       55.000   1/22/08 Plnd Req            RM   1/28/08 915984
       55.000   3/25/08 Plnd Req            RM   3/31/08 915984
 F1=Help F2=Itm Note  F3=Exit  F4=Prompt  F5=Refresh  F8=Forward  F9=PO Rlse
 F10=Purchase Orders  F12=Cancel  F13=Planning  F14=Fac Planning  F24=More Keys

Date: 07/11/2006 Time: 1:21:31 PM
```

Figure C21. List of Orders for Finished Style 915984 –screen shot

```
Document Name: untitled

MRP300-03                          Planning/Pegging Inquiry          7/11/06 13:19:38
 Item 915984            +   66222 057 CYRANO PEARL              On Hand          56.000
 Facility 01  +    Class IW Lead Time    5    0  U/M LY      Alloc Mfg         56.000
 Order Policy Incremental        Lot Size         60.000     Alloc Cus           .000
 MRP Code M     Activity Y       Incr Lot         60.000     On Order            .000
 JIT Code   Horizon Date  7/31/06 Min Bal           .000     Non Net             .000
 Method 1 Orders Only              Batch           1.000
 Method 2 Orders Consume Forecast    Demand Fence Date    9/04/06    Yield  99.70
 Type GRE GDS POOL   Class Code       MFG Code                    Red = Blanket
 -------------P E G G I N G-------------                           Trq = Sample
      Qty Req     Need    For        Ref No. Whse  Due    Item/Customer
       55.000    7/10/06 Plnd Req            RM   7/14/06 915984
       56.000    7/11/06 SO           807264 RM   7/17/06 915984
       55.000    8/02/06 Plnd Req            RM   8/10/06 915984
       55.000   12/28/06 Plnd Req            RM   1/08/07 915984
       55.000    3/16/07 Plnd Req            RM   3/26/07 915984
       55.000    6/01/07 Plnd Req            RM   6/11/07 915984
       55.000    8/17/07 Plnd Req            RM   8/27/07 915984
       55.000   10/26/07 Plnd Req            RM  11/05/07 915984
       55.000    1/22/08 Plnd Req            RM   1/28/08 915984
       55.000    3/25/08 Plnd Req            RM   3/31/08 915984
 F1=Help F2=Itm Note  F3=Exit  F4=Prompt  F5=Refresh  F8=Forward  F9=PO Rlse
 F10=Purchase Orders  F12=Cancel  F13=Planning  F14=Fac Planning  F24=More Keys

Date: 07/11/2006 Time: 1:21:47 PM
```

Figure C22. Details for Item 915984 –screen shot

```
Document Name: untitled

MRP300-02                               Planning/Pegging Inquiry        7/11/06 13:20:02
 Item 915984           +  66222 054 CYRANO PEARL              On Hand          45.000
 Facility 01  +    Class 33 Lead Time    6    0  U/M LY     Alloc Mfg           .000
 Order Policy Incremental        Lot Size        55.000   Alloc Cus         150.000
 MRP Code M     Activity Y       Incr Lot        55.000    On Order          56.000
 JIT Code    Horizon Date  7/11/06 Min Bal         .000     Non Net            .000
 Method 1 Orders Only              Batch          1.000
 Method 2 Orders Consume Forecast   Demand Fence Date  9/04/06   Yield  89.69
 Type FINISHED GDS Class Code OL    MFG Code S    Red = Blanket Trq = Sample
          --------------Orders-------------- -------Requirements-----
 Action   Ref#    Quantity  Rel      Due Fr Wh  Ref#  Quantity     Need     Balance
LT Violt Planned        49  71006   71406     C269201        50    7/14/06        44
         S807264        50  71106   71706                          0/00/00        95
         Planned        49  80306   81006     C270443        50    8/10/06        94
                                              C270944        50    8/21/06        44
                                              Forecst         2    9/11/06        41
                                              Forecst         2    9/18/06        39
                                              Forecst         2    9/25/06        36
                                              Forecst         2   10/02/06        34
                                              Forecst         2   10/09/06        31
                                              Forecst         2   10/16/06        28
 F1=Help F2=Itm Note  F3=Exit  F4=Prompt  F5=Refresh  F8=Forward  F9=PO Rlse
 F10=Purchase Orders  F11=Fold  F12=Cancel  F13=Pegging  F24=More Keys

Date: 07/11/2006 Time: 1:21:57 PM
```

Figure C23. Customer List for Item 91598 –screen shot

```
cument Name: untitled

?300-03                              Planning/Pegging Inquiry          7/11/06 13:20:13
tem 915984                 +  66222 054 CYRANO PEARL              On Hand          45.000
acility 01   +    Class 33 Lead Time    6    0  U/M LY          Alloc Mfg           .000
rder Policy Incremental          Lot Size        55.000         Alloc Cus         150.000
RP Code M      Activity Y        Incr Lot        55.000         On Order           56.000
IT Code    Horizon Date  7/11/06 Min Bal           .000         Non Net             .000
ethod 1 Orders Only                 Batch         1.000
ethod 2 Orders Consume Forecast    Demand Fence Date  9/04/06   Yield   89.69
ype FINISHED GDS    Class Code OL      MFG Code S                     Red = Blanket
------------P E G G I N G--------------                               Trq = Sample
    Qty Req     Need    For        Ref No. Whse   Due     Item/Customer
     50.000   7/14/06 Cust Ord   269201  06   7/14/06   [redacted]
     50.000   8/10/06 Cust Ord   270443  06   8/10/06
     50.000   8/21/06 Cust Ord   270944  06   8/21/06
      2.500   9/11/06 Forecast           06   9/17/06
      2.500   9/18/06 Forecast           06   9/24/06
      2.500   9/25/06 Forecast           06  10/01/06
      2.800  10/02/06 Forecast           06  10/08/06
      2.800  10/09/06 Forecast           06  10/15/06
      2.800  10/16/06 Forecast           06  10/22/06
      2.800  10/23/06 Forecast           06  10/29/06
1=Help F2=Itm Note  F3=Exit  F4=Prompt  F5=Refresh  F8=Forward  F9=PO Rlse
10=Purchase Orders  F12=Cancel  F13=Planning  F14=Fac Planning  F24=More Keys

te: 07/11/2006 Time: 1:22:10 PM
```

Figure C24. Piece Ticket

BEAMS

BB01 ITEM DESCRIPTION
404764 08448 POLY 150/34 PKGDY [redacted]

TB01 ITEM DESCRIPTION

FILLING

ITEM DESCRIPTION	POUNDS	PKG
402822RAYON SPUN 20/2 GOLD 0639J	[redacted]	
402822RAYON SPUN 20/2 GOLD 0639J	[redacted]	
402822RAYON SPUN 20/2 GOLD 0639J	[redacted]	
402822RAYON SPUN 20/2 GOLD 0639J	[redacted]	

SELVAGE

401076 00020 30/2 KP NON TINT 10105 [redacted]
401448 00006 3/70/36 T23 POLY NONTINT [redacted]

PRINT PAPER

ITEM DESCRIPTION	YARDS

GREIGE STYLE MASTER

ITEM NUMBER	DESCRIPTION
712351	65445 057 [redacted]

LOOM	SHOP ORDER	OFF P.O.
L385	807490	

DRAW	TIE	STYLE	FILL	CARD
PGEAR	BOX	REED	SLEY	ENDS

SLEY	G-PPI-F	REED	SPREAD
[redacted]	[redacted]	[redacted]	[redacted]
G WIDTH	HOOKS	ENDS DENT	SEL TYPE
[redacted]	[redacted]	[redacted]	[redacted]

SEL ENDS	CARD ORDER	CDS IN REPEAT
4/E 4/D	X1565/1	[redacted]
LEASE CARD	REREED	BOX MOTION
	NO	
DOBBY DRAW	DOBBY CHAIN	PATT REPEAT
		[redacted]
ORD YARDS	Tissue Pick	DOFF PICKS
[redacted]		[redacted]

[redacted]

Color 000018

Var 070

Figure C25. Run Out Report – Production

Runout Report

Date 7/11/06 Shift 1st

Section I

Warp Outs			Warp Outs For Next 24 Hours		Breakouts	No Warps	Draws
718 M T			715	736			
726 out T	TB		720	727			
385 M T			387	377			
207 L T							
740	out	P/S					
387	out	P/S					

Warp Out Completed/ In Process

721 c
211 c
734 c
711 p/o
205 leasing

No Filling

Run: 224-211-210-209-207-206-206-119-121
122-667-668

222 · 405456

(3)

Misc. Notes

No plans: 208-381-708

723-shop
709 -lost ends
223 hold for approval

Figure C26. Preventive Maintenance List

Shut down preventive maintenance

1.Wash down air wash number 3 **complete 6/20/05** **complete 12/26/05**

2.Wash down cooling tower for air compressor **complete 5/20/05** **complete 12/26/05**

3. Clean filters in basement **complete 7/05/05** **complete 12/26/05**

4.Blow out and clean filters in switchgear and all transformers throughout plant **complete 7/05/05**

5.Replace and or clean spray nozzles in #3 airwash **complete 6/20/05** **complete 7/05/05**

6. PM warp racks **complete 7/05/05**

7.PM and clean battery charging area **complete 6/20/05** **complete 12/26/05**

8 Wash down and clean cooling tower for chiller. **complete 6/13/05** **complete 12/26/05**

9.Change oil and filters in 500 HP air compressor, lubricate all other compressor parts **complete 7/05/05**

10. Wash out and clean sub station for chiller **complete 7/05/05**

11. Run air lines for wide weaving machines **complete 7/05/05**

12.Hang lights in weaver alley wide looms **complete 7/05/05**

13.Grease all pumps and cooling tower fan motors **complete 7/05/05**

14.Replace filters on cloth room supply room ac unit **complete 7/05/05**

15.PM exhaust fans on roof **to be done** **complete 10/05**

16.Repair all air leaks in plant **to be done** **complete 9/05 (ongoing)**

17.PM grading frames and conveyor system in cloth room m **to be done** **complete 12/26/05**

18.Rod out and clean Carrier chiller unit **do this winter** **complete 12/26/05**

19. PM water pumps,grease e bearings etc. **complete 12/26/05**

20. PM motors and pumps waste treatment plant **complete 12/26/05**

9.4 Appendix D: Introduction Letter

North Carolina State University is a land-
Grant university and a constituent institution
of The University of North Carolina

Department of Textile and Apparel
Technology and Management
www.tx.ncsu.edu/tam/

NC STATE UNIVERSITY

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Raleigh, NC 27695-8301
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919.515.3733 (fax)

Yatin Karpe
Graduate Ph.D. Candidate January 27, 2006
College of Textiles, NCSU

XXXX
Plant Manager, Weaving -XXXX

Subject: Background information of research in order to request an interview session

Mr. XXXX

Hello, my name is Yatin Karpe, and I am a graduate doctoral candidate at the College of Textiles, North Carolina State University. This letter is with reference to sending you some background information on our research topic, in order to possibly request your consent for participation in the same.

I am working on my Ph.D. doctoral dissertation titled "Knowledge Management in Textiles: Using Information Engineering Methodology to investigate mapping of Weave-Room Efficiency Decision Performance", under the guidance of Dr. George Hodge. I would first like to give you a brief introduction about the same, before requesting your willingness to participate in an interview session. The overall objective of the project is to fundamentally increase the decision-effectiveness in textile manufacturing by designing a new and efficient Information Engineering methodology that would capture and disseminate the appropriate management information, resulting in effective and efficient decision-making by the textile personnel, and thus addressing a critical need presently facing the textile industry. Information Engineering is defined as a technique for extracting the "meaning" contained in the information to allow the understanding needed by the user to make the "right" decision. Past research in decision-making has been related mostly with CIM concepts and has concentrated mostly on the computer end (hardware and software). But as the businesses have become more complex and the information systems have started generating increasing amounts of information, the discriminating power of the decision-maker to select and digest the "right" information has been stretched to the limit and has led to a common problem in today's world called information overload, which in turn has resulted in the "Hardware-Software-Humanware" Gap (Communication Gap). Hardware is the capability to collect and store data. Software is the technological process used to present data so that meaning can be derived from it. Human capability is still required to process data for meaning. In order to minimize or reduce this communication gap, which could result in efficient and effective decision-making, there is a continuous need to provide information to the decision-maker, which is meaningful and understandable, precise, complete, relevant to the decision, ready at the right time and free of excessive element (redundant information). Too much information or information overload has resulted in inferior decision-making and influenced the information utilization statistics. Preliminary reports indicate that only 10-15% of all the information contained/available in existing plant reports is actually utilized towards the specific decision-making process and more than 80% of the time to reach a decision is spent in segregating the vital (useful) information, which is normally hidden under the redundant (useless) information. Right decisions are not made by merely obtaining information, but by the correct diagnosis of the meaning of that information. If we interpret the meaning correctly, then we get the right message, which means we will probably make the right decision. Hence we have created the Decision Cycle and Information Engineering is at the heart of this cycle.

Taking these concepts into consideration, our primary research objective is to develop an information engineering methodology for mapping (using IDEF Modeling principle) and simplifying the weave room performance decision-making process. Presently we are only focusing on one decision, i.e. the weave room performance decision, since it is an indicator of the overall health of the textile plant. This particular research will focus on enhancing the decision-making process, not by creating another computer program that will generate more information, but by possibly enhancing the efficiency of the decision-making process. The output of the research will result in decreased information overload, increased data utilization, fewer errors and possibly reduced number of people involved in the decision-making effort. We will need to conduct 2-3 rounds of interviews with you and/or other concerned personnel who are responsible for decision-making of the weave-room performance decision. The results of the study will be shared with the participating companies and their suggestions/observations/advise will be closely and continuously sought.

So, is it possible for you to spare approximately a few hours of your valuable time to participate in a one-on-one interview? Please feel free to contact me for any other information that you may need. Your cooperation and assistance in this matter will be greatly appreciated. I will call you sometime next week to determine a good time or alternately you can email me a couple of good dates/times that I could visit your plant. My details are given below. Awaiting your reply,

Sincerely
Yatin Karpe
yskarpe@yahoo.com
(919) 749-9416 (mobile); (919) 784-0123 (home)

9.5 Appendix E: Pilot Questionnaire

PILOT QUESTIONNAIRE Time: Date:

1. COMPANY INFORMATION:

Name:	**Contact**:	**Address**:	**Tel. / Fax No.**:	**email**:

2. WEAVING PLANT INFORMATION:

Weaving Machines in Plant		**Employees**	**Products**	
Total No.	**Type**			

3. DECISION-MAKING:

Decision-Makers – WHO	**Decisions-Made – WHAT?**	**Decision Importance – (Scale of 1-5: Least-Most Important)**				
		1	**2**	**3**	**4**	**5**

4. Could you possibly put the Weave-Room Efficiency Decision in context with other decisions and explain further?

5. **Please explain in detail the weave-room efficiency decision process w.r.t. the following IDEF Modeling strategy?**

IDEF Decision Context	Decision Steps	⇓ IDEF Elements \ Decision Attributes ⇒	Data	Report	Time	People	Biases			
		Input								
		Control								
		Output								
		Mechanism								
		Input								
		Control								
		Output								
		Mechanism								
		Input								
		Control								
		Output								
		Mechanism								
		Input								
		Control								
		Output								
		Mechanism								
		Input								
		Control								
		Output								

IDEF Decision Context	**Decision Step**	⇓ IDEF Elements / Decision Attributes ⇒			
		Input			
		Control			
		Output			
		Mechanism			

IDEF Decision Context	**Decision Step**	**Decision Attributes ⇒** **⇓ IDEF Elements**			
		Input			
		Control			
		Output			
		Mechanism			

6. In your opinion, what is the approximate time spent for the weave-room efficiency decision?

7. And Why?

8. In an ideal situation, what in your opinion should be the components of the weave-room efficiency decision-process?