14:57:46 OCA PAD AMENDMENT - PROJECT HEADER INFORMATION 11/24/93

Active

Project #: E-27-618 Cost share #: Rev #: 3
Center # : 10/24-6-R7151-0A0 Center shr #: OCA file #: 131
Work type : RES
Contract#: DLA900-87-D-0018-0015 Mod #: 02 Document : DO
Prime #: Contract entity: GTRC

Subprojects ? : Y CFDA: N/A
Main project #: PE #: P75102

Project unit: TEXT ENGR Unit code: 02.010.130
Project director(s):
JAYARAMAN S TEXT ENGR (404)894-2490

Sponsor/division names: US DEPT OF DEFENSE / DEFENSE LOGISTICS AGY
Sponsor/division codes: 101 / 008

Award period: 910208 to 930722 (performance) 931221 (reports)

Sponsor amount	New this change	Total to date
Contract value	0.00	254,157.67
Funded	0.00	254,157.67
Cost sharing amount		0.00

Does subcontracting plan apply ?: N

Title: PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

PROJECT ADMINISTRATION DATA

OCA contact: Brian J. Lindberg 894-4820

Sponsor technical contact	Sponsor issuing office
MR. DONALD F. O'BRIEN/DPMSO	MS. SALLY DIDONATO/DPSC-FPCA
(703)274-6445	(215)737-5632
DEFENSE LOGISTICS AGENCY	DEFENSE PERSONNEL SUPPORT CENTER
CAMERON STATION	2800 SOUTH 20TH STREET
ALEXANDRIA, VA 22304-6100	PHILADELPHIA, PA 19101-8419

Security class (U,C,S,TS) : U ONR resident rep. is ACO (Y/N): Y
Defense priority rating : DO-C9 GOVT supplemental sheet
Equipment title vests with: Sponsor X GIT

Administrative comments -
MOD. 02 EXTENDS TIME TO COMPLETE THE FINAL REPORT THROUGH DECEMBER 21, 1993.

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 02/08/94

Project No. E-27-618 Center No. 10/24-6-R7151-0A0

Project Director JAYARAMAN S School/Lab TEXT ENGR TE

Sponsor US DEPT OF DEFENSE/DEFENSE LOGISTICS AGY

Contract/Grant No. DLA900-87-D-0018-0015 Contract Entity GTRC

Prime Contract No.

Title PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

Effective Completion Date 930722 (Performance) 931221 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	
Final Report of Inventions and/or Subcontracts	Y	
Government Property Inventory & Related Certificate	Y	
Classified Material Certificate	N	
Release and Assignment	Y	
Other	N	

Comments

Subproject Under Main Project No.

Continues Project No.

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Managment	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other CARL BAXTER-FMD	Y
	N

NOTE: Final Patent Questionnaire sent to PDPI.

E-27-618
DLA 900-87-D-0018-00

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

3, 4, 5, 6, 7, 8

I. Project Review for May - June 1991

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the months of May and June 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the research investigator.

I.3 Travel

Drs. Jayaraman and Malhotra visited with Mr. Dan Wright of Dowling Textiles, a leading producer of hospital apparel products, to explore the possibility of Dowling Textiles participating in the project as one of the test beds for AMA. During the discussions, a few potential areas of application of AMA were identified. A copy of the function/dynamics model was given to Mr. Wright.

During a follow-up telephone conversation, it was decided that discussions (including another visit to Dowling) would continue in July after the plant resumed operations following the July break.

Dr. Jayaraman made a presentation on the IDEF methodology and AMA at a workshop organized by DLA at Cameron Station for researchers participating in the various AAMTD projects. The discussions centered on how AMA could serve as the basic framework and/or communication vehicle for the various researchers to identify and expound their research projects.

II. RESEARCH STATUS

II.1 Research Outline

A brief document outlining the purpose of this research, the proposed role of the participating company in the project, and the expected benefits from the cooperative effort has been prepared; this document will be mailed to members of the Apparel Manufacturing Technology Center (AMTC) Steering Committee and other apparel manufacturers. After evaluating the responses from the companies to the proposal, two or three companies will be selected for participation in the project.

The AMTC manufacturing facility is also being considered as one of the demonstration sites because of the availability of the state-of-the-art resources at the center, and the accessibility of the center to the researchers and the apparel industry.

II.2 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MMII) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shopfloor control, purchasing, costing, and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

The user interface and the data sets of entering and maintaining part definitions in the materials management module were customized for apparel manufacturing. Since product changes and new product introductions are routine in apparel enterprises, an interface for maintaining product-related information has been added to the system. This interface is intended to be used by the product development personnel and it replaces the original interface that was designed for materials management personnel. New products and the materials used in their construction are now introduced by product development, which also maintains the design data on products through this interface. Once a new product is introduced into the system, the inventory control related information is added by materials management. The system maintains information on styles and garment types within a style. The lot control facility of the materials management system has been used to distinguish garments of different sizes within a garment type.

Work on customizing the master production scheduling and material requirement planning modules is in progress.

III. PLANS FOR NEXT MONTH

III.1 Mailing of Research Outlines

The research outlines will be mailed to apparel companies.

III.2 Identification of Implementation Sites

Work will continue on identifying potential test beds for the project. The dialogue initiated with Dowling Textiles will continue.

III.3 Hewlett-Packard Manufacturing Management System

Work on customizing the HP master production scheduling and material requirement planning modules of MM II will continue.

E-27-618
#9,10

PROBLEM SOLVING FOR APPAREL MANUFACTURERS:

UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR JULY, 1991

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of July 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the Research Investigator.

I.3 Travel

Drs. Jayaraman and Malhotra visited Dowling Textiles, a leading producer of hospital apparel products, to follow-up on the earlier meeting to explore the possibility of Dowling Textiles participating in the project as one of the test beds for AMA. Dowling was represented by Mr. Dan Wright (Executive Vice President), Mr. David Heuselbeck (President) and Mr. Vijay Shah (Vice President, Finance/Information Systems).

The presentation began with an introduction to AMA and the IDEF methodology and covered the proposed mechanism of interaction and cooperation between Dowling and Georgia Tech on the project. Issues related to personnel and time commitments were discussed. Dowling was favorably inclined to the proposed collaboration which would be centered around the production planning function. Mr. Wright and his colleagues would discuss Dowling's participation and convey their decision to Dr. Jayaraman in early August.

II. RESEARCH STATUS

II.1 Research Outline

A brief document outlining the purpose of this research, the proposed role of the participating company in the project and the expected benefits from the cooperative effort has been prepared; this document was mailed to member companies of the Apparel Manufacturing Technology Center (AMTC) Steering Committee. After evaluating the responses from the companies to the proposal, two or three companies will be selected for participation in the project.

The AMTC manufacturing facility is also being considered as one of the demonstration sites because of the availability of the state-of-the-art resources at the center, and the accessibility of the center to the researchers and the apparel industry.

II.2 Interactions with Dowling Textiles

Please see section I.3.

II.3 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shopfloor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

The user interface and the data sets of entering and maintaining part definitions in the materials management module were customized for apparel manufacturing. Since product changes and new product introductions are routine in apparel enterprises, an interface for maintaining product-related information has been added to the system. This interface is intended to be used by the product development personnel and it replaces the original interface that was designed for materials management personnel. New products and the materials used in their construction are now introduced by product development, which also maintains the design data on products through this interface. Once a new product is

introduced into the system, the inventory control related information is added by materials management. The system maintains information on styles and garment types within a style. The lot control facility of the materials management system has been used to distinguish garments of different sizes within a garment type.

Work on customizing the master production scheduling and material requirement planning modules of the MM II system was completed during this month. The customized version of the materials management system is now ready for testing. The production management sub-system of the MM II system was found unsuitable for adaptation for apparel manufacturing. Therefore, the production control tasks will be left for the other available systems in the center. Work has been initiated to devise a scheme for coordinating the operations of MM II materials management system with the Gerber unit production control system.

III. PLANS FOR NEXT MONTH

III.1 Mailing of Research Outlines

Depending on the interactions with Dowling and the responses to the initial round of mailing, another mailing to apparel companies will be considered.

III.2 Identification of Implementation Sites

Work will continue on identifying potential test beds for the project. The dialogue initiated with Dowling Textiles will continue.

III.3 Hewlett-Packard Manufacturing Management System

Work on coordinating the operations of the HP MM II system with the Gerber Unit Production System will continue.

E-27-618
#11, 12

PROBLEM SOLVING FOR APPAREL MANUFACTURERS:

UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR AUGUST, 1991

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of August 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the Research Investigator.

I.3 Travel

Please see Dowling Textiles in Section II.1 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

Dowling Textiles' response to the July 25th presentation on the scope and issues related to the research endeavor has been positive, with Mr. Dan Wright conveying Dowling's decision to Dr. Jayaraman. The willingness of Dowling to participate on the project is greatly appreciated; this decision has been communicated to Mr. Don O'Brien and Ms. Julie Tsao at DME/RO.

On August 22, Dr. Jayaraman visited Dowling Textiles and met with Mr. Dan Wright, Mr. Vijay Shah and the two team members representing Dowling: Mr. Andrew Boyd and Ms. Ali Barr. Mr. Boyd is responsible for production planning at Dowling, while Ms. Barr is reviewing the purchasing mechanism in place at Dowling. After the introductions, Dr. Jayaraman spoke about the proposed mechanism of interaction and anticipated work/time commitments. This was followed by a fairly detailed introduction to the IDEF Methodology vis-a-vis AMA. The methodology was subsequently illustrated with a walk through parts of AMA. Towards the end of the meeting, Mr. Dan Wright sought feedback from Mr. Boyd and Ms. Barr on their interest in participating on the project. Both Mr. Boyd and Ms. Barr reiterated their interest and willingness to participate on the project. Once again, production planning emerged as the general target area for the proposed modeling and system development effort.

On August 26, Drs. Jayaraman and Malhotra met with Mr. Boyd and Ms. Barr; Mr. Boyd gave a detailed account of the production planning activity at Dowling. Ms. Barr spoke briefly about the purchasing activity.

II.2 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shopfloor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

A report on the work carried out until now is being prepared for submission to HP.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles Interaction

The interaction with Dowling Textiles will proceed on a regular basis.

III.2 Hewlett-Packard Manufacturing Management System

Continue documenting the work carried out on the system.

13,14

September Monthly Report

APPAREL MANUFACTURING TECHNOLOGY CENTER

Contract Number: DLA900-87-0018
Performance Period: 910901 - 910930

Sponsored by:

THE UNITED STATES DEPARTMENT OF DEFENSE
DEFENSE LOGISTICS AGENCY

Submitted by:

Economic Development Laboratory
Georgia Tech Research Institute
Georgia Institute of Technology
and
Southern College of Technology

October 18, 1991

Table of Contents

Executive Summary 1

Research Projects

- Generic Architecture for Apparel Manufacturing 6
- Knowledge Based Framework For Trouser Procurement 8
- Analysis of Defects in Trouser Manufacturing 10
- Problem Solving for Apparel Manufacturers: Utilization of AMA 13
- Ergonomic Principles 16
- In-Process Quality Control: Fabric Defects 18
- Flexible Work Groups 22
- Problem Solving for Apparel Manufacturers: In-Plant Assistance 24
- Location Technologies for Apparel Assembly 27
- Nontraditional Economic Justification of Equipment 28

Data Accession List 35

Program Schedules

Notes

GEORGIA TECH / SOUTHERN TECH
APPAREL MANUFACTURING TECHNOLOGY CENTER

SEPTEMBER MONTHLY REPORT

EXECUTIVE SUMMARY

Outreach and Industry Liaison

John Adams conducted an energy efficiency audit of Dowling Textile Company. The activity, involving two undergraduate students, identifies opportunities for the host company to achieve greater efficiency in utility costs.

Several manufacturers were contacted and invited to special demonstrations at the AMTC during the following months. Demonstrations will focus on the special interests of the guests plus overall manufacturing innovations related to BDU and similar apparel items.

On September 12, Carol Ring and Howard Pettigrew met with Scott Hall from Fame Products, Inc. Hall is investigating the advantages of the automated Reece Pocket Setter. Carol Ring stitched several samples on fabric furnished by Hall with the Reece Automatic Pocket Set Machine, Model 46. Advantages in method, quality and standard time were discussed. Pettigrew explained the mechanical adaptability of different clamps for several styles. Hall will present these samples and information obtained as part of his justification for purchasing the automated equipment.

Carol Ring and Howard Pettigrew met with Dan Dauby and Primo Quattrini of Private Line Group, Inc on September 17. Private Line is purchasing a CAD system for patterns and markers in the near future. Educational opportunities at Southern Tech involving CAD technology and other apparel equipment for (present and future) employees and future engineer resources were discussed at length. Several pieces of sewing equipment including the Rimoldi 406 Automatic Belt Loop and Union Special 2800 E-3 J-Stitch machine were demonstrated and discussed as possible investments for the Private Line bottom plant.

Dr. Jayaraman conducted several meetings with Dowling Textiles throughout September. On September 4, a written summary of the production process was given to Dowling and discussions on this topic were held. On September 10, Dowling detailed the purchasing process. On September 17, a written summary of the purchasing process was given to Dowling. Also, Dowling was given a time-task schedule of objectives and tasks which will serve as the roadmap for the project. Meetings were held with manufacturing personnel on September 17 and 20.

Dr. Wayne Tincher assisted in planning a tour of the vision research laboratory for the Burlington Industries Denim Division during the Bobbin Show. A letter of appreciation from Ms. Darlene Ball, Manager for Customer Support for the division and co-chairperson

of the Apparel Research Committee Subcommittee on Research Needs, is included in the Notes section.

Trade Shows and Meetings

AMTC presented a booth at the 1991 Bobbin Show. Traffic was excellent - Approximately 270 show attendees requested information at the booth. In addition, most AMTC personnel attended the Bobbin Show.

Highlights of the Bobbin Show this year included: voice activated motors; ergonomic work stations; integrated systems; computerized cutting machines for small manufacturing; pneumatic attachments for sewing machines; and advanced pattern development systems.

John Adams sat as a panelist at the Apparel Research Committee Seminar: "A technology Briefcase: Research & Development Around the World". The session received excellent presentations from Fred Golden of Fashion Institute of Technology; William Watkins of Veit, Inc.; Joe Off of Textile/Clothing Technology Center; and Paul Taylor of the University of Hull, UK. Dan Wright of Dowling Textiles voiced that the session was the best he attended at the show.

Larry Haddock and Bill Cameron attended the Apparel Education Foundation dinner in Atlanta on September 23. This year's honoree was Mr. Lawrence R. Pugh, Chairman and Chief Executive Officer of VF Corporation. This dinner raised $150,000 to benefit students enrolled in an apparel curriculum including Southern Tech students.

Dr. Wayne Tincher attended the International Textile Machinery Association (ITMA) exposition in Hanover, Germany from September 24-27. This is the world's largest exhibit of textile and related manufacturing equipment. In 1991, ITMA had 1,300 exhibitors from 35 countries and occupied over 2 million square meters of exhibit space. One small building was devoted to apparel manufacturing equipment, but this was not a major feature of the show.

In connection with Ergonomic Principles, Mike Kelly presented the poster show at the Human Factors Society annual meeting in San Francisco, CA.

John Bartholdi and Charlotte Jacobs-Blecha travelled to Cameron Station to discuss their pending proposal with Don O'Brien and Julie Tsao. Mr. Bartholdi presented the plans to implement the methodologies which result from this research project.

Pilot Plant Equipment and Systems

Gerber Garment Technology removed our computerized cutter and replaced it with a new

model.

At the Bobbin Show AMTC talked with various vendors regarding some special pieces of equipment that are still needed (on consignment) to enhance the high technology in the BDU manufacturing demonstration lab.

Battle Dress Uniform Production Plans

We continue to train operators one day per week and conduct demos at least one day per week. Generally, demonstrations are conducted on Thursdays. Each demonstration features the problems and interests of an invited apparel company. The demonstrations are also open to the public.

Papers Published

No papers were reported to be published during the month of September. However, several abstracts were in preparation for the coming Third Academic Apparel Research Conference to be held in February 1992. Also, industry interest has manifested in commercializing the results of the Sewing Defects project, if prototype testing is successful.

Demonstrations and Tours during August, 1991

In addition to our training activity and visiting the Bobbin Show, we were able to conduct several demonstrations during the month of September.

September 12	Eight students from DeKalb Technical College came to the AMTC for a demonstration.
September 18	Nineteen customers of IBM were here for a Plant Applications Sales Seminar and participated in a demonstration.
September 23	Connie Pfeiffer and a party of six from Wright Patterson Air Force Base were provided a demonstration.
	Mr. James Della Polla and Colonel Bill Meadows from DPSC led a group of eight for a demonstration.
September 30	Eight students from Berry College participated in a demonstration of the labs.

Activities Scheduled for Next Month

We have invited four different apparel manufacturing firms to come to AMTC during the month of October for special demonstrations. They have agreed to a meeting after the demonstration where we will discuss the trends of the industry and exchange of information. This is an effort to seek guidance from the people in the industry regarding directions we should take in order to provide a better service to the industry.

AMTC Proposals Submitted for Review

Design and Development of a Generic Architecture for Apparel Manufacturing: Support Other Groups That Need to Contribute or Use the Architecture (Maintenance of AMA) was submitted in September.

AMTC Projects Recently Funded

There were no new projects funded during September.

Ongoing Research

Research Project	Principle Investigator
Gen. Architecture for Apparel Manufacturing	Sundaresan Jayaraman
Knowledge Based Framework	Sundaresan Jayaraman
Analysis of Defects Trouser Manufacturing	Sundaresan Jayaraman
Problem Solving for Apparel Manufacturers: Utilization of AMA	Sundaresan Jayaraman
Ergonomics	Dan Ortiz
Fabric Defects	Wayne Tincher
Flexible Work Groups	C. Jacobs-Blecha
Apparel Problem Solving	Susan Shows
Location Technologies	Wayne Tincher

Economic Justification of Equipment — Bill Riall

Detailed status reports follow.

Research Projects Detail

GENERIC ARCHITECTURE FOR APPAREL MANUFACTURING

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER, 1991

To be successful, competitive and achieve excellence in manufacturing, the U.S. apparel industry must lead in successful use of the most advanced concepts and methods including Computer-Integrating Manufacturing (CIM). An important prerequisite for the successful implementation of CIM is an architecture of the apparel manufacturing enterprise. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in July 1988 and is being carried out in three phases. This report reviews the progress made during the month of September, 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Mr. Rajeev Malhotra, graduate student who completed his PhD in this area, was the Graduate Research Assistant.

I.3 Travel

No travel specifically for this project was conducted during September.

II. RESEARCH STATUS

II.1 Integrated Framework for Enterprise Modeling (IFEM)

Work has been continuing on the development of IFEM, a new approach to enterprise modeling that overcomes the shortcomings of the $IDEF_2$ methodology and integrates the function, information and dynamics models of an enterprise into a single framework.

II.2 Final Report

Work on writing the Final Project Report is in progress.

II.3 Original Research Task Schedule

A copy of the time-task schedule included in the original research proposal is attached.

III. PLANS FOR NEXT MONTH

III.1 Final Report

Work will continue on finishing the Final Project Report.

KNOWLEDGE BASED FRAMEWORK FOR TROUSER PROCUREMENT

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER, 1991

The Department of Defense is the single largest consumer of apparel items in the free world procuring approximately $1.6 billion worth of apparel every year. The old practice of using sealed bid procedures and awarding contracts to the lowest bidder is giving way to Best Value Procurement. Such an informed and knowledge-based procurement approach would not only help the government but would also have an overall beneficial effect on the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to assist in the Best Value Procurement efforts.

I.1 Introduction

The research work began in July 1988 and is being carried out in three phases. This report reviews the progress made during the month of September, 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Howard Olson is the Research Investigator and Mr. Sambasivan Narayanan is the Graduate Research Assistant.

I.3 Travel

No travel specifically for this project was conducted during September.

II. RESEARCH STATUS

II.1 Software Delivery

BEST Forms and BEST Software have been ready for delivery to DLA. BEST runs on an MS-DOS machine with 2MB of extended memory and Nexpert Object (Run-time version). BEST Forms require the Quattro spreadsheet program. BEST Forms are also available as a WordPerfect file.

II.2 Apparel Industry Magazine Article on Research Endeavor

As a result of an article in the August 1991 issue of Apparel Industry Magazine, Ms. Kara Buttimer of Eagle's Eye Company in Conshohocken, PA, requested additional information on the project. A copy of BEST Forms has been sent to Ms. Buttimer.

II.3 Final Report

Work is continuing on writing the final report on the project.

II.4 Original Research Task Schedule

A copy of the time-task schedule included in the original research proposal is attached.

III. PLANS FOR NEXT MONTH

The specific plans for the coming month are outlined in this section.

III.1 Final Report

Work on the final project report will be continued.

ANALYSIS OF DEFECTS IN TROUSER MANUFACTURING

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER, 1991

The production of high quality and defect-free apparel goods is a crucial necessity for combating imports from overseas apparel manufacturers. Products of superior quality not only fetch a premium price but also account for customer satisfaction and consistent consumer demand. Consequently, there is a need to examine ways of reducing defects and improving product quality. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to improve the quality of apparel products manufactured in the country.

I.1 Introduction

The research work began in December 1988 and is being carried out in three phases. This report reviews the progress made during the month of September 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Phiroze Dastoor is the Research Investigator, while Dr. Krishna Parachuru served as one until recently. Mr. K. Srinivasan has been the Graduate Research Assistant on the project.

I.3 Travel

No travel specifically for this project was conducted during September.

II. RESEARCH STATUS

II.1 Software Implementation of Sewing Defects (on UNIX)

The software implementation of SDAS on the UNIX operating system has been completed. However, addition of further details regarding packing and folding defects, as well as some trim defects may continue during the testing stage. The X11-based graphical user interface has been completed. Using this graphics front-end to SDAS allows several sessions of SDAS to be run on different networked machines, each communicating over TCP/IP with a common global Oracle database for the purpose of recording defect occurrences. This demonstrates a distributed processing capability, which is very important in actual shop-floor inspection.

II.2 Software Implementation of Sewing Defects (on DOS)

The porting of SDAS software to DOS is complete. The system has been tested, and the user interface is complete.

II.3 Database Integration with FDAS and SDAS Systems (on UNIX)

The SDAS software (written in Nexpert) has been fully integrated with the Oracle database system. The SDAS + Oracle development model takes advantage of the multi-user features of Oracle on a UNIX computer system, and is able to collect/transmit information from/to multiple sessions of the SDAS system.

Similarly, FDAS also uses the Oracle database system to keep track of the defect data it generates.

II.4 Database Integration with FDAS and SDAS Systems (on UNIX)

Nexpert Forms interfaces have been developed on the DOS platform, as visual front-ends for the two software systems. Both FDAS and SDAS now communicate with the Oracle DBMS for writing defect records, as already accomplished on the UNIX system. However, only single sessions of each system can interact with a single copy of Oracle running on the same DOS computer.

II.5 Writing of User Manuals

Both user manuals are 90% complete. They outline the different ways the user can use

FDAS and SDAS on the DOS platform but have yet to incorporate instructions regarding the recording of defects data into the Oracle database (since that work has just been finished for both FDAS and SDAS).

The systems share some commonality, in terms of modes of usage of their respective user interfaces and the protocols used to communicate with the database. However, their internal workings and structure are quite different, and the design and implementation information will be included in the project report and not in the user manual.

II.6 Original Research Task Schedule

A copy of the time-task schedule included in the original research proposal is attached.

III. PLANS FOR NEXT MONTH

III.1 Design and Implementation of SDAS (on UNIX and DOS)

Work on further additions to the SDAS knowledge base specifically dealing with trim defects (zippers, thread, buttons, etc.) as well as folding/finishing problems will be continued.
The software will also have references to some of the major fabric defects. However, this will
be applicable only for defect tracking purposes, since detailed classification or analysis of fabric defects is taken care of by FDAS.

III.2 Writing of User's Manuals

The FDAS and SDAS user manuals have to be updated with information on using the Oracle database in tandem with the main FDAS/SDAS software, for recording defects data.

III.3 Writing of the Final Project Report

Work will continue on writing the Final Project Report.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS:

UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER, 1991

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of September 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the Research Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, is joining the effort as a Graduate Research Assistant.

I.3 Travel

Please see Dowling Textiles in Section II.1 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

Meetings at Dowling Textiles have been continuing on a regular basis. At the meeting on September 4th, a written summary of the production planning process (based on the August 26th meeting) was given to Mr. Andrew Boyd and Ms. Ali Barr of Dowling. Additional discussions were held on the production planning process. On September 10th, Mr. John Hangar, the Dowling Vice President responsible for Fabric Purchasing, explained the purchasing process in detail. A written summary of the purchasing process was presented to Dowling on September 17th. On the same day, meetings were held with individuals responsible for trim procurement and marker making & cutting departments, to gain an understanding of the existing operations. Another meeting was held on September 20th with manufacturing personnel.

At the September 17th meeting, a time-task schedule outlining the objectives of the endeavor and the various tasks in the project was given to Mr. Boyd and Ms. Barr. The schedule was discussed and there was general consensus on the scope and plan of action. This document will serve as the roadmap for the duration of the project. In short, the progress on the project has been quite good and AS IS modeling will commence in the coming month.

II.2 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shopfloor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

A report on the work carried out until now is being prepared for submission to HP.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

The interaction with Dowling Textiles will proceed on a regular basis. The AS IS modeling of Dowling's Production Planning process will be initiated.

III.2 Hewlett-Packard Manufacturing Management System

Continue documenting the work carried out on the system.

DESIGN & DEVELOPMENT OF A SELF-STUDY COURSE FOR APPAREL SUPERVISORS IN THE PRACTICAL APPLICATION OF ERGONOMIC PRINCIPLES

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER, 1991

I.1 Introduction

The primary mission of this research task is the development of a self-study course in applied ergonomics for supervisors in the apparel manufacturing environment. The purpose of the effort is to create ergonomic awareness at the hands-on manufacturing level where physiological and psychological problems related to work station and equipment design are readily observed and corrected. Ergonomics can impact the workplace in the prevention of musculoskeletal disorders, the reduction of operator fatigue, and the improvement of operator adaptation to advanced manufacturing technology. Corresponding manufacturing concerns addressed include: production, training, attrition, absenteeism, and workforce availability.

The phases of the task leading up to the actual production of the course provide an assessment of ergonomic conditions in the conventional workplace, and an investigation of ergonomic concerns in advanced technology apparel manufacturing respectively. Each phase contributes to the information base for development of the course as well as providing valuable information (e.g. operator anthropometric data to the ergonomic research, equipment design, and apparel manufacturing communities).

I.2 Project Personnel

Dan Ortiz is the Project Director. Project support for Phase IV include: Nancy Davis, Research Associate II, Director Publications Branch; and Rae Adams, Research Associate I.

I.3 Travel

Mike Kelly travelled to San Francisco, CA to present the poster show at the Human Factors Society annual meeting.

II. RESEARCH STATUS

PHASE IV: DEVELOPMENT OF ERGONOMICS TRAINING MATERIALS

The manual and video entitled "A Stitch in Time: The Supervisor's Guide to Ergonomics" is now available to industry. Over 95 requests for the training package (i.e., tape and/or manual) have been received and processed in the month of August. Seventy-five requests were processed in the month of September. Over 400 manuals and 345 tapes have been mailed out to industries and institutions across the United States and Europe and Mexico.

A presentation of the Video and Manual was completed at the Bobbin Show. Also, a poster show describing our phase results and the purpose of the manual and video was presented at the Human Factors Society annual meeting in San Francisco, CA.

PHASE V: ERGONOMICS IN MODULAR MANUFACTURING

We are presently processing the data collected at Plants D and E. The carpal tunnel syndrome symptom survey (pain and numbness in the hands at night) revealed that Plant E (trouser manufacturing) had a substantially greater prevalence of individuals reporting the symptom (over 30 percent of interviewees) than Plant D (less than 10 percent). The plant E results parallel the results obtained at two trouser plants in the Phase I study (more than thirty percent also reported the symptom). Although only preliminary this finding suggests that between station movement may not have a positive effect on the prevalence of this CTS symptom among sewing operators. Many of the jobs in the Plant E modules require similar hand postures (predominantly flat press and pinch grip) and levels of repetition. Consequently, the only relief from the risk factors associated with cumulative trauma disorders appears to be during the walk between workstations. These findings will be explored further as data analysis progresses toward completion.

III. PLANS FOR NEXT MONTH

A return trip to Plant D to complete the workstation measures and collect additional comfort data from standing workers will be made in October.

The "Stitch in Time" video will be shown at a Clemson Apparel Ergonomics Seminar

IN-PROCESS QUALITY CONTROL: FABRIC DEFECTS

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER

I.1 Introduction

The DLA project on In-Process Quality Control: Automatic Detection of Fabric Defects has completed its thirtieth month of program work. The project technical management is under the direction of Wayne C. Tincher, the project Principal Investigator, and the administrative management is under the supervision of John Adams, the AMTC program manager.

I.2 Project Personnel

Wayne C. Tincher has responsibility for the overall design of the cut part inspection workstation and is directing the work on color measurement of cut parts and the criteria for color acceptability for parts that can be sewn together. He is being assisted on the project by Mr. Amit Kumar, graduate student in the School of Textile and Fiber Engineering. The development of the machine vision systems for cut part inspection is under the direction of Mr. Wayne Daley, Research Engineer in the Georgia Tech Research Institute. Mr. Daley is being assisted by Richard Carey, research Engineer, Marlon Moses, an Electronics Technician and Frank Schrorer a Student Assistant. Mr. Wiley Holcomb has responsibility for developing the transport system for the cut parts, designing the take-off device, and overall integration of the components for the cut-part inspection demonstration unit.

I.3 Travel

There was no project related travel during this month.

II. RESEARCH STATUS

II.1 Survey Existing Technology

No work was undertaken on this phase of the project during the month.

II.2 Identify and Define Defects

Work on this phase of the project is essentially complete.

II.3 Lighting and Optics Design

Work on this phase of the project is essentially complete.

II.4 Test Design Concepts

Work on this phase of the project is essentially complete.

II.5 Develop Machine Vision Algorithms

No work was undertaken on this phase of the project in September.

II.6 Develop Color Analysis System

This phase of the project is essentially complete.

II.7 Construction of Proof-of-Concept Workstation

Virtually all of the activity this past month has been directed toward assembly of the proof-of-concept cut-part inspection workstation.

All of the major equipment items are now on order or on hand. We currently have on hand the area vision system and personal computer; the color measurement system and personal computer; the loader the programmable logic controller; and the servo drive for the conveyor. The conveyor is scheduled to ship on October 25.

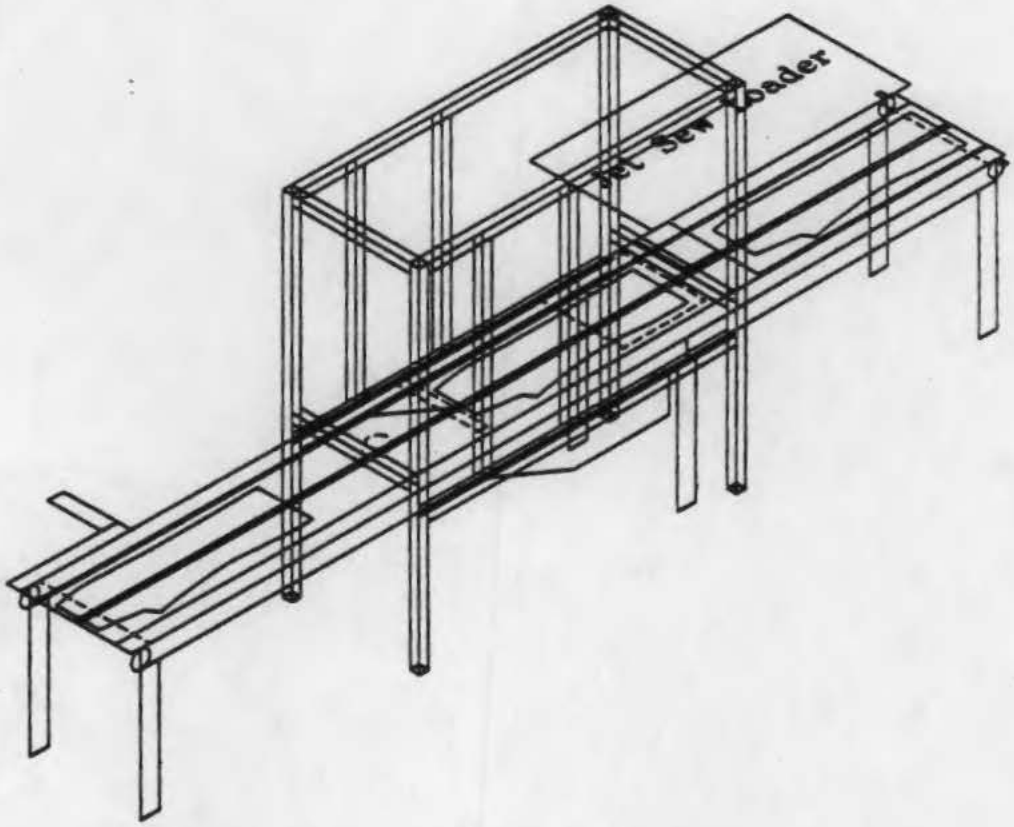
An EG&C Reticon line camera system has been selected for the proto-type unit and orders

have been placed for this last component.

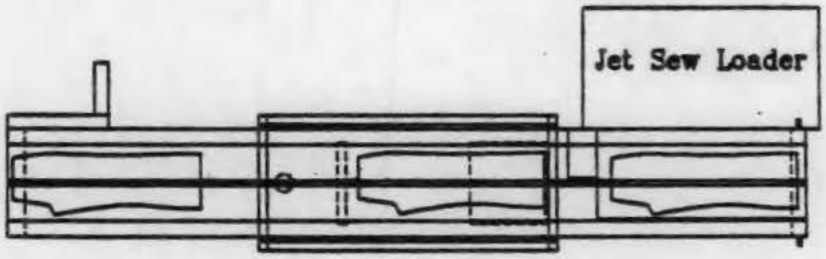
Detailed design work is continuing on the components that are being fabricated at Georgia Tech, including the instrument stand, the unloader, and the pallet mechanism. A line drawing showing the placement of the various units is given in the attached figure. The dotted lines in the central portion of the lower drawing indicate the positions of the area camera, line camera and color measurement system with the appropriate loading and unloading areas of the belt to the left and right. Construction of the frame and instrument mounting systems has begun.

III. PLANS FOR NEXT MONTH

Major effort during the remainder of the project will continue to be devoted to the procurement of parts and construction of the prototype workstation.



Conveyor, Instrument stand, and Loader



Planview of Conveyor, Instrument stand, and Loader

FIGURE

APPLICABILITY OF FLEXIBLE WORK GROUP METHODS

TO THE MANUFACTURE OF MILITARY UTILITY TROUSERS

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER, 1991

I.1 Introduction

The DLA project on Flexible Work Groups (FWG) has completed its twenty-fifth month of program work. The technical and administrative project management is under the supervision of Dr. Charlotte Jacobs-Blecha, the Project Director. This monthly report is composed of the summary and technical reports submitted by the Project Director and members of the project team, and reviews the month's technical progress as proposed in the Program Schedule.

I.2 Project Personnel

In addition to the Project Director, other personnel working on the project are as follows. From EDL are Richard Carey, research engineer and graduate student Steve Nichols. From the School of Industrial and Systems Engineering (ISyE) are Dr. H. Donald Ratliff, Regent's Professor; Dr. John Bartholdi, Associate Professor; and Ph.D. student, Don Eisenstein.

I.3 Travel

Travel was made this month by John Bartholdi and Charlotte Jacobs-Blecha to Cameron Station to discuss with Don O'Brien and Julie Tsao our pending proposal. The proposal has been accepted subject to two requested modifications regarding implementation. These issues have been addressed by the project team and an associated apparel company. A presentation was made by John which explained what we have planned to do to implement the methodologies resulting from this research project. Don O'Brien agreed to immediately provide a funding extension for six months, allowing time for the modified proposal to be submitted, reviewed, and approved.

II. RESEARCH STATUS

II.1 Analysis of FWG

We have continued to study the coordination of workers in a flexible work group.

1. Decentralized Control of Workers

We continue to investigate the decentralized coordination of workers on a manufacturing line such as the TSS (Toyota Sewing System). We have previously discussed the uniform processor model where the difference in speed between workers is uniform over each task. We have shown that if one orders the workers on the line from slowest to fastest that the system converges to a stable configuration that attains the largest possible production rate. This convergence has been proven for only systems in which workers never need wait for a machine. However, our simulation has provided experimental evidence that such a line converges whether or not there is a "bottleneck" task. If such behavior can be proved to occur for all such lines, this would mean that the line is stable and a high throughput is achieved even when the line is overstaffed or the speed of workers increases unexpectedly. To fully understand these lines we need a better understanding of when bottlenecks occur in such systems. With workers of different speeds a given task may be a bottleneck if operated by a slow worker, yet will not be a bottleneck if operated by a faster worker. We have some loose or sufficient conditions under which a task is a bottleneck, but we hope to find some tighter or necessary conditions for a task to be a bottleneck.

2. Graphical Simulation Model

The simulation model continues to provide insight and experimental evidence for the behavior of the TSS line. This month in particular, through our latest enhancements to the model, we were able to observe the convergence of the uniform processor model in the presence of a bottleneck machine. This effort will continue as we further examine bottlenecks in the uniform processor model.

3. Documentation and presentations

We continue to document our results in a formal report. In particular we continue our documentation of the uniform processor model.

II.2 Development of VME

Work continues on the VME to close the connections between the user interface and the algorithms produced by the research on modular manufacturing. This task is nearing completion.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS:

IN-PLANT ASSISTANCE

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER, 1991

Since January 1990, the Problem Solving for Apparel Manufacturers project has assisted manufacturers in solving problems by applying advanced manufacturing technologies, productivity engineering, and innovative management practices. AMTC is supporting DLA's goal to strengthen the domestic apparel industry by helping individual companies improve their manufacturing capabilities.

I.1 Introduction

This report covers progress made during September, 1991 and outlines tasks to be accomplished during the coming months. It provides a means of comparing actual progress achieved with the original time-task schedule identified in the project proposal.

I.2 Project Personnel

Gerry Doubleday and Susan Shows are co-directors of the project. Other AMTC personnel are participating as necessary on specific assignments.

I.3 Travel

September travel included visits to company sites to conduct implementation tasks and to meet with management to discuss implementation projects.

II. PROJECT STATUS

Ten diagnostic projects have been completed, with an eleventh project underway. Three implementation projects are on-going.

The project directors met with two Georgia Tech staff members who are interested in working on the project. Paolo Chiappina, an industrial engineer in the Augusta regional office, has a background in apparel manufacturing. Frank Mewborn works in the Madison regional office and was previously assigned to the Trade Adjustment Assistance Center. Both Paolo and Frank have conducted numerous projects in apparel plants and will work with Gerry and Susan to identify potential contractors and conduct analysis projects.

Independent consultants working with AMTC were contacted in September and advised about the new funding for the problem solving project. They will assist in locating potential contractors.

II.1 Diagnostic Projects

Moka Shoes - boot manufacturer. The diagnostic analysis for this government contractor was completed in September. Gerry Doubleday will meet with company management next week to discuss scheduling for the 30 man-day implementation project which will include:

1) revision of the incentive system
2) training for (2) industrial engineering technicians
3) training for IEs and supervisors in performance management techniques

Wellco Shoes - boot manufacturer. Moka Shoes is a wholly owned subsidiary of Wellco. AMTC will meet with management in October to discuss the possibility of conducting a diagnostic project for Wellco's North Carolina plant.

II.2 Implementation Projects

Implementation projects currently underway:

L.A.T. Sportswear - tee shirt manufacturer. Project has been underway since May to assist this firm in a plant expansion effort. AMTC audited equipment and rates, and made recommendations about building construction, layout, and equipment selection for the new facility.

Preliminary drawings and specs were presented to company management in September. Plant layout and staffing requirements were developed, along with a blueprint of the proposed building. Recommendations to invest in automated pattern making and cutting

equipment were also presented. The company president is currently reviewing the proposal.

Kym Company - trouser manufacturer. Implementation is nearing completion. One additional session of supervisory training is planned at the company's request.

The company's president is still interested in implementing a group incentive system, but has other problems to address at present. Gerry Doubleday and Susan Shows will meet with him at his earliest convenience to discuss project costs and funding alternatives.

The company has been receiving bidding information for government contracts. However, management advises that recent requests for bid have not matched their capabilities.

U.S. Textiles - sweatshirt manufacturer. AMTC made a proposal to provide further assistance to the company in its efforts to secure government bids. Management has not responded to the proposal.

Other implementation projects scheduled to begin:

Maid Bess - uniform manufacturer. interested in installing modular work groups.

Elder Hosiery - hosiery manufacturer. wants to implement a formal product costing system. Proposal sent to company management in September.

II.3 Marketing Efforts

Marketing activities which have been on hold will begin in October.

III. PLANS FOR NEXT MONTH

Continue with diagnostic and implementation projects.

Begin outreach efforts to identify new clients.

LOCATION TECHNOLOGIES FOR APPAREL ASSEMBLY

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER, 1991

The work on this project has been completed and the final report has been submitted.

A follow-on proposal is in preparation involving application of the results of this study in development of two low-cost vision technologies for application in apparel manufacturing.

NONTRADITIONAL ECONOMIC JUSTIFICATION OF EQUIPMENT

I. MONTHLY PROJECT REVIEW FOR SEPTEMBER, 1991

I.1 Introduction

The DLA project continuing work on nontraditional economic justification methods for equipment purchases has completed its eighteenth month. The technical and administrative project management is under the supervision of Dr. B. William Riall. The objective of this project is to provide decision-makers in the apparel industry with software and training to improve the quality of the assessments made on equipment considered for purchase. Previous research has indicated that many of the benefits important to the health of apparel firms are not presently included in such assessments, thus biasing the decision against investment. This monthly report describes the progress made on each of the tasks scheduled for this month.

I.2 Project Personnel

Personnel who have worked on the project include Dr. Bill Riall, Mr. Robert Lann, and graduate student assistant Bill Shamblin. Dr. Riall was responsible for project management and the development of the specifications for the software. Mr. Lann is responsible for developing the software and Mr. Shamblin is responsible for data collection.

I.3 Travel

No travel was conducted in this reporting period.

II. RESEARCH STATUS

II.1 Task I - Equipment Review and Classification

Equipment has been classified into 9 categories according to their function within the apparel plant. The software under development will provide the user with guidance in applying the software to each of these categories as a first step towards economic analysis.

Design
Marker making
Spreading
Cutting
Assembly
Finishing
Warehousing
Materials handling
Production Management

II.2 Task II - Development of Economic Performance Characteristics of Equipment

Discussions with equipment manufacturers and other knowledgeable persons have resulted in reasonably clear pictures of the interactions among most of the various functions performed by apparel equipment. The extent of these interactions is less than originally anticipated. Yet to be analyzed are modular systems and production management. These represent two extremely complex situations best evaluated after the basic structure of the software is established. Additional effort is now being devoted to specifying the algorithms and data sources that can be used in the quantification of each of these parameters. Qualitative factors are being developed separately.

II.3 Task III - Development of Preliminary Evaluation Criteria

Efforts have been concentrated on quantitative evaluations using traditional yardsticks (NPV, etc.) applied to items not traditionally quantified. The expansion of the scope of parameters subjected to quantification is seen as the first step towards a nontraditional approach. Where quantification is not possible, alternative structures for decision-making will be provided. It appears now that this nontraditional structure will consist of a weighted scoring system. The method used to input data into the scoring system will use some of the concepts of the analytical hierarchy process (AHP), rather than use a complete AHP approach. This is because of the complexity and the level of difficulty in interpreting the

results is greater for AHP than the typical executive is willing to support.

An additional task has been identified to assist in the evaluation. Often the greatest benefits are in the area of new markets made possible by the capabilities of new technologies. Assessing the value of these benefits requires an examination of the markets either quantitatively or qualitatively. The new task is the development a framework in which the market potential assessment can be made. This assessment would then be incorporated into the strategic planning components of the weighted scoring system.

II.4 Task IV - Software Development

The structure for the software has been established and is following the format common to many of the most widely used software packages available commercially today, and expected to be available in the future. This format was first used by Lotus and continues greatly enhanced with Excel and Windows. It uses a menu bar at the top of the screen with each menu choice representing another submenu or action which is displayed in the area beneath the menu bar. This structure has the advantage of allowing the user access to the full range of actions available without moving through lengthy tree structures.

The primary elements of the menu bar and their functions are:

Help: Provides general help on how to move through the menu system.

Profile: Allows the user to enter the data which will be used by all analyses. These data would include, for example, the fringe benefits rates to be applied to labor costs, the discount rate used in the NPV calculation, and the tax rates.

Data: First asks whether the user is working with an existing project, or a new project. A new project is given a name and a description can be provided. The user is then given the option of providing either investment data, operating data, or reviewing a summary of the data already entered. Investment costs are further subdivided into equipment purchases and project implementation costs. Further subdivisions are provided to assist the user in identifying the cost items which may be applicable. Three of the areas often left out of analyses for which methods of estimation are included in the software are turnover costs (i.e., the benefits of deskilling), inventory costs, and project introduction costs.

Analysis: The user is asked whether a Financial or Project Scoring analysis is desired. If Financial analysis is chosen, a structure is provided in which scenarios are compared and risk is assessed. The project scoring alternative includes ten categories each of which is weighted for importance by the user followed a scoring of each of up to five projects chosen for the analysis.

Reporting: Allows the user to print either the input data or the analysis results.

Files: Provides the user with file listing, renaming, and deletion capabilities.

A major revision to the planned structure of the software has taken place. The cost categories for the various equipment types has resulted in a comprehensive list applicable across all equipment types. It was apparent that a tradeoff existed between how fast the software would work, how complex it was to learn and use, and how specific the cost categories were to each equipment type. If, as originally planned, a different set of data input and analysis screens were to be used for each of the nine equipment types identified, then the software would require extensive use of overlays because of the 640K RAM limitation in effect for all DOS machines. These overlays reduce the speed at which the software is operated. Also, when the costs categories are different for each equipment type, the task of learning to use the software is greatly increased. The benefits of tailoring nine sub-categories of cost data would be a function of how different the approach would be from one equipment type to another. The analysis has shown a considerable congruence among equipment types. It was therefore decided that equipment specificity in the help screens available to the user would capture virtually all of the benefits of a more complex system with a considerable savings in speed and usability.

The software is currently being written in Pascal. A new version of Pascal, with additional features and greater efficiency, has been adopted for the project.

An extensive series of help messages are being developed that can be accessed by highlighting the element of the software of interest at any point in the analysis. Output formats have been developed for all but the revenue impact and scoring system reports.

II.5 Task V - Training Program Development

A preliminary structure for the training has been developed. It is anticipated that the training will require three days of intensive work with class sizes limited to 12-15 persons. The class will be divided in 3-5 teams each having responsibility to analyze a situation and report their results to the class for discussion. An approach investigated was to compose the teams of three persons from the same company representing the perspectives of production, marketing, and finance. Feedback from the apparel companies contacted has revealed that it is not feasible to expect three persons to be able to attend the training from a single company. It does appear feasible, however, to structure the cases used in the analyses so that one of the team members represents production interests and has the production data, one the financial, and one the marketing. The course agenda is tentatively established to be:

Day 1

Introduction and Plan for the course
What do we want to accomplish here?
How will we go about doing this?
What will be expected of you?

What can you expect of me?

Introduction to Net Present Value
- The irrefutable logic of NPV:
- Why money received next year is not the same as money received today. How can they be made comparable? (Check textbooks for presentations & exercises/demonstrations)
- Why is NPV such a good decision rule?
- Why is NPV not the best decision rule?

- Exercise 1: calculating a simple NPV

The limitations of NPV: components of a quality decision
- The forecasting nature of the decision process
- Looking into the future: dealing with uncertainty
- Assessing risk
- Conducting sensitivity analysis
- Intangibles
- The discount rate question
- With vs Without: the two basic alternatives common to all investment decisions

- Exercise 2: Applying the logic to With vs Without to calculate a NPV
  Incorporating different perspectives

Comprehensive Decision-Making
- The role of quantitative analysis
- The role of qualitatative analysis

Lunch

Introduction to COMPASS: Getting started

<u>Investment Costs</u>

Purchases: Equipment
Inventories
Software

Implementation: Project Introduction
Training
Facilities
Integration
Set-up & Debugging

<u>Operating Costs</u>

Labor: Direct
Indirect
Turnover

Other Items: Fabric
External
Quality
Supplies
Interaction
Floor Space

Revenue Summary

Presenting an Example: Improving sewing productivity

How to use the documentation
- Exercise: Finding your way with Compass

Overnight Assignments (Read 1st case)

Adjourn

Day 2

Discuss case situation: Assessing a more automated marker-making system
Break into groups & Conduct analysis
Present results

Discussion; Critique

Lunch

Present Case 2: Assessing modular manufacturing units
Break into groups & Conduct analysis
Present results

Discussion; Critique

Distribute and Introduce Case 3

Adjourn

Day 3

Discuss case 3 situation: Variations on the other cases used to hone analysis & presentation skills.

Break into groups & Conduct analysis
Present results

Discussion; Critique

Wrap-up & Summarize

Complete Evaluation forms & Adjourn

The review of additional software options, as discussed in section II.4 has delayed the schedule for the training. It is now anticipated that the training will be conducted in March-April. Investigations with industry officials have indicated that a Spring presentation would be more convenient for their participation.

III. PLANS FOR NEXT MONTH

The revenue analysis component will receive attention in the coming month and help-screen texts are anticipated to be completed next month but not integrated into the software until the following month.

Data Accession List

APPAREL MANUFACTURING TECHNOLOGY CENTER

Contract Number: DLA900-87-0018
Performance Period: 910901 - 910930

Sponsored by:

THE UNITED STATES DEPARTMENT OF DEFENSE
DEFENSE LOGISTICS AGENCY

Submitted by:

Economic Development Laboratory
Georgia Tech Research Institute
Georgia Institute of Technology
and
Southern College of Technology

October 18, 1991

Date of visit: 9/11/91
Scott Hall
Plant Manager
Fame Products
Jaspar, GA

Date of visit: 9/12/91
Sherry Bryant
Assistant Professor
DeKalb Tech
8 Students

Date of visit: 9/17/91
Mr. Dan Dauby
Plant Manager
Private Line Group, Inc.
P.O. Box 580
Bowman, GA 30624

Date of visit: 9/17/91
Mr. Primo Quattrini
Vice President of Mfg.
Private Line Group, Inc.
IH 100 North
Franklin, GA 30271

Date of visit: 9/17/91
Mr. John M. Redman
Senior Economist
U.S. Department of Agriculture
1301 New York Avenue, NW
Washington, DC 20005

Date of visit: 9/17/91
Mr. Chuck Mague
IBM

Date of visit: 9/18/91
Margie Dixon
Project Leader
SIEMENS
3333 State Bridge Rd.
Alpharetta, GA 30202

Date of visit: 9/18/91
Mr. Bob Asseedi
IBM Tower
Atlanta, GA

Date of visit: 9/18/91
Mr. Roy Hopper
Marketing Representative
IBM
1201 W. Peachtree St.
Atlanta, GA

Date of visit: 9/18/91
Anne Amithge
Marketing Representative
IBM
1201 W. Peachtree St.
Atlanta, GA

Date of visit: 9/18/91
Daphene Jones
SEM
IBM
1201 W. Peachtree St.
Atlanta, GA

Date of visit: 9/18/91
Mr. James Bon
SEM
IBM
1201 W. Peachtree St.
Atlanta, GA

Date of visit: 9/18/91
Rochell McLain
SE
IBM
1201 W. Peachtree St.
Atlanta, GA

Date of visit: 9/18/91
Mr. Charlie Parsons
IS
IBM
1201 W. Peachtree St.
Atlanta, GA

Date of visit: 9/18/91
Lek Torrence
IBM
1201 W. Peachtree St.
Atlanta, GA

Date of visit: 9/18/91
Mr. Barry Balint
IBM
1201 W. Peachtree St.
Atlanta, GA

Date of visit: 9/18/91
Pamela Moys
IBM
1201 W. Peachtree St.
Atlanta, GA

Date of visit: 9/18/91
Diane Hartness
Marketing Representative
IBM
Albany, GA

Date of visit: 9/18/91
Buzzy Stevens
Marketing Representative
IBM
Albany, GA

Date of visit: 9/18/91
Harris Warsaw
IBM
Albany, GA

Date of visit: 9/18/91
Cathy LeMan
Marketing Representative
IBM

Date of visit: 9/18/91
Randy Wilson
Analyst
GoldKist
244 Perimeter Center
Atlanta, GA

Date of visit: 9/23/91
Major Daniel Starford
Operations Officer
U.S. Army - DPSC - VO
2800 S. 20th Street
Philadelphia, PA 19101

Date of visit: 9/23/91
Scott Golthoraite
Industrial Specialist
DPSC - V
2800 S. 20th Street Bldg. 13
Philadelphia, PA 19101

Date of visit: 9/23/91
Ardena Jarrells
Sample Maker
USAF
WPAFB
Dayton, OH 45433

Date of visit: 9/23/91
Maria Mavrouleas
Pattern Designer
USAF
WPAFB
Dayton, OH 45433

Date of visit: 9/23/91
Ana Haug
Sample Maker
USAF
WPAFB
Dayton, OH 45433

Date of visit: 9/23/91
David Lanthorn
A.F. Clothing B

Date of visit: 9/23/91
Connie Pfeiffer
Clothing Pattern Designer
USAF

Date of visit: 9/23/91
Dimitrios G. Lookoumidis
USAF Clothing

Date of visit: 9/23/91
John Yourk
Directorate of Manufacturing
Defense Personnel Support Center
2800 South 20th Street
Philadelphia, PA 19145

Date of visit: 9/23/91
Frank John Viola, Jr.
Directorate of Manufacturing
Defense Personnel Support Center
2800 South 20th Street
Philadelphia, PA 19145

Date of visit: 9/23/91
Fred Taylor, VME
Director of Manufacturing
Defense Personnel Support Center
2800 South 20th Street
Philadelphia, PA 19101

Date of visit: 9/23/91
Joseph V. D'Adamo
Industrial Specialist
Defense Personnel Support Center
2800 South 20th Street
Philadelphia, PA 19101

Date of visit: 9/23/91
James Della Polla
Chief, Mgt. Engineering
Defense Personnel Support Center
2800 South 20th Street
Philadelphia, PA 19101

Date of visit: 9/26/91
Bev Dinham-Smith
Director
HEART INTA
Kingston, Jamaica

Date of visit: 9/26/91
Paulette A. Rhode
Director/Export
Crimson Dawn Mfg.
2 Central Avenue
Swallowfield 5
Kingston, Jamaica

Date of visit: 9/26/91
Mabel Codling
Senior Instructor
James HEART Academy
76 Marcus Yancey Dr.
Kingston 13, Jamaica

Date of visit: 9/26/91
Gloria Russell
Consultant/Pattern Maker
HEART
Kingston, Jamaica

Date of visit: 9/26/91
Paul Herdsman
Program Manager
HEART
Kingston, Jamaica

Date of visit: 9/27/91
German Estefan
Senior General Manager
Carvajal S.A.
P.O. Box 46
Cali-Colombia, SA

Date of visit: 9/27/91
Jorge H. Bojanini
Q.C. Manager
Carvajal S.A.
P.O. Box 46
Cali-Colombia, SA

VISITORS TO AMTC
9/30/91

Elizabeth Watts, M.S., CHE, IDEC
Assistant Professor
Berry College
5011 Mount Berry Station
Rome, GA 30149

STUDENTS

Kristina Strayton

Stacey Powers

Cathy Watkins

Tracy Jinks

Amy Summerlin

Kim Crane

Karen Hays

Program Schedules

APPAREL MANUFACTURING TECHNOLOGY CENTER

Contract Number: DLA900-87-0018
Performance Period: 910901 - 910930

Sponsored by:

THE UNITED STATES DEPARTMENT OF DEFENSE
DEFENSE LOGISTICS AGENCY

Submitted by:

Economic Development Laboratory
Georgia Tech Research Institute
Georgia Institute of Technology
and
Southern College of Technology

October 18, 1991

APPAREL ADVANCED MANUFACTURING TECHNOLOGY DEMONSTRATION PROGRAM SCHEDULE

PERIOD ENDING 9-30-91

TASK	YEAR	1				2				3				4				5			
ITEM	Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
DEMONSTRATION PLANT																					
- Establishment		●		●																	
- Demonstrations																					
Major				●		●		●		●		●		●		●		●		●	
Minor					●		●		●		●		●		●		●		●		O
COALITION																					
- Establishment		●			●																
- Operation & Maintenance			●																		O
TECHNOLOGY TRANSFER																					
- AMIS				●																	O
- Publicity		●																			O
ECONOMICS ANALYSES		●			●																
ADVISORY COMM. MEETINGS		●		●		●		●		●		●		●		●		●		O	
REPORTING																					
- Monthly (3/quarter)		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	O	O	O
- Quarterly		●	●	●	●																
- Annually					●				●				●				●				O

SITE PERPETUATION

GENERIC ARCHITECTURE FOR APPAREL MANUFACTURING PROGRAM SCHEDULE

PERIOD ENDING 9-30-91

SHORT TERM TASK	YEAR	1												2											
nd SUBTASK ITEM	MONTH	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
PHASE I FUNCTION ARCHITECTURE																									
Review Industrial Practice		●			●																				
Develop Functional Architecture			●			●																			
Specifications																									
Build Model and Document							●			●															
Technical Report										●															
PHASE II INFORMATION ARCHITECTURE																									
Study Information in Industry									●			●													
Develop Hierarchial Information Flow											●		●												
Develop Information Architecture												●		●											
Specifications																									
Build Model and Document													●		●										
Technical Report															●										
PHASE III DYNAMICS ARCHITECTURE																									
Construct "What If" Scenarios															●		●								
Analyze Information Transfer																●			●						
Develop Dynamics Architecture and																		●			●				
Simulate & Document Model																									
Develop Generic Apparel Architecture																				●					●
Technical Report																									●

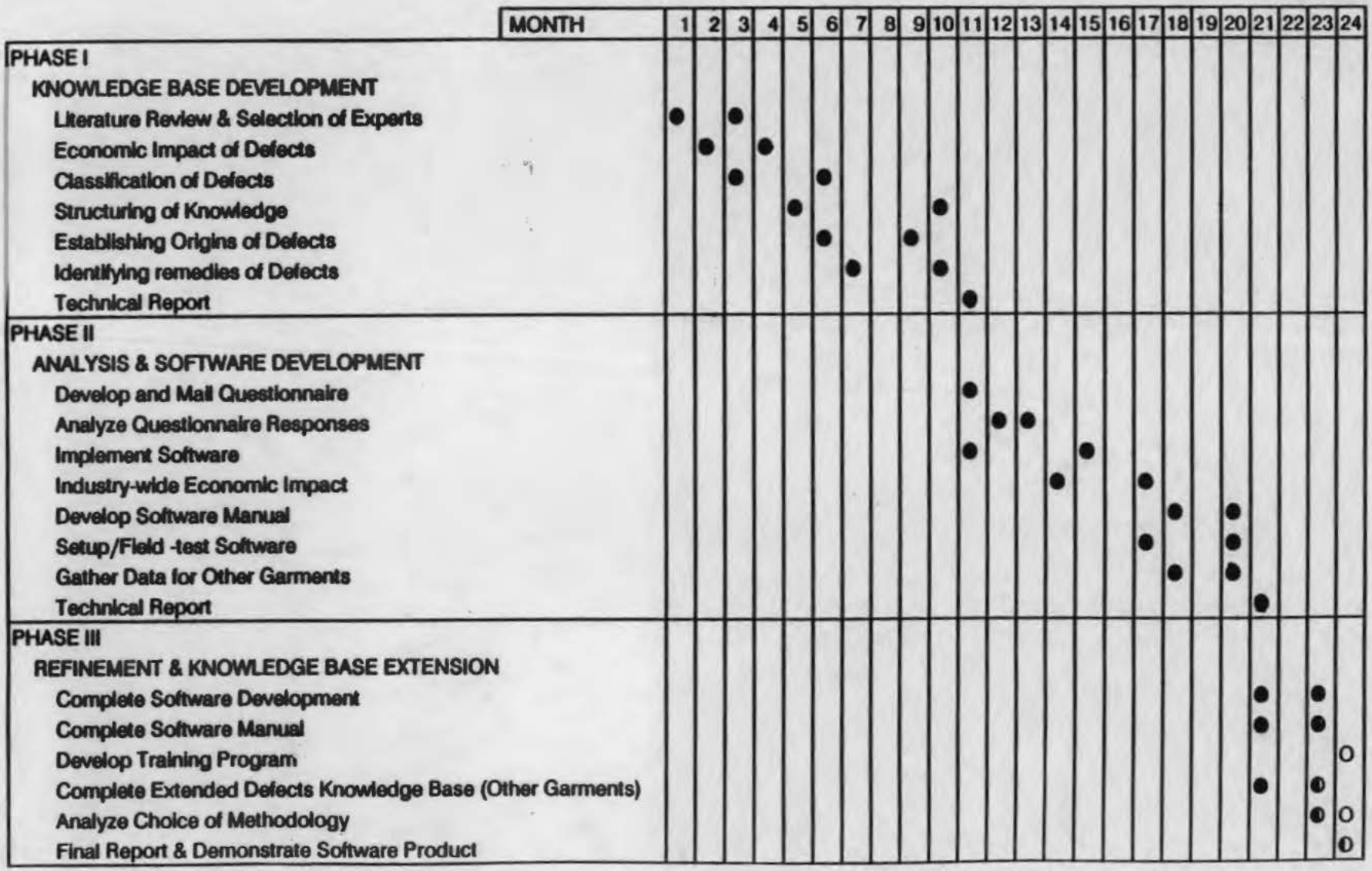
KNOWLEDGE BASED FRAMEWORK FOR TROUSER PROCUREMENT PROGRAM SCHEDULE

PERIOD ENDING 9-30-91

SHORT TERM TASK and SUBTASK ITEM	YEAR	1												2											
	MONTH	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
PHASE I																									
Review Past Research Efforts		●		●																					
Develop & Refine Industry Questionnaire			●			●																			
Collect Info. Through Questionnaire					●			●																	
Analyze Results of Questionnaire							●			●															
Technical Report										●															
PHASE II																									
Develop Sturctured Report of Current Practice									●			●													
Define Additional Factors											●		●												
Interact Findings with Industry				●									●		●										
Develop Renking Scheme				●									●		●										
Technical Report															●										
PHASE III																									
Implementation, Programming, Debugging, Manual Development															●					●					
Field Testing and Refinement																				●				●	
Technical Report and Installation																									◐

ANALYSIS OF DEFECTS IN TROUSER MANUFACTURING PROGRAM SCHEDULE

PERIOD ENDING 9-30-91



PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA PROGRAM SCHEDULE

Exhibit 3.6A

PERIOD ENDING 9-30-91

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirement	●●●																	
Develop/Distribute Literature/ Announcement	●●●	●●●																
Review Response			●●●															
Interact with Candidates				●●●	●●●													
Present List to DLA					●●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●○	○○○											
Train/Educate in AMA							○○○	○○○										
Analysis and Modeling								○○○	○○○	○○○	○○○	○○○	○○○					
PHASE III: EVALUATION																		
Review Solution														○○○	○○○			
Cost/Benefit Analysis															○○○	○○○	○○○	
Prepare for Workshop/Seminar																	○○○	○○○
Final Report																		○○○

PRINCIPLES OF ERGONOMICS PROGRAM SCHEDULE

PERIOD ENDING 9-30-91

SHORT TERM TASK and SUBTASK ITEM	YEAR	1												2											
	MONTH	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
PHASE I																									
Literature Review & Site Selection		●●		●●																					
Task Analysis			●●					●●																	
Analysis			●●				●●																		
Data Collection			●●				●●																		
Performance Measure Development				●●				●●																	
Phase I Report								●●																	
PHASE II																									
Task Analysis								●●		●●															
Plan Candidate Interventions									●●	●●															
Hold Test Interventions										●●			●●												
Phase II Report													●●												
PHASE III																									
Develop Candidate Approaches													●●		●●										
Conduct Tests of AMTC														●●							●●				
Phase III Report																						●●			
PHASE IV																									
Identify Training Objectives																		●●	●●						
Identify Instructional Approaches																			●●	●●					
Prepare Materials																			●●			●●			
Hold Test Materials																						●●	●O		
Revise Materials																						●●	●O		
Present Training Workshop																							●O		
Final Report																							OO		

IN-PROCESS QUALITY CONTROL: FABRIC DEFECTS PROGRAM SCHEDULE

PERIOD ENDING 9-30-91

SHORT TERM TASK and SUBTASK ITEM	YEAR	1												2											
	MONTH	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
PHASE I																									
Survey Existing Technology		●		●																					
Identify & Define Defects		●			●																				
Defect Optical Properties				●		●																			
Lighting & Optics Design					●		●																		
Test Design Concepts						●	●																		
PHASE II																									
Develop Machine Vision Algorithms								●			●														
Design Software									●								●								
Develop Color Analysis System								●					●												
Develop Conceptual Model												●							●						
Design & Construct Modules														●					●						
Test Modules																		●	●						
PHASE III																									
Acquire Components																				●	◐				
Assemble Inspection System																					O			O	
Test and Demonstrate																							O		O
Final Report																								O	O

FLEXIBLE WORK GROUPS PROGRAM SCHEDULE

PERIOD ENDING 9-30-91

SHORT TERM TASK	PHASE I												PHASE II											
nd SUBTASK ITEM MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
tudy Existing FWG's																								
Literature Review	●●●	●●●	●●●	●●●	●●●	●●●																		
Site Visits					●●●	●●●	●●●	●●●	●●●	●●●	●●●													
Summary of Findings												●●●												
Study of Current Work Methods																								
Site Visits	●●●	●●●	●●●	●●●																				
Data Collection				●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●												
Analysis of FWG																								
Literature Review	●●●	●●●	●●●	●●●	●●●	●●●																		
Modeling and Analysis		●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●○○							
Design of Methodology														●●●	●●●	●●●	●●●	●●●	●●●	○○○				
Experimentation																		●●●	●●●	○○○	○○○	○○○		
Summary of Results																						○○○		
Development of VME																								
Specifications	●●●	●●●	●●●																					
Hardware Implementation			●●●	●●●	●●●	●●●	●●●	●●●																
Software Implementation			●●●	●●●	●●●	●●●	●●●	●●●																
Design Database					●●●	●●●	●●●	●●●																
Design and Implement Initial Prototype					●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●										
Demonstration 1															●●●	●●●	●●●	●●●	●●●	○○○	○○○	○○○		
Refinement and Expansion														●●●										
Demonstration 2																								○○○
Establish Experimental FWG																								
Identification of Workers													●●●											
Training														●●●	○○○									
Experimentation and Observation															○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○		
Data Collection															○○○	○○○	○○○	○○○	○○○	○○○	○○○	○○○		
Reporting																								
Phase I												●●●												
Phase II																							○○○	○○○

APPAREL PROBLEM SOLVING PROGRAM SCHEDULE

Exhibit 3.7A

PERIOD ENDING 9-30-91

SHORT TERM TASK and SUBTASK / MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
PHASE I																								
Establish Eligibility Requirement	●●																							
Develop Target Marketing List	●●	●●																						
Develop Promotional Literature	●●	●●																						
Distribute Literature			●●	●●	●●	●●	●●	●●	●●	●●	●●	●●	●●	●●	●●	●●	OO	OO	OO	OO				
Formulate Analysis Methodologies	●●	●●	●●	●●																				
Telephone Interviews with Potential Clients																								
PHASE II																								
Visit Potential Clients					●●	●●	●●																	
Conduct Analysis for Selected Firms						●●	●●	●●	●●	●●	●●	●O												
PHASE III																								
Finalize Implementation Packages											●●													
Begin Implementation of Companies with Completed Analysis												●●	●●	●O	OO	OO	OO	OO	OO	OO	OO	OO	OO	OO
Continue Additional Analysis / Implementation Projects												●●	OO	OO	OO	OO	OO	OO	OO	OO	OO	OO	OO	OO

LOCATION TECHNOLOGIES FOR APPAREL ASSEMBLY PROGRAM SCHEDULE

Exhibit 4.0 A

PERIOD ENDING 9-30-91

SHORT TERM TASK and SUBTASK ITEM	MONTHS							
	1	2	3	4	5	6	7	8
Selection of Garments	●●							
Establish Manufacturing Requirements	●●	●●	●●	●●				
Review Current Methods		●●	●●	●●				
Review Available Location Technologies			●●	●●	●●	●●		
Identify Most Useful Technology					●●	●●	●●	
Prepare Final Report							●●	●●

Notes

Burlington Denim

A division of Burlington Indust

Division Offices
P. O. Box 21207
Greensboro, N. C. 27420

October 3, 1991

Dr. Wayne Daley
Georgia Institute of Technology
School of Textile and Fiber Engineering
Atlanta, GA 30332

Dear Wayne:

Many thanks for spending time with us last Thursday to describe your work on Vision Inspection. We appreciate Dr. Tincher making the arrangements.

We are very interested in following the progress of this work and would like to visit Southern Tech when the module is complete and installed there.

The work you have done is a giant step forward in this arena and w hope it will lead to a full width fabric inspection system in the future.

If we can be of any assistance in your efforts please contact me.

Sincerely,

Darlene Ball, Manager
Customer Support

DLB/wb

cc: ~~Dr. Wayne Tincher~~ - Georgia Institute of Technology
Mr. Bill Hunter - Burlington Industries/Mooresville, NC
Mr. Van Knox - Burlington Industries/Mooresville, NC
Mr. Pryor Millner - Burlington Industries/Mooresville, NC
Mr. Nathan Sandefur - Burlington Industries/Mooresville, NC
Mr. Jim Slagle - Burlington Industries/Mooresville, NC

E27-618
#15,16

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR OCTOBER, 1991

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of October 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the Research Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, is joining the effort as a Graduate Research Assistant.

I.3 Travel

Dr. Jayaraman met with Mr. Don O'Brien and Ms. Julie Tsao of DLA/DMERO in Philadelphia and briefed them on the status of the research effort, in particular the ongoing work with Dowling Textiles.

Also, please see Dowling Textiles in Section II.1 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

Based on the input received at meetings with Dowling personnel, a preliminary version of the *AS IS* model of Dowling's planning and purchasing functions was created using the IDEF methodology. At a subsequent meeting with Mr. Andrew Boyd and Ms. Ali Barr of Dowling, the model was reviewed and areas for modification were identified. Since then, the model has undergone substantial changes during several discussions and revisions by the Georgia Tech team. The refined *AS IS* model has been sent to Dowling for review. The research effort is proceeding according to the plans laid out earlier.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. Ms. Zhou, Mr. Srinivasan and Dr. Jayaraman visited Dowling for interactions with personnel responsible for shop-floor operations. Dowling has furnished information on several garments which will be used in the study. One objective behind this effort is to investigate opportunities for computer assistance in the operation of the shop-floor at Dowling.

II.2 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shop-floor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

A report on the work carried out until now is being prepared for submission to HP.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

The interaction with Dowling Textiles will proceed on a regular basis. The results from a

review of the AS IS model of Dowling's Production Planning process will be used to refine the AS IS model and to initiate TO BE modeling with the help of AMA.

III.2 Hewlett-Packard Manufacturing Management System

Continue documenting the work carried out on the system.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA PROGRAM SCHEDULE

Exhibit 3.6A

PERIOD ENDING 10-31-91

SHORT TERM TASK id SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
HASE I: SELECTION																		
Establish Eligibility Requirement	●●●																	
Develop/Distribute Literature/ Announcement	●●●	●●●																
Review Response			●●●															
Interact with Candidates				●●●	●●●													
Present List to DLA					●●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●●	○○○											
Train/Educate in AMA							○○○	○○○										
Analysis and Modeling								○○○	○○○	○○○	○○○	○○○	○○○					
PHASE III: EVALUATION																		
Review Solution														○○○	○○○			
Cost/Benefit Analysis															○○○	○○○	○○○	
Prepare for Workshop/Seminar																	○○○	○○○
Final Report																		○○○

#17,18.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR NOVEMBER, 1991

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of November 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the Research Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, has joined the effort as a Graduate Research Assistant.

I.3 Travel

None specifically for this project. At the AAMA/ARC Conference held in Atlanta, Dr. Jayaraman met with Mr. Dan Wright of Dowling Textiles and discussed the progress on the work being carried out in collaboration with Dowling. Mr. Wright expressed his satisfaction with the effort to-date.

Also, please see Dowling Textiles in Section II.1 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

A few additional comments were received from Mr. Andrew Boyd and Ms. Ali Barr of Dowling on the refined *AS IS* model sent to Dowling last month. These changes have since been incorporated into the model. The research effort is proceeding according to the plans laid out earlier.

At the last meeting of the project team at Dowling, the objectives for the TO BE model were set. These are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting. Currently, the analysis of the planning and purchasing functions is being carried out using the AS IS model to determine the feasibility of the TO BE model objectives. Ms. Ali Barr is studying the purchase order records of the past year to obtain an estimate of realistic fabric delivery times. Mr. Andrew Boyd is analyzing the past factory orders for trends in types of goods ordered which could help in better understanding the finished fabric requirements.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. Dowling furnished additional information on the shop-floor operations which is being used by Ms. Zhou in her work. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling.

II.2 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shop-floor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

The initial draft of the report covering the work carried out has been prepared.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Work on the Dowling TO BE architecture vis-a-vis AMA will be initiated.

III.2 Hewlett-Packard Manufacturing Management System

Review the initial draft of the report for HP.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA PROGRAM SCHEDULE

Exhibit 3.6A

PERIOD ENDING 11-30-91

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirement	●●●																	
Develop/Distribute Literature/ Announcement	●●●	●●●																
Review Response			●●●															
Interact with Candidates				●●●	●●●													
Present List to DLA					●●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●●	○○○											
Train/Educate in AMA							○○○	○○○										
Analysis and Modeling								○○○	○○○	○○○	○○○	○○○	○○○					
PHASE III: EVALUATION																		
Review Solution														○○○	○○○			
Cost/Benefit Analysis															○○○	○○○	○○○	
Prepare for Workshop/Seminar																	○○○	○○○
Final Report																		○○○

#19,20

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR DECEMBER, 1991

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of December 1991. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the Research Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, has joined the effort as a Graduate Research Assistant. Ms. Yin Zhou is another Graduate Research Assistant on the project.

I.3 Travel

Please see Dowling Textiles in Section II.1 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

At the November meeting of the project team at Dowling, the objectives for the TO BE model were set. These are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting.

The initial version of the TO BE Information model for the integrated production planning system has been developed. This model was subsequently discussed with Dowling team members. Further review of the model and comments from Dowling are awaited.

The data on purchase orders, delivery times and factory order trends have been collected and analyzed to determine if fabric procurement in the TO BE system could be carried out without forecasting. The results of the analysis will be reflected in the TO BE function model to be developed in the future.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. She has been developing simulation models of the shop-floor operations using Dowling's data. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling.

II.2 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shop-floor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

A review of the initial draft of the report covering the work carried out has commenced.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Work on the Dowling TO BE architecture vis-a-vis AMA will be continued.

III.2 Hewlett-Packard Manufacturing Management System

Continue review of the report draft for HP.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA PROGRAM SCHEDULE

Exhibit 3.6A

PERIOD ENDING12-31-91

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirement	●●●																	
Develop/Distribute Literature/ Announcement	●●●	●●●																
Review Response			●●●															
Interact with Candidates				●●●	●●●													
Present List to DLA					●●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●●	●●○											
Train/Educate in AMA							●●○	○○○										
Analysis and Modeling								●○○	○○○	○○○	○○○	○○○	○○○					
PHASE III: EVALUATION																		
Review Solution														○○○	○○○			
Cost/Benefit Analysis															○○○	○○○	○○○	
Prepare for Workshop/Seminar																	○○○	○○○
Final Report																		○○○

#21,22

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR JANUARY, 1992

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of January 1992. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the Research Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, has joined the effort as a Graduate Research Assistant. Ms. Yin Zhou is another Graduate Research Assistant on the project.

I.3 Travel

Please see Dowling Textiles in Section II.1 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

The TO BE information model (for integrated planning and purchasing) for Dowling Textiles was presented to Dowling at a meeting held during the month. During the discussion of the model, a few areas for modification were identified. These changes are currently being incorporated into the model. The major objectives behind the TO BE model are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting.

Discussions were also held on the presentation at the upcoming Academic Apparel Researchers Conference. A preliminary outline has been developed.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. She has been developing simulation models of the shop-floor operations using Dowling's data. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling. During the visit to Dowling, time was also spent on the shop-floor to study the operations and to obtain additional data for the work.

II.2 Paper for the Academic Apparel Researchers Conference

Dr. Jayaraman wrote the paper for the upcoming Academic Apparel Researchers Conference and circulated it to the team members. After review and approval of Dowling, the paper was submitted to MTIAC.

II.3 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shop-floor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

A review of the initial draft of the report covering the work carried out is in progress.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Work on the Dowling TO BE architecture vis-a-vis AMA will be continued. Continue work on the shop-floor simulation and analysis.

III.2 Hewlett-Packard Manufacturing Management System

Continue review of the report draft for HP.

III.3 Academic Apparel Researchers Conference

Prepare for a presentation at the upcoming AARC Conference in Marietta, Georgia.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA PROGRAM SCHEDULE

Exhibit 3.6A

PERIOD ENDING1-31-92

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirement	●●●																	
Develop/Distribute Literature/ Announcement	●●●	●●●																
Review Response			●●●															
Interact with Candidates				●●●	●●●													
Present List to DLA					●●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●●	●●O											
Train/Educate in AMA							●●●	OOO										
Analysis and Modeling								●OO	OOO	OOO	OOO	OOO	OOO					
PHASE III: EVALUATION																		
Review Solution														OOO	OOO			
Cost/Benefit Analysis															OOO	OOO	OOO	
Prepare for Workshop/Seminar																	OOO	OOO
Final Report																		OOO

#23, 24

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR FEBRUARY, 1992

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of February 1992. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the Research Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, has joined the effort as a Graduate Research Assistant. Ms. Yin Zhou is another Graduate Research Assistant on the project.

I.3 Travel

Please see Dowling Textiles in Section II.1 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

The TO BE information model (for integrated planning and purchasing) for Dowling Textiles has been modified to reflect the suggestions made by Dowling. The major objectives behind the TO BE model are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting.

Discussions were held on the presentations for the Academic Apparel Researchers Conference. At the Conference, Dr. Jayaraman outlined the project scope and activities carried out to-date. Ms. Ali Barr and Mr. Andrew Boyd (from Dowling Textiles) presented Dowling's perspective on the project and discussed the benefits to the organization from the effort. Later in the afternoon, the prototype information system (based on the modeling efforts) was demonstrated to visitors during the Plant Tour of AMTC. The prototype information system is nearly complete.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. She has been developing simulation models of the shop-floor operations using Dowling's data. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling. During the visit to Dowling, time was also spent on the shop-floor to study the operations and to obtain additional data for the work.

II.2 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shop-floor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

A review of the initial draft of the report covering the work carried out is in progress.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Develop a plan to implement the prototype planning and purchasing information system at Dowling. Continue work on the shop-floor simulation and analysis.

III.2 Hewlett-Packard Manufacturing Management System

Continue review of the report draft for HP.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA PROGRAM SCHEDULE

Exhibit 3.6A

PERIOD ENDING 2-28-92

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirement	●●●																	
Develop/Distribute Literature/ Announcement	●●●	●●●																
Review Response			●●●															
Interact with Candidates				●●●	●●●													
Present List to DLA					●●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●●	●●●											
Train/Educate in AMA							●●●	●OO										
Analysis and Modeling								●●●	OOO	OOO	OOO	OOO	OOO					
PHASE III: EVALUATION																		
Review Solution														OOO	OOO			
Cost/Benefit Analysis															OOO	OOO	OOO	
Prepare for Workshop/Seminar																	OOO	OOO
Final Report																		OOO

E-27-613
#25,26

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR MARCH, 1992

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of March 1992. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Dr. Rajeev Malhotra is the Research Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, has joined the effort as a Graduate Research Assistant. Ms. Yin Zhou is another Graduate Research Assistant on the project.

I.3 Travel

Please see Dowling Textiles in Section II.1 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

The TO BE information model (for integrated planning and purchasing) for Dowling Textiles has been modified to reflect the suggestions made by Dowling. The major objectives behind the TO BE model are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting.

A prototype information system based on the TO BE Information model has been developed using SQL forms and Oracle database. The system was demonstrated at Dowling to Ms. Ali Barr and Mr. Andrew Boyd. A user guide to accompany the information system has also been written. This system will be installed at Dowling for use and evaluation by Dowling personnel. Based on the input, the system will be modified to suit Dowling's needs.

During the visit to Dowling, the research team got a brief demonstration of the software system (running on the AS/400) recently acquired by Dowling. The possibility of using the TO BE Information model to customize the newly acquired software was also discussed. Dowling management will investigate this issue further. If the customization is undertaken, the utility of the architectural approach to information systems development will be further demonstrated.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. She has been developing simulation models of the shop-floor operations using Dowling's data. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling. During the visit to Dowling, time was also spent on the shop-floor to study the operations and to obtain additional data for the work.

II.2 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shop-floor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

A review of the initial draft of the report covering the work carried out is in progress.

III.3 Interactions with Bassett-Walker

Based on the information handed out at the February AAMA/ARC meeting, an inquiry was received from Bassett-Walker on the research effort. The models along with the appropriate literature have been sent to Bassett-Walker.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Implement the prototype planning and purchasing information system at Dowling. Continue work on the shop-floor simulation and analysis.

III.2 Hewlett-Packard Manufacturing Management System

Continue review of the report draft for HP.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA PROGRAM SCHEDULE

Exhibit 3.6A

PERIOD ENDING 3-31-92

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirement	●●●																	
Develop/Distribute Literature/ Announcement	●●●	●●●																
Review Response			●●●															
Interact with Candidates				●●●	●●●													
Present List to DLA					●●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●●	●●●											
Train/Educate in AMA							●●●	●●○										
Analysis and Modeling								●●●	●○○	○○○	○○○	○○○	○○○					
PHASE III: EVALUATION																		
Review Solution														○○○	○○○			
Cost/Benefit Analysis															○○○	○○○	○○○	
Prepare for Workshop/Seminar																	○○○	○○○
Final Report																		○○○

E21-610
27,28

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR APRIL, 1992

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of April 1992. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. On April 1st, Dr. Rajeev Malhotra, the research investigator on the project, joined United Parcel Service as a Systems Design Engineer. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, has joined the effort as a Graduate Research Assistant. Ms. Yin Zhou is another Graduate Research Assistant on the project.

I.3 Travel

Please see Dowling Textiles in Section II.1 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

The TO BE information model (for integrated planning and purchasing) for Dowling Textiles has been modified to reflect the suggestions made by Dowling. The major objectives behind the TO BE model are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting. A prototype information system based on the TO BE Information model has been developed using SQL forms and Oracle database. The system was demonstrated at Dowling to Ms. Ali Barr and Mr. Andrew Boyd. A user guide to accompany the information system has also been written.

This system has been installed at Dowling for use and evaluation by Dowling personnel. Based on the input, the system will be modified to suit Dowling's needs. However, due to excessive commitments at work, the Dowling team members have not had the time to evaluate the system. Of course, this is understandable since their primary objective is to meet their organization's goals.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. She has been developing simulation models of the shop-floor operations using Dowling's data. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling.

II.2 Annual Contract Briefing

The Annual Contract Briefing (ACB) for the project was held at the demonstration center on Southern Tech Campus. A poster on the project was presented by Mr. Srinivasan and Dr. Jayaraman. A few participants evinced interest in the work. At the ACB, Dr. Jayaraman spoke with Mr. Dan Wright and Mr. Vijay Shah (both of Dowling) about the status of the project and sought their views. Both had positive comments on the work and its benefits to Dowling.

II.3 Hewlett-Packard Manufacturing Management System

To integrate the production facilities available at AMTC, the HP Manufacturing Management II (MM II) software running on HP 3000 minicomputer at the center is being customized to conform to the AMA. MM II is a general-purpose manufacturing management package that consists of modules that handle various enterprise functions such as inventory control, manufacturing requirements planning, order entry, shop-floor control, purchasing, costing and general ledger. The MM II modules share the enterprise data which

is maintained in the TurboIMAGE network database on the HP3000. The work currently in progress involves modifying the data definitions used by the MM II package to suit the specific needs of an apparel manufacturing enterprise. The MM II data definitions are being tailored to the specifications provided by the information model of AMA. The data entry screens and reports of MM II are also being customized for apparel manufacturing.

A review of the initial draft of the report covering the work carried out is in progress.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Seek input from Dowling on the prototype planning and purchasing information system installed there. Continue work on the shop-floor simulation and analysis.

III.2 Hewlett-Packard Manufacturing Management System

Continue review of the report draft for HP.

III.3 Seek Another Project Participant

Begin efforts to find another partner for the project.

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA PROGRAM SCHEDULE

PERIOD ENDING 4/30/92

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirement	●●●																	
Develop/Distribute Literature/ Announcement	●●●	●●●																
Review Response			●●●															
Interact with Candidates				●●●	●●●													
Present List to DLA					●●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●●	●●●											
Train/Educate in AMA							●●●	●●●										
Analysis and Modeling								●●●	●OO	OOO	OOO	OOO	OOO					
PHASE III: EVALUATION																		
Review Solution														OOO	OOO			
Cost/Benefit Analysis															OOO	OOO	OOO	
Prepare for Workshop/Seminar																	OOO	OOO
Final Report																		OOO

E21-618

#29,30 #[illegible]

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR MAY, 1992

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of May 1992. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, is the Graduate Research Assistant. Ms. Yin Zhou is another Graduate Research Assistant on the project.

I.3 Travel

No travel occurred specifically for this project during May.

II. RESEARCH STATUS

II.1 Current Monthly Activity

Dowling Textiles

The TO BE information model (for integrated planning and purchasing) for Dowling Textiles has been modified to reflect the suggestions made by Dowling. The major objectives behind the TO BE model are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting. A prototype information system based on the TO BE Information model has been developed using SQL forms and Oracle database. The system was demonstrated at Dowling to Ms. Ali Barr and Mr. Andrew Boyd. A user guide to accompany the information system has also been written.

This system has been installed at Dowling for use and evaluation by Dowling personnel. Based on the input, the system will be modified to suit Dowling's needs. Unfortunately, Dowling personnel couldn't find time to evaluate the system. Dr. Jayaraman spoke to Ms. Ali Barr and she explained the time constraints and said that they would try to work on the system in the very near future.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. She has been developing simulation models of the shop-floor operations using Dowling's data. Several modular cells have been simulated for the various product lines. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling.

Additional Participant

Dr. Jayaraman met with Mr. John Adams and explored opportunities for a second partner on the project. Mr. Adams will talk to Mr. Roy Terry of Terry Manufacturing and seek their participation on the project.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Seek input from Dowling on the prototype planning and purchasing information system installed there. Visit Dowling to review the results of the shop-floor simulation and analysis.

III.2 Another Project Participant

Continue efforts to find another partner for the project.

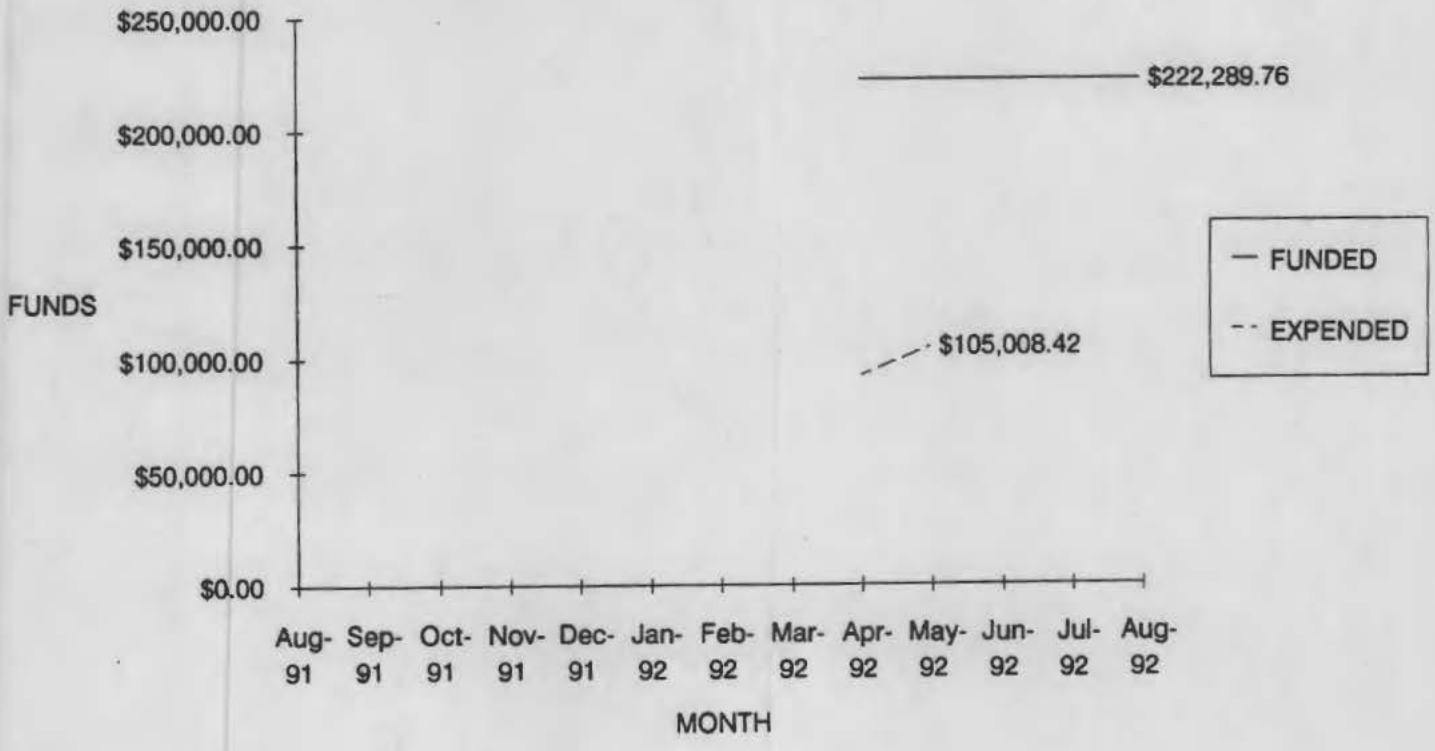
UTILIZATION OF AMA PROGRAM SCHEDULE

E-27-618

PERIOD ENDING 5/31/92

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirem	●●																	
Develop/Distribute Literature	●●	●●																
Announcement																		
Review Response			●●															
Interact with Candidates				●●	●●													
Present List to DLA					●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●	●●											
Train/Educate in AMA							●●	●O										
Analysis and Modeling								●●	●O	OO	OO	OO	OO					
PHASE III: EVALUATION																		
Review Solution														OO	OO			
Cost/Benefit Analysis															OO	OO	OO	
Prepare for Workshop/Seminar																	OO	OO
Final Report																		OO

E-27-618



E27-618

#31,32 ~~[illegible]~~

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR JUNE, 1992

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of June 1992. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, is the Graduate Research Assistant. Ms. Yin Zhou is another Graduate Research Assistant on the project.

I.3 Travel

The project team visited Dowling Textiles. For details please see II.1 below.

II. RESEARCH STATUS

II.1 Current Monthly Activity

Dowling Textiles

The TO BE information model (for integrated planning and purchasing) for Dowling Textiles has been modified to reflect the suggestions made by Dowling. The major objectives behind the TO BE model are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting. A prototype information system based on the TO BE Information model has been developed using SQL forms and Oracle database. The system was demonstrated at Dowling to Ms. Ali Barr and Mr. Andrew Boyd. A user guide to accompany the information system has also been written.

This system has been installed at Dowling for use and evaluation by Dowling personnel. Based on the input, the system will be modified to suit Dowling's needs. Ms. Ali Barr found time to play with the system and she had a few questions. During the visit to Dowling, these questions were addressed by the project team and there was a follow-up conversation with Ms. Barr. Unfortunately, Dowling personnel haven't been able to devote adequate time to evaluate the system. This is causing a delay in reaching a closure on the effort at Dowling.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling. Ms. Zhou has been developing simulation models of the shop-floor operations using Dowling's data. Several modular cells have been simulated for the various product lines. At the meeting held at Dowling Textiles, the models were reviewed and several questions were answered by Mr. Mike Justice, the Plant Manager.

Terry Manufacturing: Additional Participant

Mr. John Adams spoke to Mr. Roy Terry of Terry Manufacturing, a major defense contractor, about their participation in the project. Information on AMA and the write-up on the project were mailed to Terry. Mr. Terry has since agreed to participate in the effort.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Seek input from Dowling on the prototype planning and purchasing information system installed there. Visit Dowling as necessary.

III.2 Initial Meeting at Terry Manufacturing

Schedule the initial meeting with Terry Manufacturing to explain the scope of the effort and to initiate discussions on the selection of a target area for the utilization of AMA.

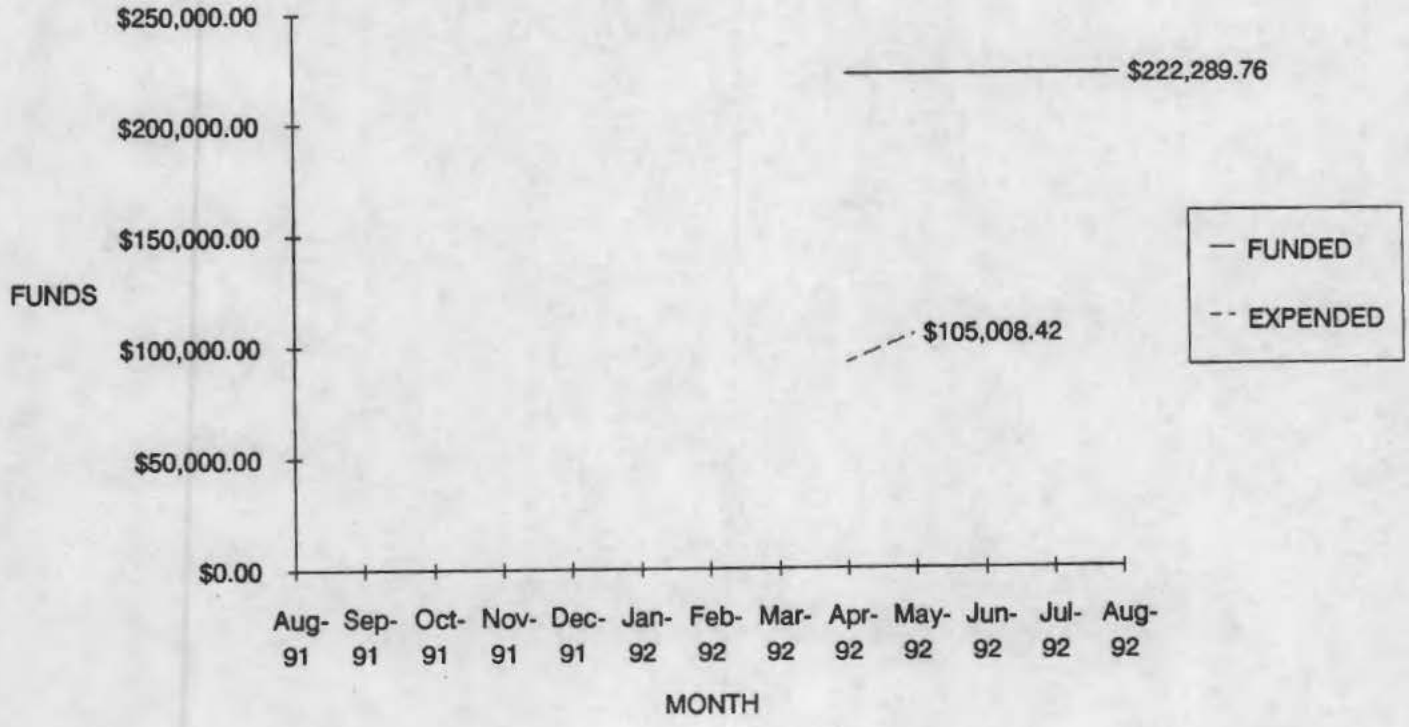
UTILIZATION OF AMA PROGRAM SCHEDULE

E-27-618

PERIOD ENDING 6/30/92

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirem	●●																	
Develop/Distribute Literature	●●	●●																
Announcement																		
Review Response			●●															
Interact with Candidates				●●	●●													
Present List to DLA					●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●	●●											
Train/Educate in AMA							●●	●●										
Analysis and Modeling								●●	●●	●●	●●	OO	OO					
PHASE III: EVALUATION																		
Review Solution														OO	OO			
Cost/Benefit Analysis															OO	OO	OO	
Prepare for Workshop/Seminar																	OO	OO
Final Report																		OO

E-27-618



E27-618

#33,34

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR JULY, 1992

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of July 1992. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, is the Graduate Research Assistant. Ms. Yin Zhou is another Graduate Research Assistant on the project.

I.3 Travel

Dr. Jayaraman and Mr. John Adams, AMTC Director, visited Terry Manufacturing, Roanoke, AL. For details please see II.2 below.

II. RESEARCH STATUS

II.1 Current Monthly Activity

Dowling Textiles

The TO BE information model (for integrated planning and purchasing) for Dowling Textiles has been modified to reflect the suggestions made by Dowling. The major objectives behind the TO BE model are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting. A prototype information system based on the TO BE Information model has been developed using SQL forms and Oracle database. The system was demonstrated at Dowling to Ms. Ali Barr and Mr. Andrew Boyd. A user guide to accompany the information system has also been written.

This system has been installed at Dowling for use and evaluation by Dowling personnel. Based on the input, the system will be modified to suit Dowling's needs. Unfortunately, Dowling personnel haven't been able to devote adequate time to evaluate the system. This is causing a delay in reaching a closure on the effort at Dowling. Dr. Jayaraman spoke with Mr. Dan Wright about this issue and some progress is anticipated next month.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling. Ms. Zhou has been developing simulation models of the shop-floor operations using Dowling's data. Several modular cells have been simulated for the various product lines.

Terry Manufacturing: Additional Participant

Dr. Jayaraman and Mr. Adams visited Terry Manufacturing on July 29, 1992. They were given a tour of the facilities by Ms. Cotina Terry. Subsequently, they met with Mr. Roy Terry, President, Ms. Terry and Ms. Ruth Bedford, Special Projects Manager. Dr. Jayaraman briefly explained the objectives of the research effort and the potential benefits to Terry. He also introduced them to AMA. A copy of AMA models and papers was also given to them.

During the discussions, several potential target areas for utilizing AMA were identified ranging from EDI to compression of the production cycle time. Mr. Terry and his staff will discuss the potential areas and get back to Dr. Jayaraman in the next few weeks.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Seek input from Dowling on the prototype planning and purchasing information system installed there. Visit Dowling as necessary.

III.2 Terry Manufacturing

Track Terry's response to the initial meeting; schedule meetings as necessary to select a target area for the effort.

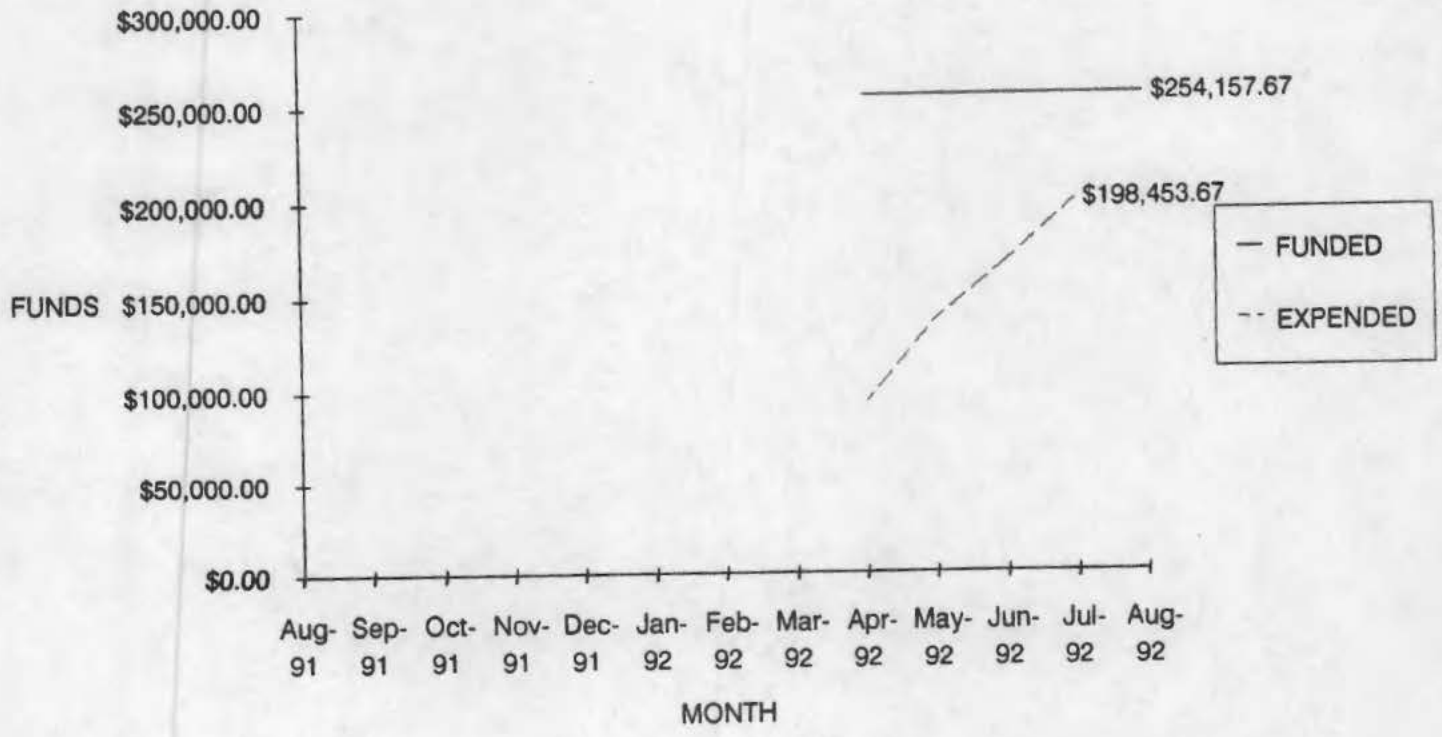
UTILIZATION OF AMA PROGRAM SCHEDULE

E-27-618

PERIOD ENDING 7/31/92

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirem	●●																	
Develop/Distribute Literature	●●	●●																
Announcement																		
Review Response			●●															
Interact with Candidates				●●	●●													
Present List to DLA					●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●	●●											
Train/Educate in AMA							●●	●●										
Analysis and Modeling								●●	●●	●●	●●	●○	○○					
PHASE III: EVALUATION																		
Review Solution														○○	○○			
Cost/Benefit Analysis															○○	○○	○○	
Prepare for Workshop/Seminar																	○○	○○
Final Report																		○○

E-27-618



E27-618
#35,36

PROBLEM SOLVING FOR APPAREL MANUFACTURERS: UTILIZATION OF AMA

I. MONTHLY PROJECT REVIEW FOR AUGUST, 1992

The basic objective of the research effort is to demonstrate the use of the apparel manufacturing architecture (AMA), developed on an earlier project, as a blueprint for implementing computer-integrated manufacturing systems in the apparel industry. This research project is funded by the U.S. Defense Logistics Agency (DLA) as part of its efforts to enhance the state-of-the-art in apparel manufacturing.

I.1 Introduction

The research work began in May 1991 and is being carried out in three phases. This report reviews the progress made during the month of August 1992. It also outlines the work to be carried out in the coming month. The report provides a means of comparing the actual progress achieved with the original time-task schedule identified in the initial project proposal.

I.2 Project Personnel

Dr. Sundaresan Jayaraman is the Principal Investigator. Mr. K. Srinivasan, graduate student working on his Ph.D. in the area of CIM, is the Graduate Research Assistant. Ms. Yin Zhou is another Graduate Research Assistant on the project.

I.3 Travel

Dr. Jayaraman and Mr. John Adams, AMTC Director, visited Terry Manufacturing, Roanoke, AL. For details please see II.2 below.

II. RESEARCH STATUS

II.1 Dowling Textiles

The TO BE information model (for integrated planning and purchasing) for Dowling Textiles has been modified to reflect the suggestions made by Dowling. The major objectives behind the TO BE model are to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting. A prototype information

system based on the TO BE Information model has been developed using SQL forms and Oracle database. The system was demonstrated at Dowling to Ms. Ali Barr and Mr. Andrew Boyd. A user guide to accompany the information system has also been written. This system has been installed at Dowling for use and evaluation by Dowling personnel. Based on the input, the system will be modified to suit Dowling's needs.
Mr. Dan Wright spoke at the AMTC Advisory Board Meeting held at the Center on Dowling's experience with the prototype system installed at Dowling. Since Dowling had recently acquired a complete system (software/hardware) for use, Mr. Boyd and Ms. Barr have had to devote a great deal of their time to learning, customizing and using this system; this commercial system spans the entire range of Dowling's operations whereas the prototype system covers only the planning and purchasing operations. Moreover, in the prototype system the focus was on ensuring the functionality of the system (to closely mirror Dowling's operations) and not on interface issues. Consequently, the former appeared to be difficult to use relative to the latter. In summary, Mr. Wright pointed out that the overall experience for Dowling was positive and beneficial and that Mr. Boyd and Ms. Barr wanted to continue their interaction with the Tech research group on this project to the extent that their schedules permitted.

Ms. Yin Zhou, another of Dr. Jayaraman's graduate students, is studying the shop-floor operations at Dowling as part of her M.S. thesis. One objective behind this effort is to investigate opportunities for computer assistance in shop-floor operations at Dowling. Ms. Zhou has been developing simulation models of the shop-floor operations using Dowling's data. Several modular cells have been simulated for the various product lines. Dr. Jayaraman is presently reviewing the draft of her M.S. thesis.

II.2 Terry Manufacturing: Additional Participant

Mr. Roy Terry confirmed Terry Manufacturing's interest in being a partner on the project. Subsequently, Dr. Jayaraman and Mr. Adams visited Terry Manufacturing on August 25, 1992; the objective of this visit was to continue discussions on the selection of a topic for the research effort and to discuss the logistics. In addition to Mr. Roy Terry, Ms. Ruth Bedford and Mr. Sidney Johnson participated in the meeting. Based on the interactions, Dr. Jayaraman proposed a plan of action for the effort in the area of information systems for shared production agreement that Terry Manufacturing has with DPSC and McDonald's Corporation.

III. PLANS FOR NEXT MONTH

III.1 Dowling Textiles

Seek input from Dowling on the prototype planning and purchasing information system

installed there. Visit Dowling as necessary.

III.2 Terry Manufacturing

Visit Terry Manufacturing to introduce the IDEF methodology and AMA and to begin detailed discussions on the chosen area for the effort.

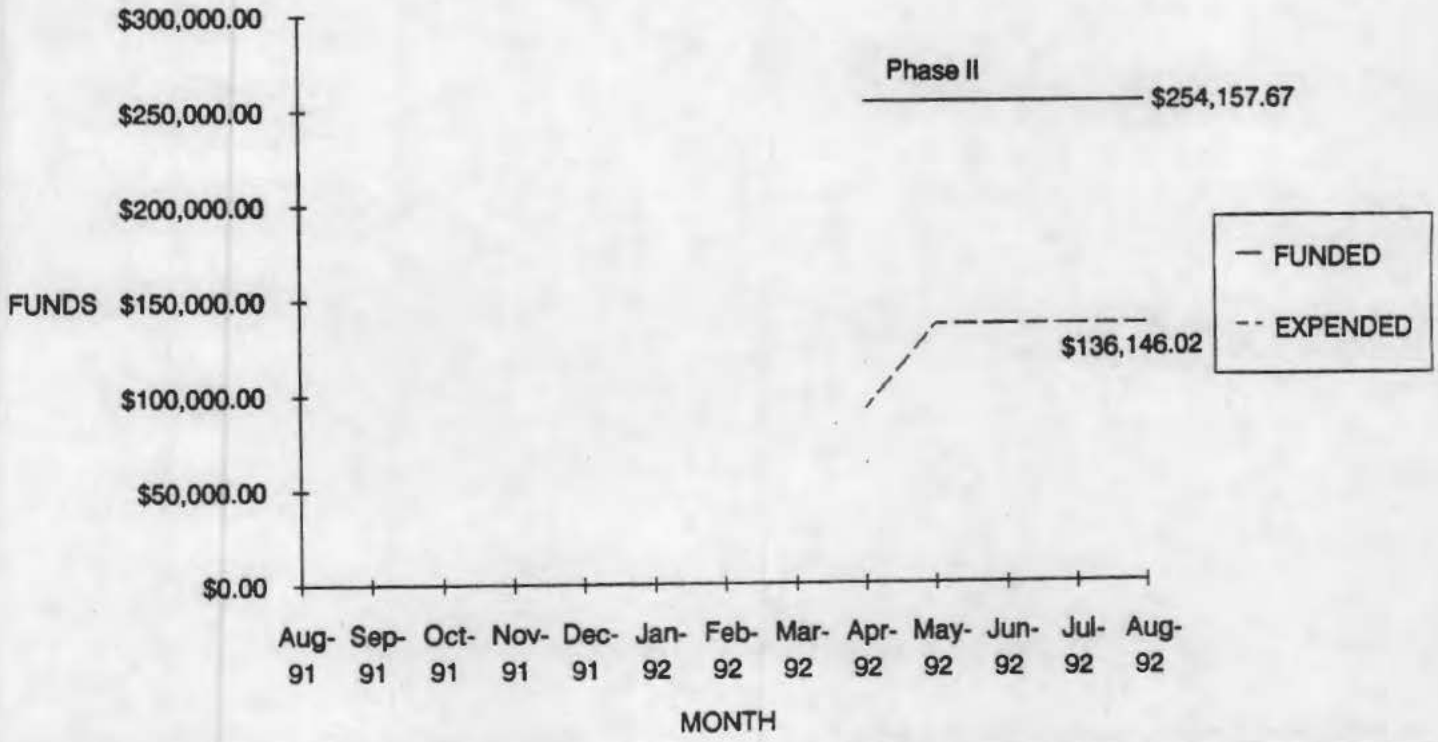
UTILIZATION OF AMA PROGRAM SCHEDULE

E-27-618

PERIOD ENDING 8/31/92

SHORT TERM TASK and SUBTASK ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PHASE I: SELECTION																		
Establish Eligibility Requirem	●●																	
Develop/Distribute Literature	●●	●●																
Announcement																		
Review Response			●●															
Interact with Candidates				●●	●●													
Present List to DLA					●●													
PHASE II: ANALYSIS																		
Establish Problem/Task						●●	●○											
Train/Educate in AMA							●●	○○										
Analysis and Modeling								●●	●●	●●	●●	●●	○○					
PHASE III: EVALUATION																		
Review Solution														○○	○○			
Cost/Benefit Analysis															○○	○○	○○	
Prepare for Workshop/Seminar																	○○	○○
Final Report																		○○

E-27-618



IN CONFIDENCE

E-27-618
57

UTILIZATION OF APPAREL MANUFACTURING ARCHITECTURE

Volume I: Summary Technical Report

Research Sponsored by:

U.S. Defense Logistics Agency
DLA-AQPOT
Cameron Station
Alexandria, Virginia 22304-6100

DLA Contract #: DLA900-87-D-0018/0015

Reported by:

Dr. Sundaresan Jayaraman
Principal Investigator

Georgia Tech Project #: E-27-618

Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, Georgia 30332

Tel: 404/894-2490
Fax: 404/894-8780

December 1993

SJ-TR-ARCH-9312

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	12/15/93	Final; 2/08/91 - 12/21/93

4. TITLE AND SUBTITLE
Utilization of Apparel Manufacturing Architecture Volume I: Summary Technical Report

5. FUNDING NUMBERS
C

6. AUTHOR(S)
Jayaraman, Sundaresan; Srinivasan, K;
Malhotra, Rajeev

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, GA 30332-0295

8. PERFORMING ORGANIZATION REPORT NUMBER
SJ-TR-ARCH-9312

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Defense Logistics Agency
DLA-AQPOT
Cameron Station
Alexandria, VA 22304-6100

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
UNLIMITED DISTRIBUTION

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Research has been carried out to demonstrate the role and importance of the Apparel Manufacturing Architecture (AMA) to the apparel industry through practical applications of AMA to specific tasks in two apparel plants -- Dowling Textiles and Terry Manufacturing. Working with Dowling personnel, an information system for integrated planning and purchasing was designed, developed and implemented at Dowling. Likewise, an information system for *shared production* was developed at Terry Manufacturing so that it would be capable of increasing its production (in response to DoD's surge requirements) by anywhere between 20 and 60%. Both the developed systems have been tested by plant personnel. The other objective of the effort, viz., transfer the developed technology and modeling know-how to the real-world has also been accomplished.

14. SUBJECT TERMS	15. NUMBER OF PAGES
CIM; Apparel Architecture; Information Systems; Plant Demonstration	48
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

UTILIZATION OF APPAREL MANUFACTURING ARCHITECTURE

Volume I: Summary Technical Report

Research Sponsored by:

U.S. Defense Logistics Agency
DLA-AQPOT
Cameron Station
Alexandria, Virginia 22304-6100

DLA Contract #: DLA900-87-D-0018/0015

Reported by:

Dr. Sundaresan Jayaraman
Principal Investigator

Georgia Tech Project #: E-27-618

Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, Georgia 30332

Tel: 404/894-2490
Fax: 404/894-8780

December 1993

SJ-TR-ARCH-9312

Research Project Personnel

Harinarayanan Balakrishnan
K. Srinivasan
Yin Zhou
Graduate Research Assistants

Dr. Rajeev Malhotra
Research Investigator

Dr. Sundaresan Jayaraman
Principal Investigator

ACKNOWLEDGMENTS

This research project was funded by the US Defense Logistics Agency (DLA) under contract number DLA-900-87-0018/0015. The authors would like to thank Mr. Donald F. O'Brien, Ms. Julie Tsao and Ms. Helen Kerlin of DLA for making this research endeavor possible.

Mr. Daniel Wright of Dowling Textiles deserves since appreciation and thanks for championing this project at Dowling. Ms. Ali Barr and Mr. Andrew Boyd from Dowling Textiles deserve thanks for their participation in the project.

Mr. Roy Terry of Terry Manufacturing championed and actively participated in the Terry project and deserves sincere thanks. Ms. Ruth Bedford, Mr. Sidney Johnson, Ms. Cheryl Pate and Mr. Rudolph Terry from Terry Manufacturing also deserve thanks for their time and input during the course of the project.

Finally, Mr. John Adams and Ms. Neysa Brown of AMTC provided the necessary administrative support during the project and their efforts are thankfully acknowledged.

* * *

Table of Contents

Volume I		Page
	Executive Summary	ii
1.	INTRODUCTION	1
	1.1 Apparel Manufacturing Architecture	1
	1.2 Research Objectives	2
2.	RESEARCH METHODOLOGY	2
	2.1 Research Procedure	3
	2.2 Dissemination of Research Results	5
3.	DOWLING TEXTILES: CASE STUDY IN PLANNING AND PURCHASING	6
4.	TERRY MANUFACTURING: CASE STUDY IN SHARED PRODUCTION	7
5.	CONCLUSIONS AND LESSONS LEARNED	8
References		13

Appendix I
Literature for Selection of Industry Partners

Appendix II
Paper Presented at the 20th International Apparel Research Conference

Other Volumes

Volume II

Dowling Textiles: Case Study in Integrated Planning and Purchasing
[*Contains Proprietary Information*]

Volume III

Terry Manufacturing: Case Study in Shared Production
[*Contains Proprietary Information*]

Executive Summary

To stay competitive in the global market, the textile-apparel industrial complex must evaluate and deploy state-of-the-art manufacturing and information technologies. The vitality of this complex is also critical to the US Department of Defense (DoD) which relies on this industrial base to clothe its personnel and maintain a state of readiness. To enable the apparel industry to become competitive by adopting advanced techniques and tools, the US Defense Logistics Agency sponsored the development of an apparel manufacturing architecture (AMA) at Georgia Tech. AMA is a comprehensive set of specifications for implementing computer-integrated manufacturing in an apparel enterprise.

The primary objective of this research is to demonstrate the role and importance of AMA to the apparel industry through practical applications of AMA to specific tasks in apparel plants. Other objectives of the effort are to transfer the developed technology and modeling know-how to the real-world and to serve as a catalyst for similar modeling and process reengineering efforts in the industry.

Based on a set of defined evaluation criteria, Dowling Textiles in McDonough, Georgia, and Terry Manufacturing in Roanoke, Alabama, were selected as industry partners on the research effort. A research methodology was developed and used for carrying out the project. Working with Dowling personnel, an information system for integrated planning and purchasing was designed, developed and implemented at Dowling. The underlying objective was to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting. Likewise, an information system for shared production was developed at Terry Manufacturing. The objective here was to enable Terry Manufacturing to be capable of increasing its production (in response to DoD's surge requirements) by anywhere between 20 and 60%. Both the developed systems have been tested by plant personnel.

The following major lessons were learned from these efforts: AMA enabled the rapid development of the architectures for the two systems by serving as a *reference* architecture; moreover, AMA stands to be enriched by incorporation of the detailed specifications of certain functions from the two enterprise-specific models. Thus, there is a symbiotic relationship between the generic architecture for the domain of apparel manufacturing and the architecture for a specific enterprise. Very few *new* information entities had to be introduced in the enterprise-specific information models. Therefore, once a core set of information entities is carefully specified (as in AMA), the entities can be reused to support many new functions with little modification. Hence, a well-designed information system will be a catalyst for rapid changes in an enterprise as opposed to being one more impediment to them. Finally, the industry partners found the architectural approach and the research methodology to be understandable and easy to use. The research results and lessons learned have been presented at conferences.

* * *

1. INTRODUCTION

The textile-apparel industrial complex is characterized by a multitude of conflicting demands: smaller lot sizes, increased product flexibility, higher product quality and decreasing delivery times. To operate successfully in such a demanding and highly competitive global market, the industry must deploy state-of-the-art manufacturing and information management technologies and tools: Computer-Integrated Manufacturing (CIM), Quick Response (QR), Total Quality Management (TQM), Electronic Data Interchange (EDI), Design for Manufacturability (DFM), Concurrent Engineering (CE), uniform product representation standards and information exchange (e.g., APDES), shop-floor control and communication standards [2, 4].

Advanced Concepts and Technologies -- A Military Perspective: From the perspective of the Department of Defense (DoD), these concepts and technologies assume increased importance, especially in the event of a rapid mobilization such as was witnessed during the 1990-91 Desert Shield/Storm operation. DoD needs to develop, nurture and maintain a stable and steady base of suppliers who will adopt these techniques and strive towards the implementation of CALS (computer-aided acquisition and logistics support) in the C&T (clothing and textiles) procurement process. The successful implementation of CALS, by its very nature and philosophy, necessitates the adoption of the various concepts, especially QR, CE, DFM, CIM and EDI.

To enable the apparel industry to become competitive by adopting such techniques and tools, the US Defense Logistics Agency sponsored the development of an apparel manufacturing architecture (AMA) at Georgia Tech.

1.1 Apparel Manufacturing Architecture

The apparel manufacturing architecture is a comprehensive set of specifications for implementing computer-integrated manufacturing in an apparel enterprise. AMA consists of a set of models the core of which is the *information* model which defines the schema of the shared information base for an apparel enterprise. The *function* model component of the architecture specifies how the activities carried out in an apparel manufacturing enterprise interact with each other through the shared information base. The third component of AMA, the *dynamics* model, describes how the interactions among the enterprise activities take place over time [1, 3, 5, 7]. The USAF's IDEF Methodology was used in the development of AMA.

AMA encompasses activities spanning product development to distribution of finished goods. The architecture is based on extensive modeling and analysis of the operations of a major apparel manufacturing enterprise.

Role and Importance of AMA: AMA is the prerequisite for implementing various advanced concepts and technologies. The first step in developing QR and EDI systems is to carry out an in-depth analysis of the existing (AS IS) conditions and develop appropriate models. Subsequently, the models can be analyzed to create the necessary specifications for the proposed improvements (TO BE models) followed by system implementation. Thus, AMA and the architectural approach to systems analysis and development can play effective roles in implementing QR and EDI capabilities.

1.2 Research Objectives

The primary objective of this research is to demonstrate the role and importance of AMA to the apparel industry through practical applications of AMA to specific tasks in apparel plants. Other objectives of the effort are to transfer the developed technology and modeling know-how to the real-world and to serve as a catalyst for similar modeling and process reengineering efforts in the industry.

These research objectives are in line with the goals of the Georgia Tech/Southern Tech Apparel Manufacturing Technology Center (AMTC): transfer state-of-the-art manufacturing and information management technologies to the apparel industry by demonstrating high tech solutions to problems currently facing apparel manufacturers.

The research methodology is discussed in Section 2. The highlights of the two case studies are presented in Sections 3 and 4. The various models developed during the course of the research are documented separately in Volumes II and III of this report to ensure the confidentiality of information furnished by participating industry partners. The conclusions and lessons learned are presented in Section 5.

2. RESEARCH METHODOLOGY

The first step in the research effort was to identify industry partners for participation in the project. Literature describing the project was created and mailed out using the AMTC mailing list. Copies of the invitation letter and the accompanying project overview are in Appendix I. Announcements about the project were also made at various American Apparel Manufacturers Association (AAMA) Committee meetings seeking the participation of AAMA member companies.

The following set of evaluation criteria was established and used to select industry partners:

- company size (number of employees, sales dollars)
- company location (accessibility from Georgia Tech)
- government contractor history
- assessment of existing level of technology and probability of implementing high-tech solutions
- prior knowledge of and/or interest in AMA
- willingness to commit resources (human/fiscal) and actively participate in the effort
- commitment to share the results at the end of the project, without having to divulge proprietary information.

The plan was to collaborate with two industry partners on two different projects; however, during the initial stages of the project, it was decided that for optimum utilization of the project resources, it would be better to work with the companies in sequence, that is, begin the second project when the first project was nearing completion. A second reason for this decision was that the lessons learned from the first effort could be applied to the second thereby enhancing the quality of the overall research effort.

Industry Partners: Based on the evaluation criteria, Dowling Textiles in McDonough, Georgia, was initially targeted; further discussions were held with Dowling management prior to the final selection of Dowling as the first industry partner. During the final stages of the Dowling effort, the same procedure was used to select Terry Manufacturing as the second industry partner. Both selections were communicated to the project's Technical Monitor (Contracting Officer's Technical Representative) at DLA.

2.1 Research Procedure

The research, on both projects, was carried out in the various phases shown in Figure 1. Initially, discussions were held with the company's top management to identify members for participation in the team with Georgia Tech researchers. The scope of the effort and the organization's commitments to the project were also discussed.

Phase I - Domain Understanding and Task Definition: Once management had identified its team members, regular meetings of the entire team began at the plant site. At these meetings, the enterprise goals were discussed and potential target functions for modeling were explored. When necessary, team members met with individuals in the various departments to gain a better understanding of the operations. During these meetings, the company team members were introduced to the modeling methodology and AMA. The overall goals for the effort were discussed and at the end of this phase the specific project objectives were defined.

Phase I - Domain Understanding and Task Definition Team Formation Understanding the Enterprise's Goals Introduction to AMA and Modeling Methodology Defining Project Goals
Phase II - Information / Knowledge Sharing Current Status of Enterprise Operations Enterprise's Plans for the Future Discussions and Written Reports
Phase III - *As Is* Modeling Function Modeling ($IDEF_0$) Verification and Refinement of Model
Phase IV - *To Be* Modeling Information Modeling ($IDEF_1x$) Function Modeling ($IDEF_0$) Verification and Refinement of Models
Phase V - Implementation Database Management Software Selection Database Schema Definition Definition of Entities Creation of Database Queries
Phase VI - Validation System Use by Enterprise System Refinement

Figure 1. Research Methodology: The Various Phases in the Project.

Phase II - Information Sharing: In this phase, the team members obtained and shared detailed information about the chosen function. Georgia Tech researchers wrote short summaries of the important findings from these meetings and shared it with the team members to ensure correctness and completeness. The scope, purpose and viewpoint of the model to be developed were also defined.

Phase III - As Is Modeling: Based on the information from the earlier phases, modeling of the current (As Is) status of the chosen function area was carried out. The IDEF methodology was used to develop the As Is Function model of the target area. This model was circulated amongst the team members for review and refinement. By the end of this phase, the objectives for the To Be model were also defined.

Phase IV - To Be Modeling: The To Be Information Model was developed based on the objectives identified in Phase III. This was followed by the development of the To Be Function Model. Both models were reviewed and refined by the team members. During this phase, AMA served as the basis for a detailed analysis of the chosen domain and for developing solutions that were consistent with the organization's goals and long-term strategies.

Phase V - Implementation: The To Be Information model was used to define the database schema for the proposed system. The team members discussed existing company practices to define the various characteristics of the information entities (field types, field lengths, etc.). The appropriate database management software was chosen to suit the company's existing computing systems; ORACLE with SQL Forms was chosen for the Dowling implementation while PARADOX was chosen for the Terry system, both packages running on MS-DOS machines. The information system was implemented, debugged and appropriate sample queries were also defined. A user's manual was created for the system.

Phase VI - Testing and Validation: In the final phase, company team members used plant data to populate and test the system. Based on their feedback, the system was suitably refined to improve its ease of use.

2.2 Dissemination of Research Results

At the end of each project, the results were presented in appropriate forums: the Dowling results at the Third Annual Academic Apparel Researchers Conference [6], and Terry results at the 20th International Apparel Research Conference [8]. In addition, summary presentations were made at various AAMA Committee meetings.

These forums were open to researchers and apparel industry executives and thus facilitated a very widespread dissemination of the research results.

3. DOWLING TEXTILES: CASE STUDY IN PLANNING AND PURCHASING

The highlights of the case study conducted at Dowling Textiles using the research procedure outlined in the previous section are presented here.

Company Profile: Dowling Textiles Manufacturing Company, based in McDonough, Georgia, is a leading producer of hospital garments in the US. Baxter Corporation is its prime customer. In the past, Dowling has produced garments for the US government.

Dowling Team Members: Mr. Dan Wright, Executive Vice President, served as the project sponsor and adviser during the course of the effort. Ms. Ali Barr and Mr. Andrew Boyd were the two Dowling team members. Ms. Barr was responsible for reviewing the Purchasing function at Dowling, while Mr. Boyd was responsible for production planning.

Georgia Tech Team Members: Dr. Sundaresan Jayaraman, Dr. Rajeev Malhotra, Mr. K. Srinivasan and Ms. Yin Zhou.

Project Goal: The primary goal of the project was to design, develop and implement an information system for integrated planning and purchasing. The major objectives behind the To Be models were to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting.

The Models: The function and information models developed during the research are presented in Volume II of the Technical Report.

Simulation Studies: In addition to the design of the information system, the role of simulation in evaluating plant floor operations was investigated during the course of the project. The results were discussed with plant personnel.

4. TERRY MANUFACTURING: CASE STUDY IN SHARED PRODUCTION

The highlights of the case study conducted at Terry Manufacturing using the research procedure outlined in Section 2 are presented here.

Company Profile: Terry Manufacturing, based in Roanoke, Alabama, is a leading manufacturer and supplier of Battle-Dress Uniform (BDU) Coats to DoD. It is also a supplier of uniforms for fast-food restaurants such as McDonald's Corporation. Terry Manufacturing has entered into a *shared production* agreement with DoD to increase its supply of BDU Coats by 20 to 60% to meet the surge requirements in the event of a mobilization. McDonald's, as a commercial customer of Terry Manufacturing, is also a partner in this agreement. This agreement and its implementation are expected to serve as a model for such agreements with other apparel manufacturers and also manufacturers in other domains (e.g., food and medicine).

Terry Manufacturing Team Members: Mr. Roy Terry, President, served as the project sponsor and participated on the team throughout the course of the effort. The other team members were Ms. Ruth Bedford, Mr. Sidney Johnson, Ms. Cheryl Pate and Mr. Rudolph Terry.

Georgia Tech Team Members: Dr. Sundaresan Jayaraman, Mr. K. Srinivasan and Mr. Harinarayanan Balakrishnan.

Project Goal: The primary goal of the project was to design, develop and implement an information system for shared production. The objective here was to enable Terry Manufacturing to be capable of increasing its production (in response to DoD's surge requirements) by anywhere between 20 and 60%.

The Models: The function and information models developed during the research are presented in Volume III of the Technical Report.

Simulation Studies: In addition to the design of the information system, the role of simulation in evaluating plant floor operations was investigated during the course of the project. The results were discussed with plant personnel.

5. CONCLUSIONS AND LESSONS LEARNED

AMA has been used as the basis for developing enterprise-specific architectures for specific tasks in two apparel plants; based on these blueprints, information systems have been designed, developed and implemented in the plants; the details of these models and systems can be found in Volumes II and III of this Technical Report.

In addition, the following major lessons have been learned from the utilization of AMA at the two apparel plants:

Rapid Development of Enterprise-Specific Architecture: AMA enabled the rapid development of the blueprints (architectures) for the two systems by serving as a *reference* architecture. For example, the activity *Identify Potential Satellite Plants* (A1 in Figure 2) is equivalent to the AMA activity *Select Manufacturing Location* (A312 in Figure 3). In AMA, the activity is not decomposed further. However, the decomposition of A1 shown in Figure 4 can be easily integrated into AMA. So, AMA stands to be enriched by incorporation of the detailed specifications of certain functions from the two enterprise-specific models. Thus, there is a symbiotic relationship between the generic architecture for the domain of apparel manufacturing and the architecture for a specific enterprise.

Richness of AMA: Very few *new* information entities had to be introduced in the enterprise-specific information models. Therefore, once a core set of information entities is carefully specified (as in AMA), the entities can be *reused* to support many new functions with little modification. Hence, a well-designed information system will be a catalyst for rapid changes in an enterprise as opposed to being one more impediment to them.

The Research Methodology and Architectural Approach: The research methodology developed during the course of the project (Figure 1) was found to be valuable and useful. Therefore, it can be easily adopted for similar reengineering efforts at other apparel plants. The industry partners found the architectural approach and modeling methodology to be understandable and easy to use.

AMA and Development of Real Systems: AMA played a very useful role in the development of information systems that have been tested in plants using real data. Therefore, this effort has demonstrated the usefulness and applicability of AMA in developing usable information systems for the apparel industry.

Management Commitment to Evaluation and Deployment of Technology: The projects were carried out successfully because the managements of both companies were committed to the efforts. Therefore, such commitment is essential for the success of reengineering efforts in

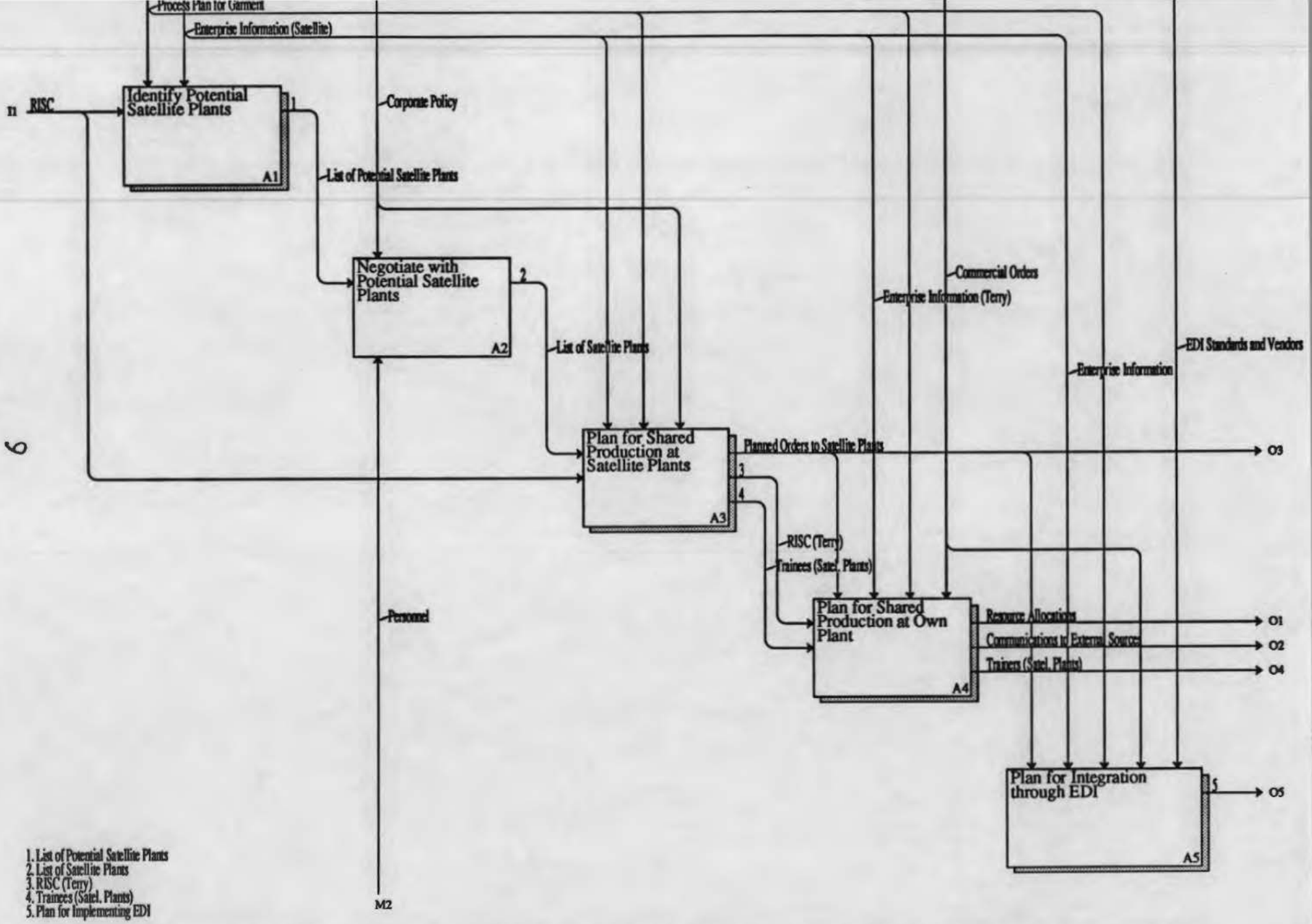
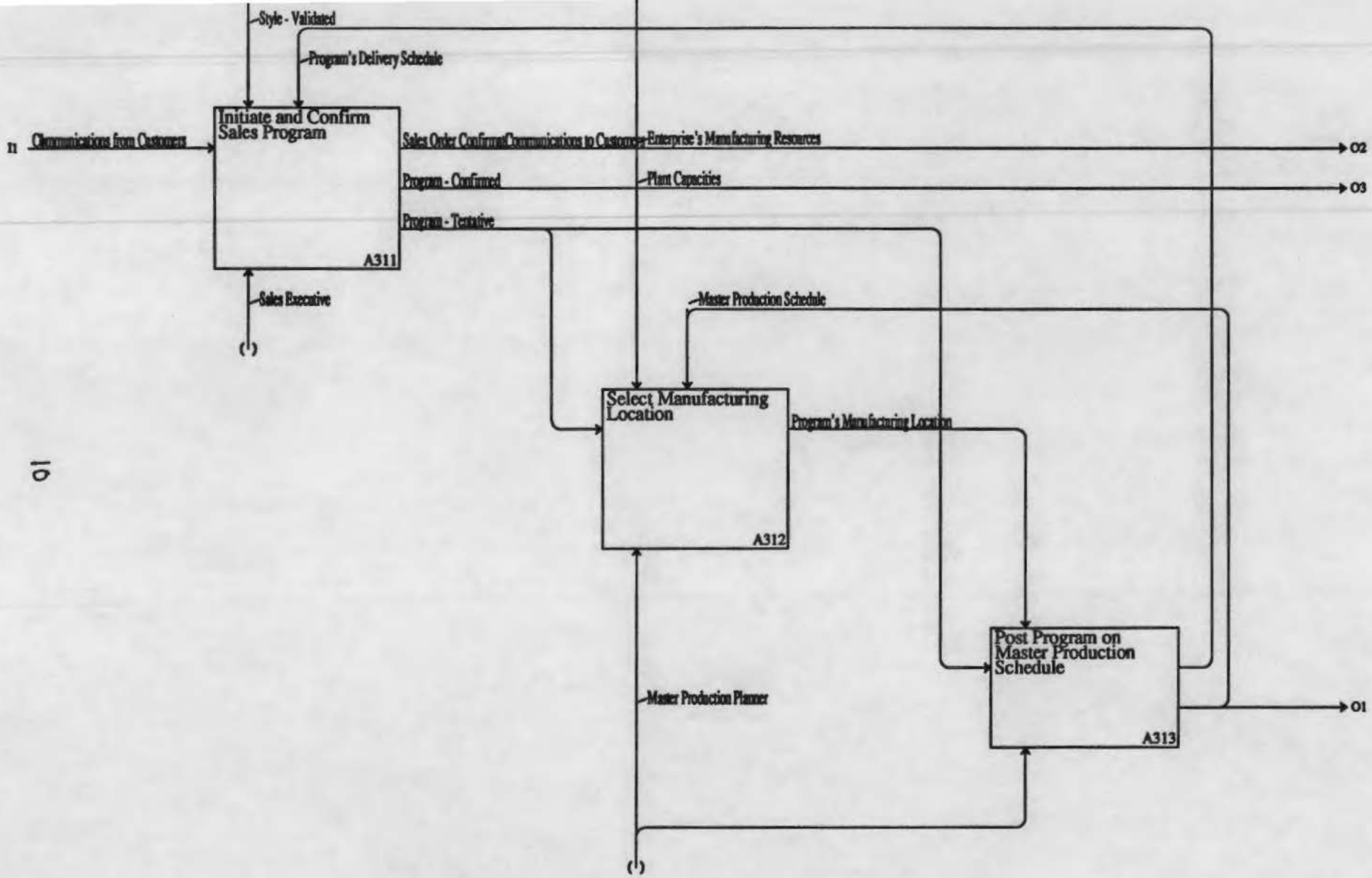


Figure 2. Specification of Activities for more than 20% increase in the Production of BDU Coats (part of the *TO BE* Function Model)



1. Sales Contract

Select Manufacturing Location

Description

Select the manufacturing location for the program based on the plant capabilities and the available capacities for producing the features of the garment.

Figure 3. Details of the Function *Plan and Prepare for Manufacture* (from AMA)

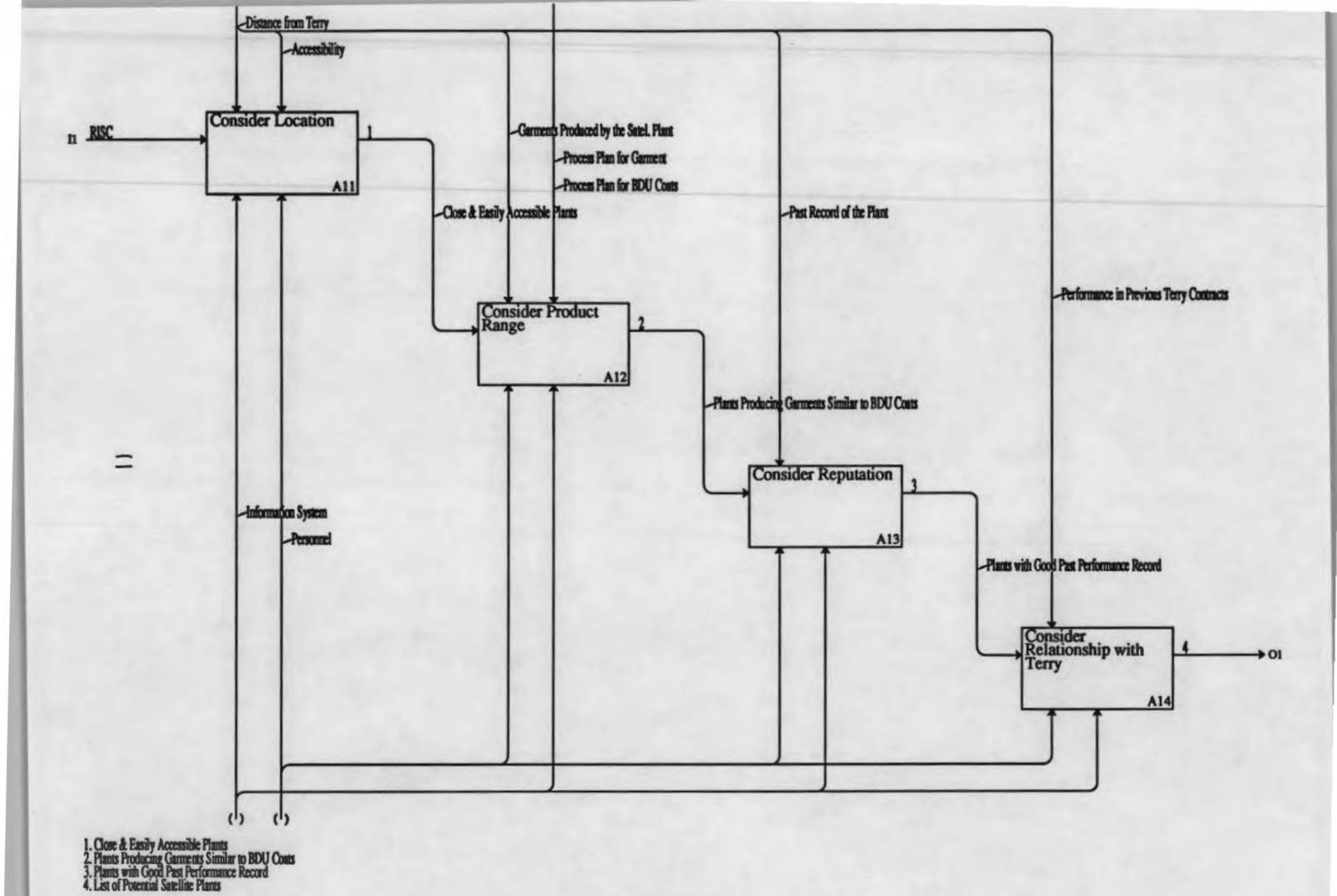


Figure 4. Details of the Function *Identify Potential Satellite Plants* (from TMA)

an organization. The team approach to problem-solving and system design has also been successfully demonstrated during the course of the research.

Education and Student Development: Three graduate students were partly supported on this project during the course of their studies at Georgia Tech. Ms. Yin Zhou completed her MS thesis; Mr. K. Srinivasan completed his PhD dissertation, while Mr. Harinarayanan Balakrishnan is in the final stages of his MS thesis. Thus, this research has had a major impact on the education and preparation of graduate students for careers in US industries.

The lessons learned have been presented at major conferences to facilitate their widespread dissemination in the apparel industry.

References

[1] Jayaraman, S., "Design and Development of an Architecture for Computer-Integrated Manufacturing in the Apparel Industry, Part I: Basic Concepts and Methodology Selection", Textile Research Journal, vol. 60, No. 5, pp. 248-254, May 1990.

[2] Jayaraman, S., "Computer-Aided Design and Manufacturing: A Textile-Apparel Perspective", Invited Lecture Delivered at a NATO Advanced Study Institute, April 3-16, 1992, Side, Turkey. *To appear in* Advancements and Applications of Mechatronics Design in Textile Engineering, (Acar, M., Ed.), Kluweir Academic Publishers, The Netherlands.

[3] Jayaraman, S., and Malhotra, R., Apparel Manufacturing Architecture [Version 1.0], Volume I: The Function and Dynamics Models, Volume II: The Information Model, Technical Report SJ-TR-ARCH-9210, Georgia Institute of Technology, Atlanta, Georgia, October 1992.

[4] Jayaraman, S., "On Concurrent Engineering in the Textile/Apparel Complex", Proceedings of the 9th International Conference on Engineering Design, pp. 723-726, The Hague, The Netherlands, August 17-19, 1993.

[5] Malhotra, R., and Jayaraman, S., "Design and Development of an Architecture for Computer-Integrated Manufacturing in the Apparel Industry, Part II: The Function Model", Textile Research Journal, vol. 60, no. 6, pp. 351-359, June 1990.

[6] Malhotra, R., Srinivasan, K., Jayaraman, S., Wright, D., Barr, A., and Boyd, A., "Utilization of Apparel Manufacturing Architecture at Dowling Textiles: A Case Study", Proceedings of the 3rd Annual Academic Apparel Researchers Conference, Atlanta, Georgia, February 1992.

[7] Malhotra, R., and Jayaraman, S., "An Integrated Framework for Enterprise Modeling" Journal of Manufacturing Systems, vol. 11, no. 6, pp. 426-441, 1992.

[8] Srinivasan, K., Jayaraman, S., and Terry, R., "An Information System for Shared Production: Design, Development and Implementation", Proceedings of the 20th International Apparel Research Conference, Atlanta, Georgia, December 1-2, 1993.

Appendix I. Literature for Selection of Industry Partners

July 12, 1991

Dear

I am pleased to inform you about another research project funded by the U.S. Defense Logistics Agency in the area of CIM in the apparel industry. The project *Utilization of Apparel Manufacturing Architecture (AMA)* is an extension of the apparel architecture project completed recently at Georgia Tech.

The project will demonstrate the use of AMA in designing and implementing CIM systems in apparel enterprises. We are seeking the participation of apparel companies like yours in this effort. I am enclosing a copy of the project outline for your review.

If you need additional information or would like to participate in the project, please feel free to write or call me.

Best regards,

Sincerely,

Sundaresan Jayaraman
Associate Professor

UTILIZATION OF APPAREL MANUFACTURING ARCHITECTURE

Executive Summary

The apparel manufacturing architecture (AMA) developed at Georgia Tech is a comprehensive set of specifications for a computer-integrated apparel enterprise. The purpose of the current research is to demonstrate the utility of AMA as a blueprint which can be used to design "real" systems for an enterprise. The proposed research and accompanying benefits to industry partners are discussed.

* * *

Introduction

Georgia Tech has been carrying out research in the area of computer-integrated manufacturing (CIM) for the apparel industry under the sponsorship of the U.S. Defense Logistics Agency (DLA). CIM can be viewed as a collection of concepts aimed at improving the ability of a manufacturing enterprise to produce a large variety of goods in small batch sizes with shorter lead times, characteristics associated with the apparel industry. The key concepts in CIM are programmable automation of the various activities carried out by a manufacturing enterprise, and integration of these activities into a cohesive system through information and knowledge sharing.

Apparel Manufacturing Architecture

The outcome of the first phase of our research has been the apparel manufacturing architecture (AMA) which is a comprehensive set of specifications for a computer-integrated apparel enterprise. AMA consists of a set of models the core of which is the *information* model which defines the schema of the shared information base for an apparel enterprise. The *function* model component of the architecture specifies how the activities carried out in an apparel manufacturing enterprise interact with each other through the shared information base. The third component of AMA, the *dynamics* model, describes how the interactions among the enterprise activities take place over time.

AMA encompasses activities spanning product development to distribution of finished goods. The architecture is based on extensive modeling and analysis of the operations of a major apparel manufacturing enterprise.

Proposed Research on AMA

In the current phase of our research effort, we plan to validate AMA by demonstrating its utility as a specification or blueprint that can be used to design "real" systems for an enterprise. For this purpose, we will select a few functional areas from AMA (e.g., product development, process planning, shopfloor control, etc.) and develop system prototypes to support the activities in the selected areas.

Industry Cooperation and Participation

We are seeking the participation of apparel companies to work with us in identifying the suitable functional areas, and implementing and testing the prototypes at their facilities. The first step would be to identify a functional area of immediate interest to the industry partner. A project team consisting of key individuals from the identified area and members of our research staff will be formed. We will have detailed discussions on AMA with the company members on the team to familiarize them with the architecture and the modeling methodology. Using this methodology, the activities of the selected functional area will be modeled and analyzed to understand how the activities are currently performed and how they differ from the specifications for the equivalent activities in AMA. Since AMA is a generic architecture, we may need to extend it to suit the specific needs of the project. After the specifications are approved by the entire team, the databases will be set up and the code written to implement the system based on the developed specifications.

Once the prototype system is ready, it will be tested and evaluated under real working conditions in the company and possibly under simulated conditions in the Georgia Tech/Southern Tech demonstration facility -- Apparel Manufacturing Technology Center (AMTC). The duration of the project will depend on the size and scope of the selected functional area and is expected to be around 6-9 months.

Benefits to Industry Partners

The project will provide the industry partner an excellent opportunity to gain extensive exposure to computer-integrated manufacturing. The company individuals on the project team will acquire hands-on experience in the use of methodologies for modeling and analysis of manufacturing enterprises and for communicating CIM system specifications to those responsible for their implementation. Such methodologies are widely used in the aerospace and automotive industries for modeling, analysis, and design of advanced manufacturing systems.

In addition, the industry partner can benefit from ready access to the state-of-the-art resources at AMTC, including production machinery, computer hardware and software to support various manufacturing and auxiliary functions.

* * *

Project Personnel

Principal Investigator: Dr. Sundaresan Jayaraman
Research Investigator: Dr. Rajeev Malhotra

Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, Georgia 30332-0295
Tel: 404/894-2490
Fax: 404/894-8780

Appendix II

An Information System for Shared Production: Design, Development and Implementation

Paper Presented at the
20th International Apparel Research Conference, Atlanta, Georgia
December 1-2, 1993.

From *Proceedings of the 20th International Apparel Research Conference*, December 1-2, 1993, Atlanta, GA.

An Information System for Shared Production: Design, Development & Implementation

K. Srinivasan, Sundaresan Jayaraman[1] and Roy Terry[2]

Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, Georgia 30332-0295

Abstract

The Apparel Manufacturing Architecture (AMA) developed at Georgia Tech is a comprehensive set of specifications for a computer-integrated apparel enterprise. Terry Manufacturing is a leading defense contractor participating in a *shared production* agreement with the U.S. Department of Defense and McDonald's Corporation. In this paper, the role of AMA in the design, development and implementation of a computer-based information system for implementing shared production at Terry Manufacturing is discussed. The paper also covers the research methodology and the lessons learned from the real-world implementation.

1. Introduction

The operation of an apparel manufacturing enterprise is complex due to the multitude of simultaneous activities in the enterprise -- design and development, manufacturing, distribution and marketing -- and the wide variety of physical and information entities supporting these activities. The rapidly changing consumer preferences and the advances in technology necessitate fre-

---

1. To Whom Correspondence Should be Addressed.
2. Terry Manufacturing Company, Roanoke, Alabama.

quent changes in machines and products, i.e., flexible automation. To manage such large, complex and dynamic enterprises, Computer Integrated Manufacturing Systems (CIMS) technology is utilized. CIMS essentially consists of automating individual functions such as design and quality control, and integrating these functions through information and knowledge sharing. Before developing software tools for integrating manufacturing functions and managing them, the various functions involved in the working of an enterprise, their information needs and dynamics have to be described accurately and in sufficient detail. Hence, modeling is a very important tool for implementing CIMS.

Standardization in modeling within and across domains (e.g., apparel, automobile and electronics) will promote sharing and reuse of models [Jayaraman 89]. Such reuse reduces the burden on the modelers and also helps to avoid inconsistency between models. To promote standardization, a three tiered approach to modeling (Figure 1) has been proposed by Srinivasan and Jayaraman [Srinivasan 90]. Concepts such as Operator, Purchase Order and Materials are common to all domains (with possible minor variations). The top-most layer models information about such concepts which are *common to all domains* and hence is called the *Domain Independent Model.* There are certain concepts which are *common to all enterprises in a specific domain*, such as Cut Order and Graded Pattern used by apparel manufacturing enterprises. The *Domain Dependent, Enterprise Independent Model* captures the information about such concepts. Finally, certain concepts may be *pertinent only to a specific enterprise*. For example, the concept Blanket Purchase Order is useful only to an enterprise entering into long-term commitments with its vendors. The *Enterprise Dependent Model* includes such concepts. Thus, the *domain independent* and *domain-specific, enterprise independent* models can serve as modules in developing a model for a specific enterprise.

1.1 Apparel Manufacturing Architecture

The Apparel Manufacturing Architecture (AMA) is a comprehensive model of a computer-integrated apparel enterprise [Jayaraman 90, Malhotra 90, Jayaraman 92]. AMA comprises both domain independent entities, such as Operators, and entities specific to the domain of apparel manufacturing such as Cut Order. AMA encompasses activities spanning product development to distribution of goods. It consists of a set of models the core of which is the information model which is the integrated schema shared by all the functions in an apparel enterprise. The function model component of the architecture specifies how the activities carried out in an apparel manufacturing enterprise interact with each other through a shared information base. The third component of AMA, the dynamics model, describes how the interactions among the enterprise activities take place over time. The architecture is based on extensive modeling and analysis of the operations of a major apparel manufacturing enterprise.

While AMA models all functions in the day-to-day operation of an apparel manufacturing enterprise, individual enterprises may face immediate challenges in specific functional areas, e.g., production planning. Using AMA to build systems that enable apparel manufacturers to meet their particular challenges effectively will validate AMA as a specification or blueprint for developing systems for "real" problems. Developing a model for an enterprise from AMA will also demonstrate the advantages of the modular approach to modeling. In addition to these benefits, system development for solving specific problems of an enterprise using AMA will provide enterprise personnel an excellent opportunity to gain extensive exposure to computer-integrated manufacturing and advantages of information systems and information technology. The enterprise personnel will also acquire experience in the use of methodologies for modeling and analysis of manufacturing enterprises and for communicating CIM system specifications to those responsible for their implementation.

2. Terry Manufacturing and Shared Production Capability

Terry Manufacturing, based in Roanoke, Alabama, is a leading manufacturer and supplier of BDU coats (camouflage coats) to the U.S. Department of Defense (DoD). It is also a supplier of uniforms for fast-food restaurants such as McDonald's Corporation. Enterprise resources such as operators and machines are preassigned to the manufacture of either BDU coats or the restaurant uniforms. This section describes the *Shared Production* agreement entered into by DoD and Terry Manufacturing with McDonald's Corporation as the commercial partner.

2.1 Shared Production: the National Guard of Manufacturing

Members of national guard are employed in civilian positions during normal times. However, in the events of mobilization or emergencies, they are called to serve the armed forces. Similarly, DoD wanted manufacturing enterprises to use their resources to produce both for DoD and the commercial market on an on-going basis and during a mobilization redeploy the resources to meet the surge in DoD requirements. The commercial customers would agree to the modified supply level during the surge period. This arrangement of sharing the production resources between defense and commercial requirements is called *shared production*. A company's ability to rapidly redeploy its resources from one product to another is called *shared production capability*.

Terry Manufacturing has entered into a Shared Production agreement with the DoD to increase its supply of BDU Coats by 20% to 60% to meet the surge requirements in the case of a mobilization. McDonald's, as a commercial customer of Terry Manufacturing, is also a partner in this agreement. This agreement and its implementation are expected to serve as a model for such agreements with other apparel manufacturers and also manufacturers in other domains.

2.1.1 Benefits of Shared Production

The advantages of shared production agreement are the following:

1. DoD has access to a steady base of suppliers with the necessary knowhow to manufacture

the products it needs and who are capable of rapidly ramping up the supply in the event of an emergency;

2. The manufacturer participating in the agreement need not be solely dependent on defense contracts and can diversify into a range of products and markets;
3. Since the employees will be cross-trained in the manufacture of diverse products, their skill levels will be higher. This will in-turn contribute to their economic well being that is eventually beneficial to the community. The ability to rapidly redeploy resources will also make the enterprise as a whole more efficient and competitive.
4. Shared production capability, i.e., ability to switch from manufacture of one product to another within a short time is the same as *quick response* capability. Such ability to respond rapidly to changes in market needs is vital for the success of any apparel enterprise. Hence, the means identified for Terry Manufacturing to achieve shared production capability and the experience in its implementation will be of interest to the apparel industry as a whole.

2.2 Strategy to Attain Shared Production Capability

The goal for Terry Manufacturing was to be an effective participant in the shared production agreement, i.e., be able to rapidly redeploy resources to increase the production for DoD in the case of an emergency.

To achieve this goal, Terry Manufacturing had to accomplish the following:

1. Develop a plan for implementing shared production by specifying in detail the different functions to be performed, such as reassigning existing resources (e.g., operators and machines), training additional operators for specific operations, and outsourcing;

2. Analyze the information needs of the various functions and design and develop an information model to support these functions; and
3. Implement an information system to support shared production.

Comprehensive function and information models are required to fulfill these requirements. The analysis, design and development of these models and the role of AMA in these are described in the following sections.

3. Design and Development of Terry Manufacturing Architecture

The design, development and implementation effort was carried out in six phases as shown in Figure 2.

3.1 Knowledge Exchange and Definition of Goals

This stage in the development of the Terry Manufacturing Architecture (TMA) comprises the activities mentioned under the first two phases in Figure 2. The first task was to identify participants from Georgia Tech and Terry Manufacturing for the architecture development team. Initially, the discussions were focused on understanding the overall goal of Terry Manufacturing, i.e., achieving shared production capability. Presentations were made to explain the concept of information systems architecture in general and the contents of the Apparel Manufacturing Architecture in particular.

During this stage, the scope, purpose and the viewpoint of the model to be developed were defined. The scope of the model was to include all activities connected with planning for shared production, such as planning for additional machines and training operators. The purpose of the model was to develop a blueprint for implementing an information system for shared production. The model takes the viewpoint of the personnel responsible for planning and implementing shared

production. It was also decided that the deliverables at the end of the project will be an $IDEF_0$ function model specifying in detail the activities to be carried out for implementing shared production, an $IDEF_1x$ information model to support these activities, and a database implementation of the information model.

3.2 AS IS and TO BE Function Models

The AS IS function model depicts the enterprise as it currently operates. The TO BE function model is the specification of how the functions are to be carried out when they are integrated through a shared information system. The schema for the shared information system is called the TO BE information model. The TO BE function and information models together are called the TO BE architecture.

The goal of Terry Manufacturing was to be capable of increasing the production of BDU coats by anywhere between 20% and 60%. To test the concept, it was planned to initially increase the production by 20% based only on Terry Manufacturing's existing resources, i.e., *without* outsourcing, acquiring new machines or hiring new operators. Since supply to commercial customers will be affected by the redeployment of resources to meet the surge requirements, contingency plans must be made to supply McDonald's Corporation. The various activities involved in the overall plan are the following:

- Plan & Provide Additional Operators
- Ensure Machinery Availability
- Ensure Material Availability
- Plan for Storage and Shipping
- Ensure availability of Funds
- Make Contingency Plans for Commercial Customers

The information flow between these activities is shown in Figure 3. The figure shows these activities using the $IDEF_0$ function modeling notation [ICAM 81]. Functions are represented by cells or boxes. For example, the activity *Plan for Storage and Shipping* is shown as the box labeled A4. The arrows (called ICOMs - Inputs, Controls, Outputs and Mechanisms) connecting the cells are entities supporting the functions. In Figure 3, for the activity *Plan for Storage and Shipping*, the input *is Request for Increase in Shared Production Capability (RISC)*; the activity is constrained or controlled by *Storage and Shipping Information*; the output generated by the activity is *Storage Space and Shipping Allocation*; and *Personnel* is the mechanism to perform the function.

To increase the shared production capability beyond 20%, outsourcing and augmentation of own resources were explored and this led to the TO BE model. Consequently, the TO BE function model is a specification of activities to be carried out for an increase in shared production capability by more than 20%. These activities are shown in Figure 4. The first step is to identify other (satellite) plants capable of performing operations involved in the manufacture of the BDU coats (Function A1 in Figure 4). Once such plants are identified, the terms for their participation in shared production have to be finalized (Function A2).

After the two preliminary functions described above, detailed plans have to be developed for the satellite plants' effective participation in shared production (Function A3). A breakdown of this function is shown in Figure 5. Based on the resources available with the satellite plant, the BDU coat operations which it can perform are identified (Function A31 in Figure 5). The optimum order size the plant can handle is also determined (Function A32).

Since the operators in the satellite plants must be trained in the selected operations and quality control procedures, appropriate plans must be developed (Function A33). The planned order levels, inspection procedures, and training plans are communicated to the satellite plants (Function A34). To effectively utilize Terry Manufacturing's resources, a "train the trainers" pro-

gram needs to be developed (Function A35); these trainers will be trained at Terry Manufacturing and they will in turn train the operators in the satellite plants.

Also, many of the operations in producing the BDU Coat are fairly complex and require special equipment and operator skills. These critical operations may be performed at Terry Manufacturing while others might be carried out at satellite plants. Therefore, when the subassemblies from the satellite plants are brought to Terry Manufacturing and integrated into the production sequence, their quality must be assured. Consequently, specific plans for inspection must be developed. Moreover, to avoid bottlenecks and other problems in integrating the subassemblies into the production line at Terry Manufacturing, there is a need for detailed information on the order placed with the satellite plant. An effective means of communicating with the satellite plants (and within Terry Manufacturing) is through electronic data interchange (EDI). Therefore, a plan for integrating all the activities through EDI must be developed (Function A5 in Figure 4).

The details of the fourth activity of the TO BE model, viz., *Plan for Shared Production at Own Plant* (Function A4 in Figure 4) are the same as the AS IS model (Figure 3) except for the differences due to the decision to acquire new resources. The decomposition of the function *Plan and Provide Additional Operators* (Function A4 in the AS IS model and A41 in the TO BE model) is shown in Figure 6. At this level, providing enough human resources for cutting, sewing and other functions such as inspection and packing is considered (Functions A411, A412 and A413, respectively in Figure 6). The details of the function *Provide Operators for Sewing* (Function A412 in Figure 6) are shown in Figure 7. As a first step, the operations needing additional operators to meet the surge requirements are identified (Function A4121 in Figure 7). Part of this need is met by identifying operators working on the commercial line possessing the skills required for these operations (Function A4122). Additional operators may have to be hired for any need not met with existing operators (Function A4123). The operators have to be trained for the operations for which they have been assigned (Function A4124).

The details of the training function (Function A4124 in Figure 7) are shown in Figure 8. Initially, planning is done to ensure that adequate resources such as machinery and materials are provided for training (Function A41241 in Figure 8). At first, the operators are trained off-line (Function A41242). Their progress is monitored continuously (Function A41245). Once the operators achieve required proficiency in performing a job, they are transferred to on-line training where they work on the regular BDU coat production line (Function A41243). The operators have to be trained periodically so that they are prepared for the surge demand at any time (Function A41244).

The other activities shown at the top level in Figures 3 and 4 are also similarly decomposed to describe the flow of information between them, the mechanisms (or resources) required to perform them and the controls (or constraints) under which they are performed [Jayaraman 93].

3.3 Information Model

Once the function model was developed, the various information entities required to carry out the functions were identified. The complete description of these entities in terms of their attributes and their interrelationships constitutes the information model. The information model was developed using $IDEF_1x$ methodology [IISS 85] which is based on a relational data model. The graphical notation of this methodology was very useful in presentations and discussions at Terry Manufacturing.

The information entities related to operators and machines are shown in Figure 9. Each entity is represented by a box and is assigned an index (e.g., the entity *Operator* has an index E1 in Figure 9). The relationship between the entities is shown by connectors between the boxes. The nature of the relationship is described by a label assigned to the connector. The attributes of the entity *Operator* are the operator number (to identify each operator uniquely), name, the plant and the department in which the operator is employed, a job code denoting the skill level, whether or

not the operator has already been assigned to meet the surge demand, a subjective rating of the operator's overall capabilities by the operator's supervisor and comments on other details about the operator. The operator's skill level in performing different operations is specified by the entity *Op-Skill*. Its attributes include the code for the operator whose skill is being specified and the specific operation for which the skill is specified, the required and completed training hours and the targeted and the currently attained efficiency. Similarly, a workstation (entity E7 in Figure 9) and its capabilities to perform different operations (entity E6 in Figure 9) are defined in the information model.

An operation is assigned a unique code, a name, standard hours to perform the operation, and the standard cost; its skill requirement specified by the job code (entity E4 in Figure 9). The operations involved in manufacturing a specific sub-assembly (e.g., Collar and Sleeve) belong to an operations group. The *OprnGroupID* attribute specifies the operations group to which an operation belongs.

The entities related to the purchase of raw materials are shown in Figure 10. Materials are represented by an unique ID, a brief description, the unit used for measuring the material quantity and its cost (entity E12 in Figure 10). The price that is paid for an item, the lead time in obtaining it are represented by entity E17 in Figure 10. This entity also shows how a particular vendor is rated as a supplier for a specific material and the code assigned by the vendor for the material (as opposed to entity E12 which gives the code assigned to the same material by Terry Manufacturing). It can be seen from entity E18 in Figure10 that each vendor is also assigned an overall rating, in addition to the rating for a particular material.

Terry Manufacturing enters into long-term agreements for purchase of specific materials from particular vendors through blanket purchase orders (entity E26 in Figure 10). The blanket purchase orders have unique numbers assigned to them, the material being ordered and its quantity and value, the period for which the agreement is valid and its current status (e.g., completed and cancelled).

Materials are ordered through purchase orders (entity E19 in Figure 10). A purchase order has a unique number, the vendor to whom it is sent and the date on which it is sent. A purchase order consists of one or more purchase order items (entity E20 in Figure 10). Each purchase order item contains the item number, the purchase order to which it belongs, the material being ordered, the ordered and actually received quantities, the date on which the vendor originally promised to deliver the material and the date on which it was actually delivered, the current status of the order (e.g., pending, delivered and cancelled) and the blanket purchase order against which the order is being placed.

Other entities and relationships covering the following facets of shared production were defined in the information model:

1. Customer orders (including RISC);
2. Storage and shipping;
3. Plants (both owned and satellite) and their capabilities; and
4. Process plan and bill of materials.

4. Database Implementation

One of the primary objectives of this endeavor was to set up an information system to facilitate shared production; therefore the next step was to validate the information model to ensure that all entities and relationships were adequately represented. This was accomplished through discussions and comparison with various forms and records at Terry Manufacturing. Once the information model was validated, it served as the basis for the development of the information system in Borland's Paradox, a relational database management system.

Each entity in the information model was implemented as a table in the database. The database contained 27 tables. The tables have been designed to capture the information about the following:

1. Operators, their training and skill levels (Figure 9);
2. Machines and their capacities to perform different operations (Figure 9);
3. Materials, vendors and other purchase-related entities (Figure 10);
4. Customers and customer orders (including surge requests);
5. Materials: on hand, shipped and ordered;
6. Quality reports for raw materials;
7. Process plans, garment sub-assemblies and materials requirements; and
8. Plants (both owned and satellite) and their capacities to make entire garments or sub-assemblies).

Queries to automate certain routine functions were also developed. Figure11 shows an example of such queries. It is designed to find out the customer order items which are yet to be delivered. The result of the query shows the customer who placed the order (U.S. DoD) and also the number of days still remaining for the promised delivery date (12). The query has to look-up data from three tables, viz., *Customer Order Item, Customer Order* and *Customer*. A ✓ mark is placed in the fields (in these tables) which are to be included in the query result, e.g., the field *CO Item No* in the table *Customer Order Item* as shown in Figure 11. The user can modify the query to include or exclude information contained in a field from the query result by simply placing or removing the ✓ marks in the respective fields. All the information to be included in the result of the query result except the name of the customer who placed the order is available in the table *Customer Order Item*. However, the user can identify the customer more easily by name than by the ID. The customer's name can be retrieved from the table *Customer*. The *Customer* table is linked to the *Customer Order Item* table through the *Customer Order* table. To link these tables while defining the query, identical strings are placed in the common fields in these tables in the query. The string ORDER placed in the *CO Number* field in both the *Customer Order Item* and *Customer*

Order tables retrieves the customer order which contains a particular customer order item by matching rows from the two tables with identical values for *CO Number*. Similarly, the string ID in the *Customer ID* field of both the *Customer Order* and *Customer* tables retrieves the customer who placed a particular order by matching rows from the tables based on the value contained in the field *Customer ID*.

Today is a keyword in Paradox. It represents the current date. It is used to calculate the number of days still left for the promised date as shows in the *Promised Date* field of the *Customer Order Item* table in the query (Figure 11). It is done by storing the promised date as a variable X and then by subtracting *today* from X. *Blank*, shown in the *Delivery Date* field in the *Customer Order Item* table is another keyword in Paradox. It ensures that only those rows in the table which do not have an entry in this field are retrieved. Therefore, it retrieves only those customer order items which are yet to be delivered.

5. Validation

At each stage during modeling and information system implementation, detailed reports were presented to Terry Manufacturing personnel. Discussions were held to verify the correctness and completeness of the models and the information system. Based on these discussions refinements were made. The tables and queries were tested subsequently with real data by Terry Manufacturing. It was also ensured that the database implementation will fulfill all of Terry Manufacturing's needs. During this phase, modifications were made to the database implementation to enhance its usefulness for Terry Manufacturing.

6. Comparison of AMA and TMA

The function and information models for Terry Manufacturing together constitute the Terry Manufacturing Architecture (TMA) as it is a formal specification for the implementation of the information system and its subsequent utilization for various functions. The role of AMA in the development of TMA is presently discussed.

The scope of the AMA function model included only the functions involved in the day-to-day operation of an apparel manufacturing enterprise. The scope of the current effort included day-to-day operations, e.g., assigning machines and operators to particular operations as well as several planning and decision making functions which are carried out only once in a while, e.g., Identify Potential Satellite Plants, and Plan for Integration through EDI. The specification of day-to-day operations in AMA could be used as such for TMA and hence made its development easier. On the other hand, the strategic planning functions were specified only at an abstract level in AMA. These functions had to be decomposed and specified in detail because of the purpose for which TMA was developed. For example, the activity Identify Potential Satellite Plants (A1 in Figure 4) is equivalent to the activity Select Manufacturing Location (A312 in Figure 12) in AMA. In AMA, the activity is not decomposed further. However, the decomposition in TMA (Figure 13), can be integrated into AMA. Hence, *AMA has not only enabled rapid development of TMA by serving as a reference architecture, but also stands to be enriched by incorporation of the detailed specifications of certain functions from TMA*. Thus, there is symbiotic relationship between the generic architecture for the domain of apparel manufacturing and architecture for a specific enterprise.

Though some functions in TMA have been newly introduced, there was very little need for introducing new information entities. Only a few information entities such as Blanket Purchase Order and Sub-Contract are new in the information model for Terry Manufacturing. It has an important implication: *once a core set of information entities has been carefully specified, the enti-*

ties can be reused to support many new functions with little modification. Hence, a well designed information system will be a catalyst for rapid changes in an enterprise as opposed to being one more impediment to them.

7. Conclusions

AMA has proved to be a valuable tool in developing the detailed specification of how Terry Manufacturing can acquire shared production capability and design an integrated information schema for the enterprise. This research effort has also proved the utility of AMA, a comprehensive architecture for the apparel industry, for design, development and implementation of systems for specific enterprises to enable them to achieve their particular goals.

Though some functions involved in the planning for shared production were not specifically detailed in AMA, almost the entire information schema required to support these functions could be found in the AMA information model. This shows that the AMA information model is robust enough to support changes in the way an enterprise carries out its business (e.g., an apparel manufacturer may decide to outsource instead of producing everything in-house) with minimum modifications.

Shared production capability, i.e., the ability to rapidly redeploy resources to produce different products at short notice has a wide appeal to the industry. Shared production capability in a general way is nothing but flexibility and quick response capability which are vitally important to any apparel manufacturer to compete successfully in a rapidly changing market. Hence, the function model and the information schema should be useful for any apparel manufacturer.

Acknowledgments

The authors wish to thank the U.S. Defense Logistics Agency for funding this research under DLA-900-87-D-0018/0015. Thanks are also due the National Science Foundation for funding this research in part through Presidential Young Investigator Research Award No. DDM-8957861.

References

Integrated Computer-Aided manufacturing (ICAM), *Function Modeling Manual IDEF$_0$*, Materials Laboratory, Air Force Wright Aeronautical Laboratories, AFSC, Wright-Patterson AFB, OH, 1981.

Integrated Information Support System (IISS), *Information Modeling Manual IDEF$_1$x*, ICAM Project Priority 6201, D. Appleton Company Inc., Manhattan Beach, CA, 1985.

Jayaraman, S., "On a Manufacturing Enterprise Architecture," *IJCAI 1989, Workshop on Integrated Architectures for Manufacturing*, August, Detroit, MI, 1989.

Jayaraman, S., "Design and Development of a Generic Architecture for Computer-Integrated Manufacturing in the Apparel Industry," *Textile Research Journal*, 60(5), 1990, pp. 247-254.

Jayaraman, S. and Malhotra, R., "Apparel Manufacturing Architectute [Version1.0], Volume I: The Function and Dynamics Models, Volume II: The Information Model," *Technical Report SJ-TR-ARCH-9210*, Georgia Institute of Technology, Atlanta, GA, October 1992.

Jayaraman, S, Malhotra, R., and Srinivasan, K., "Utilization of Apparel Manufacturing Architectute," *Technical Report SJ-TR-ARCH-9310*, Georgia Institute of Technology, Atlanta, GA, October 1993.

Malhotra, R., and Jayaraman, S., "Design and Development of an Architecture for Computer-Integrated Manufacturing in the Apparel Industry," *Textile Research Journal*, 60(6), 1990, pp. 351-360.

Pegden, C. D., Shannon, R.E.,and Sadowski, R., *Introduction to Simulation Using SIMAN*, McGraw-Hill, Inc., New York, NY, 1990.

Srinivasan, K., and Jayaraman, S., "Design and Development of an Enterprise Modeling Framework," *Workshop on AI in Enterprise Integration, AAAI-92*, San Jose, CA, July, 1992.

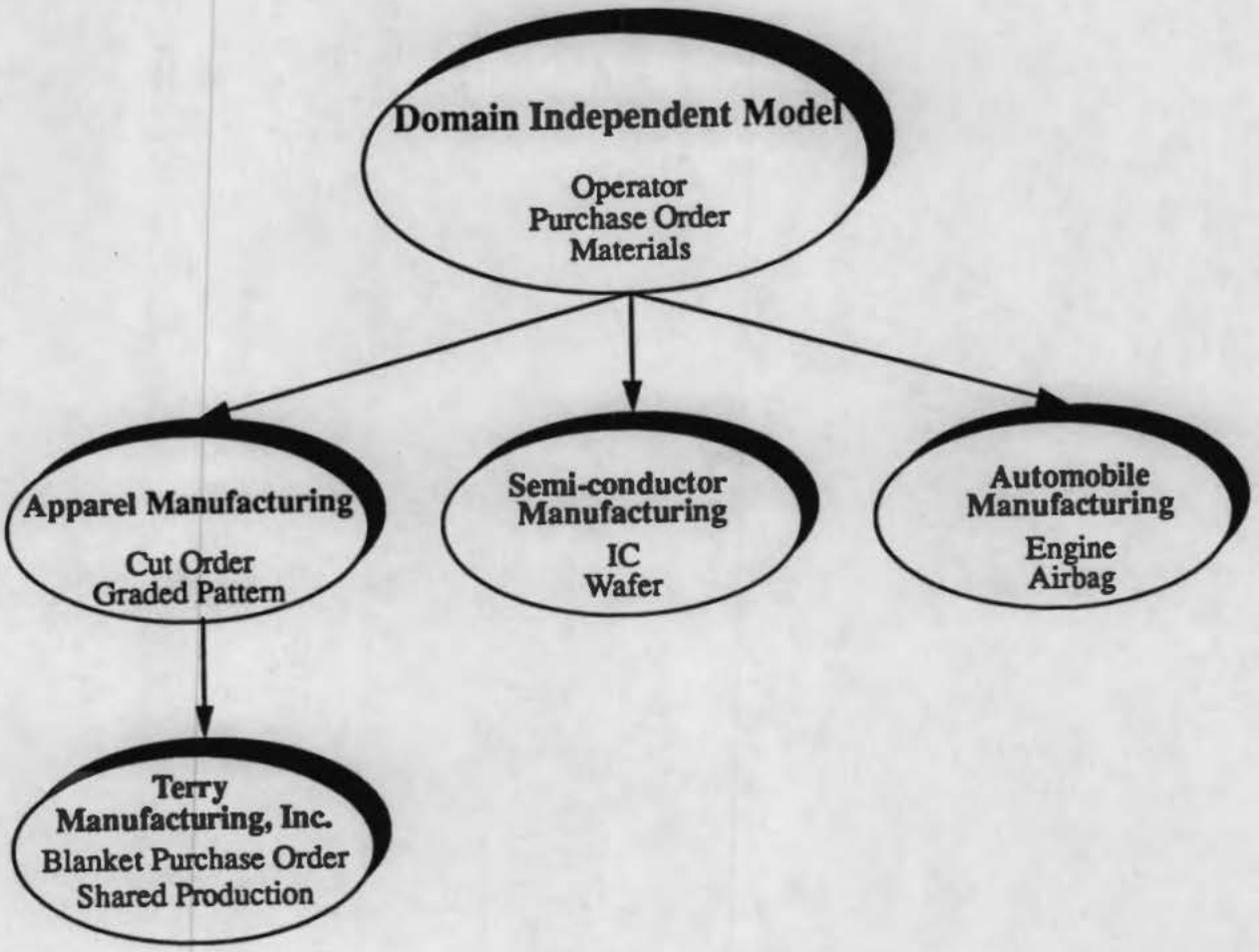


Figure 1. A Modular Approach to Modeling

1. Domain Understanding and Task Definition

- Team formation
- Understanding the enterprise's goal: shared production capability
- Introduction to the AMA modeling methodology
- Laying down the project goals: design, development and implementation of the information system

2. Information Sharing

- Current status of the enterprise with respect to its goals
- Enterprise's plans for the future
- Discussions and reports

3. AS IS Modeling

- $IDEF_0$ (AS IS) Function Modeling
- Verification of the model

4. TO BE Modeling

- $IDEF_1x$ (TO BE) Information Modeling
- $IDEF_0$ (TO BE) Function Modeling

5. Implementation

- Database schema definition
- Creation of example entities
- Creation of database queries

6. Validation

- Use by the enterprise
- Refinements

Figure 2. Phases in the Development of the Terry Manufacturing Architecture

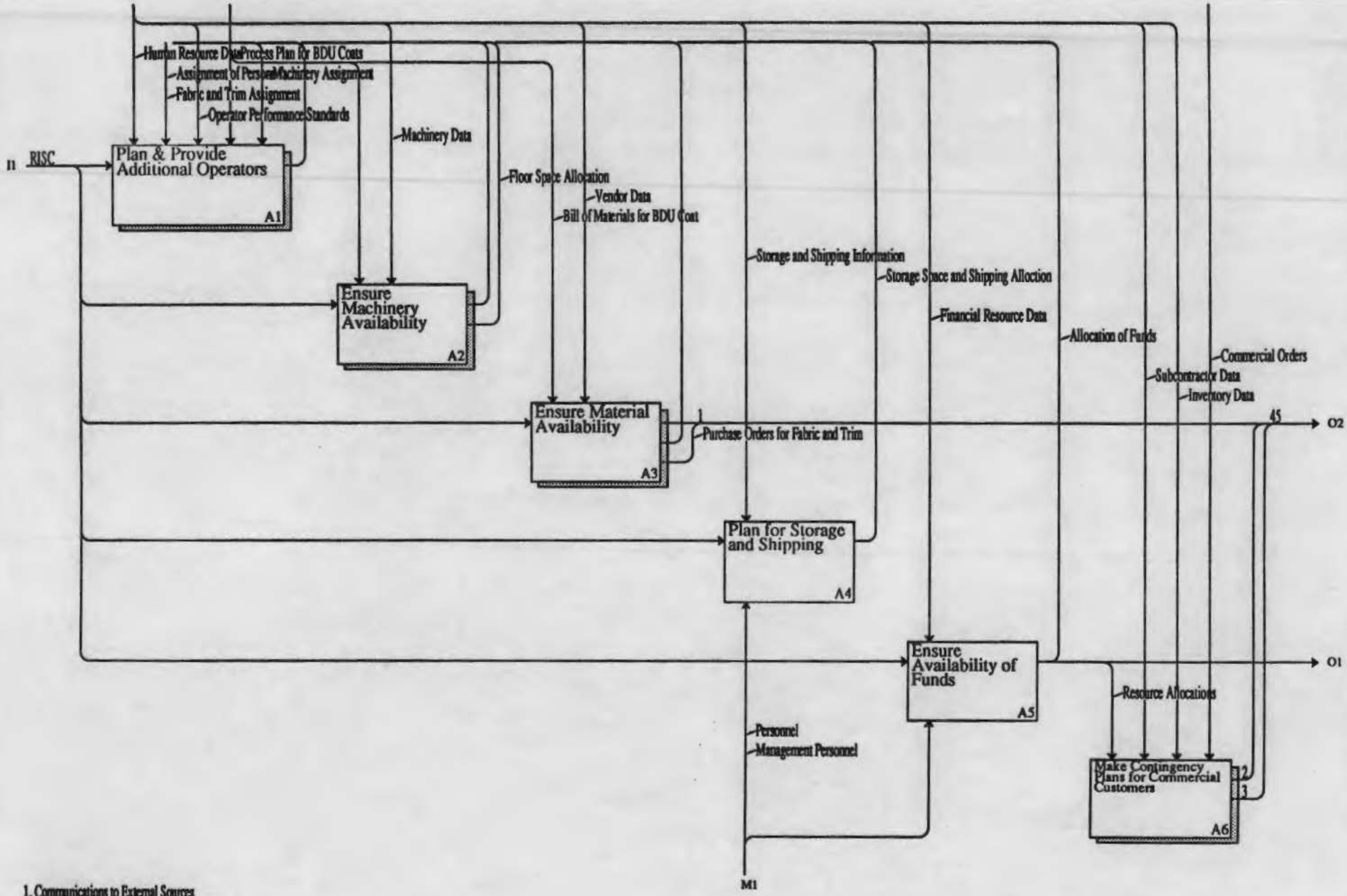


Figure 3. Specification of Activities for a 20% increase in the Production of BDU Coats (part of the *AS IS* Function Model)

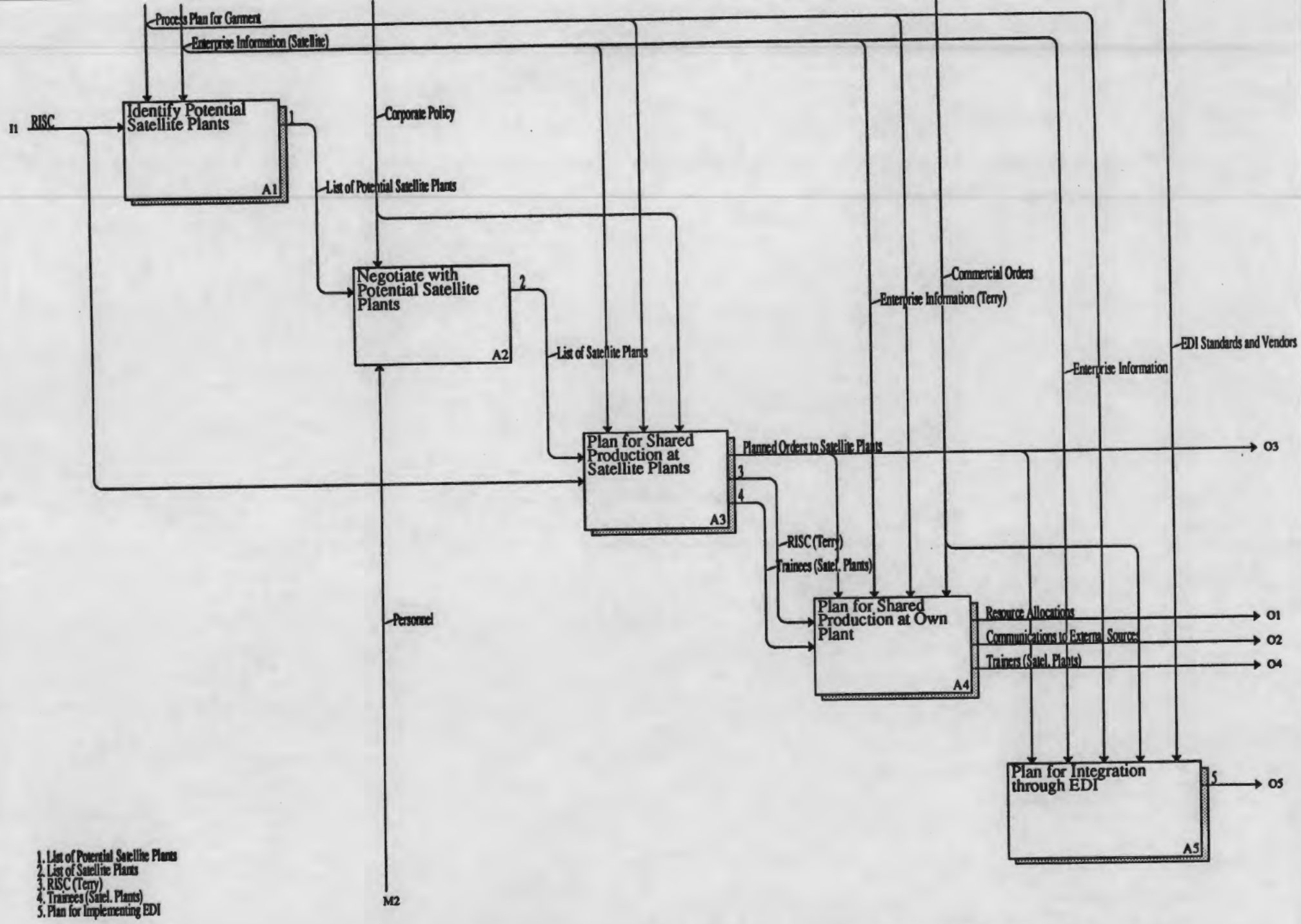


Figure 4. Specification of Activities for more than 20% increase in the Production of BDU Coats (part of the *TO BE* Function Model)

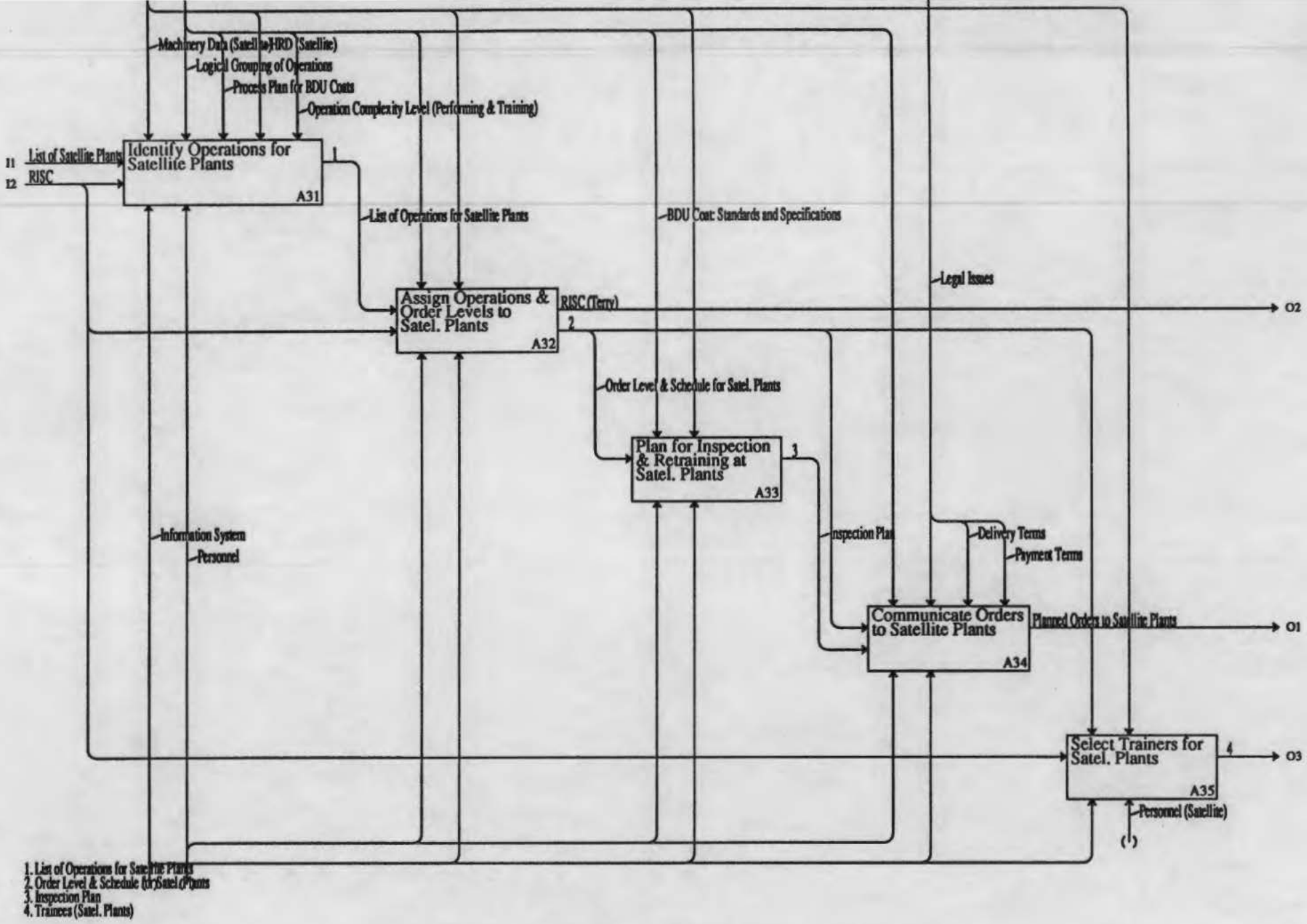


Figure 5. Details of Planning for Shared Production at Satellite Plants

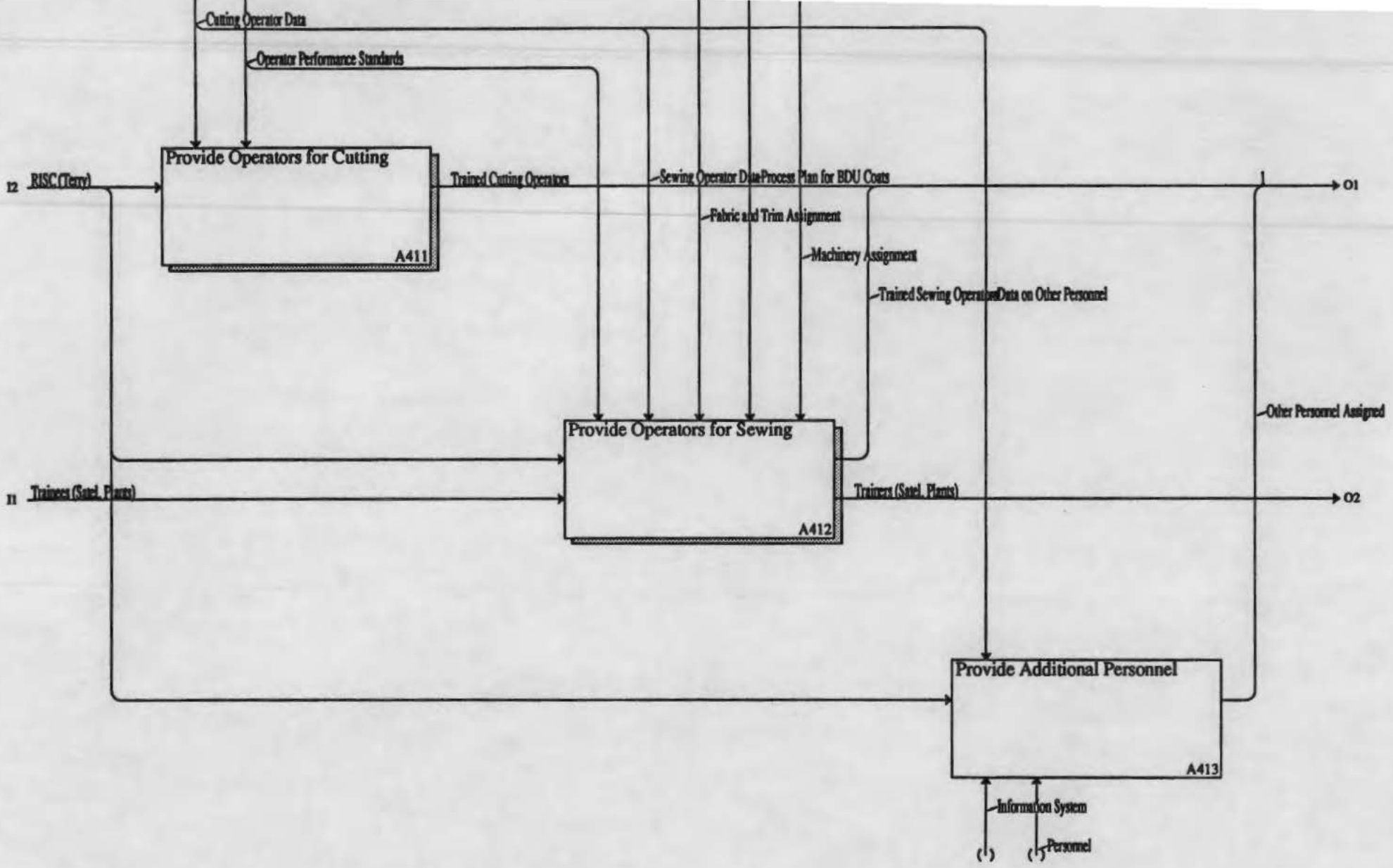


Figure 6. Details of the Function *Plan and Provide Additional Operators*

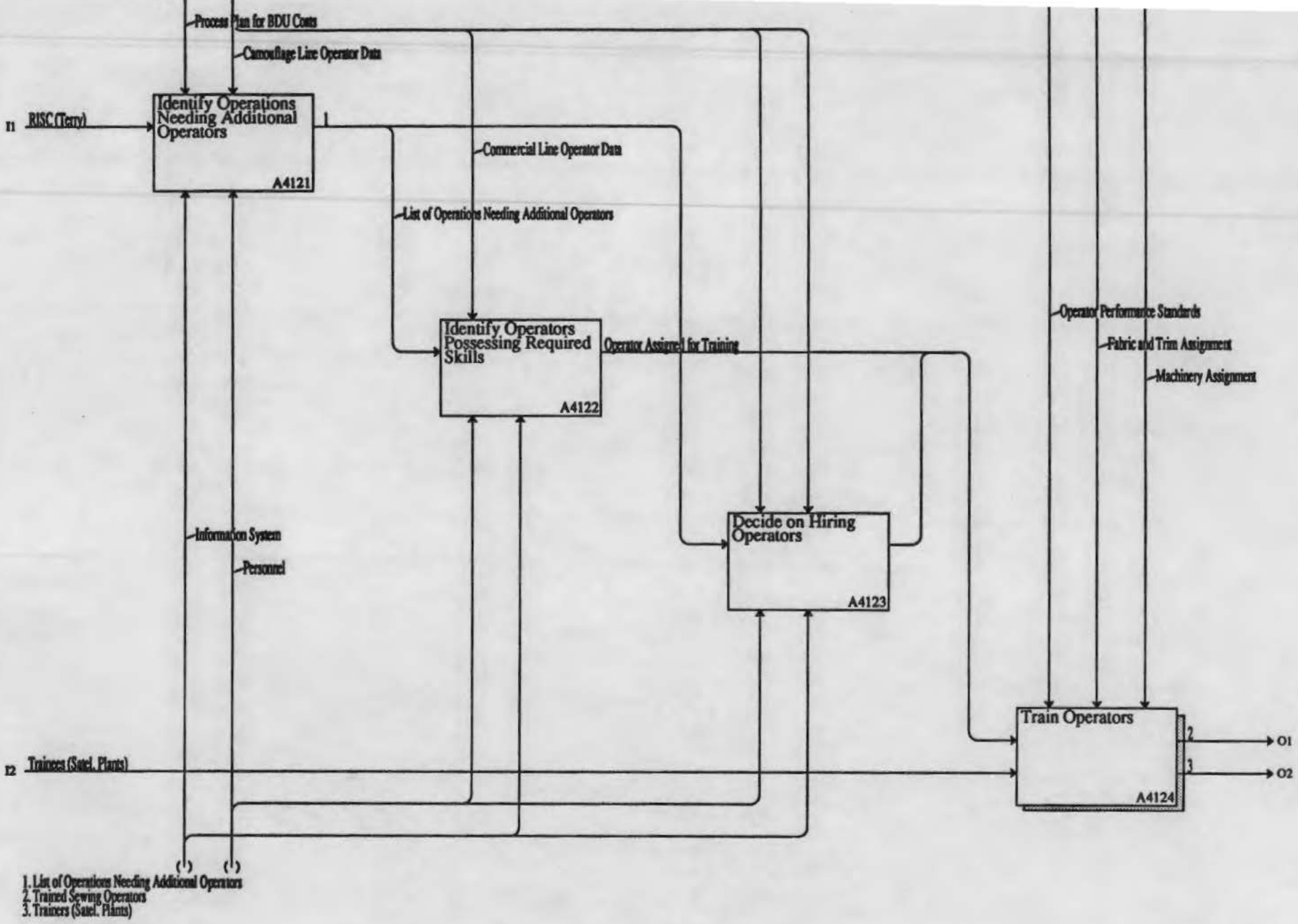


Figure 7. Details of the Function *Provide Operators for Sewing*

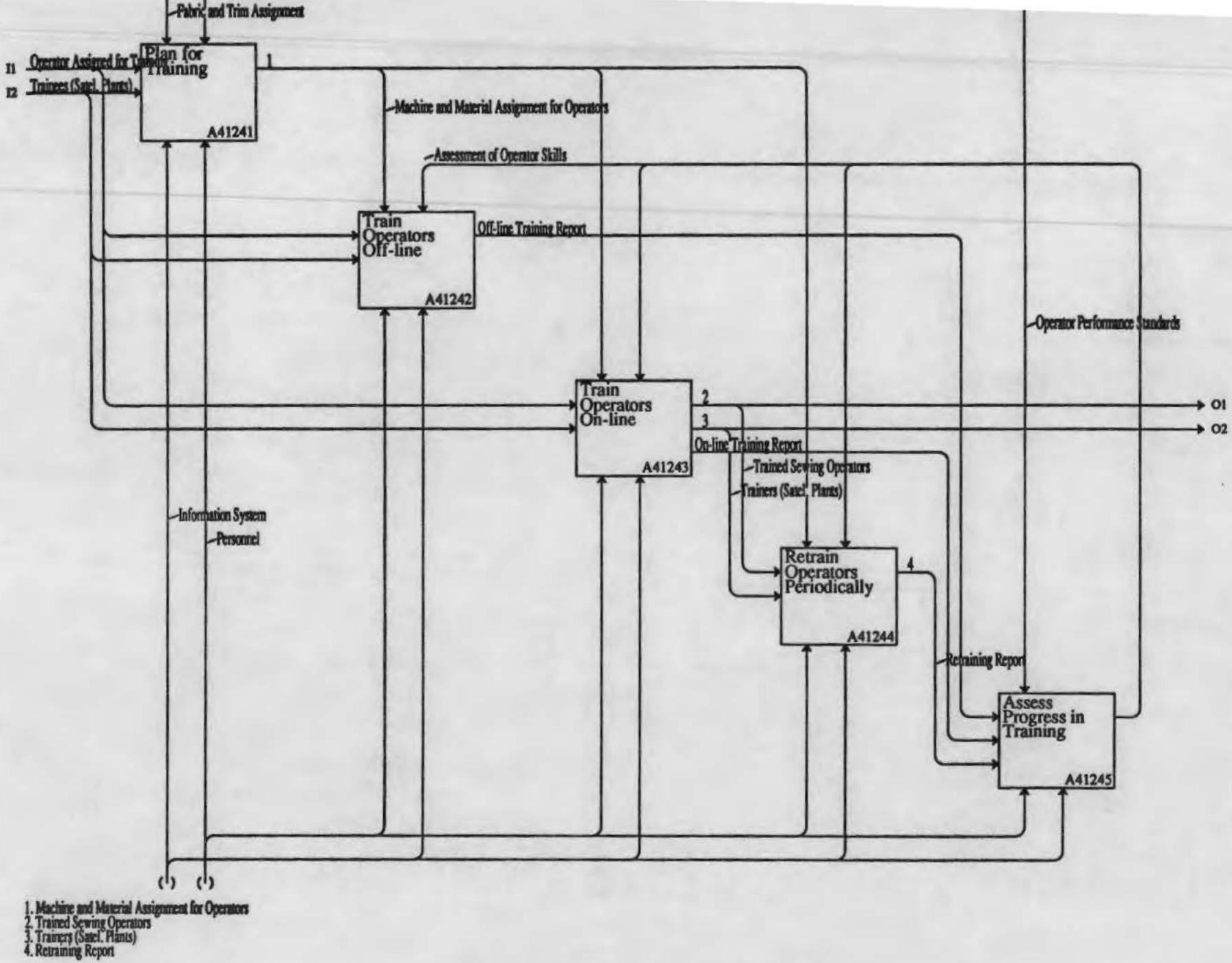


Figure 8. Details of the Function *Train Operators*

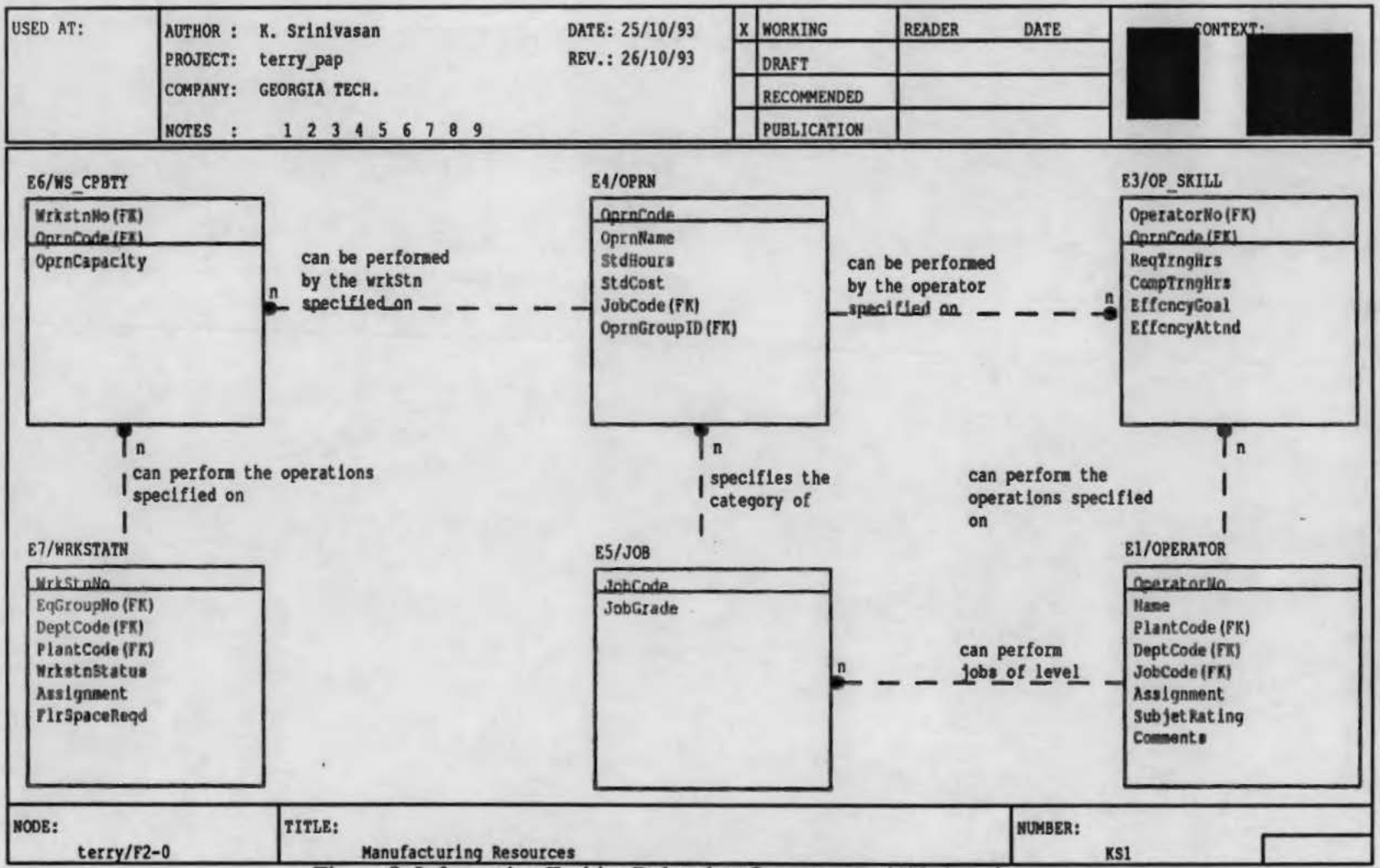


Figure 9. Information Entities Related to Operators and Workstations

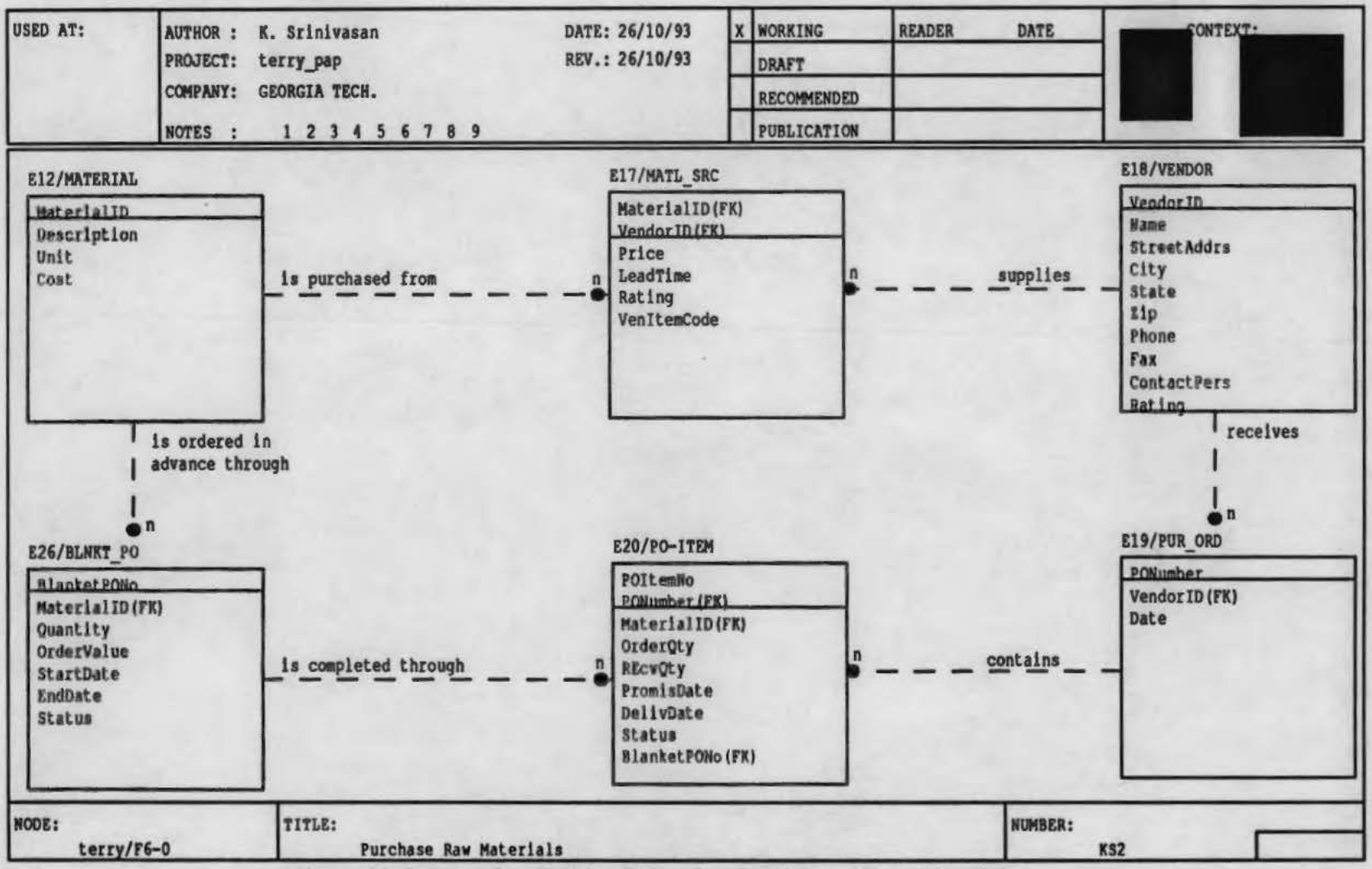


Figure 10. Information Entities Related to Purchase of Raw Materials

Table: Customer Order Item

CO Item No	CO Number	Contract No	Style ID	Quantity	Requested Date	Promised Date	Delivered Date	Status
✓	✓ [redacted]		✓	✓		[redacted] *cal* - *today* as Remaining Days	*blank*	

Table: Customer Order

CO Number	Customer ID	Order Date
[redacted]	[redacted]	

Table: Customer

Customer ID	Customer Name	Street Address	City	State	ZIP	Phone	Contact Person
[redacted]	✓						

Query Result

CO Item No	CO Number	Style ID	Quantity	Remaining Days	Customer Name
02	341	BDU-4448	100,000	12	U.S. DoD

Figure 11. Query to find out the details of Pending Customer Orders

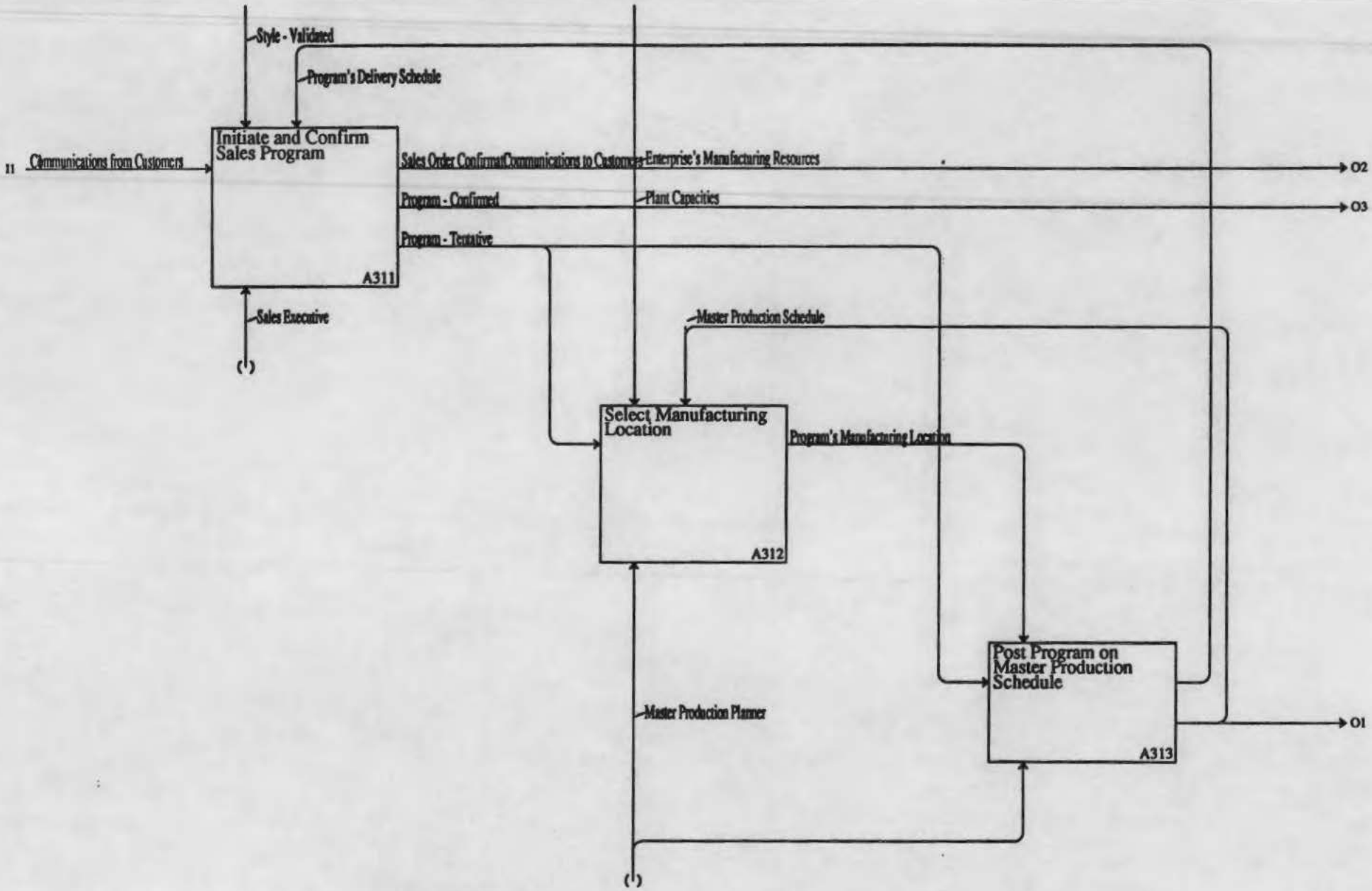


Figure 12. Details of the Function *Plan and Prepare for Manufacture* (from AMA)

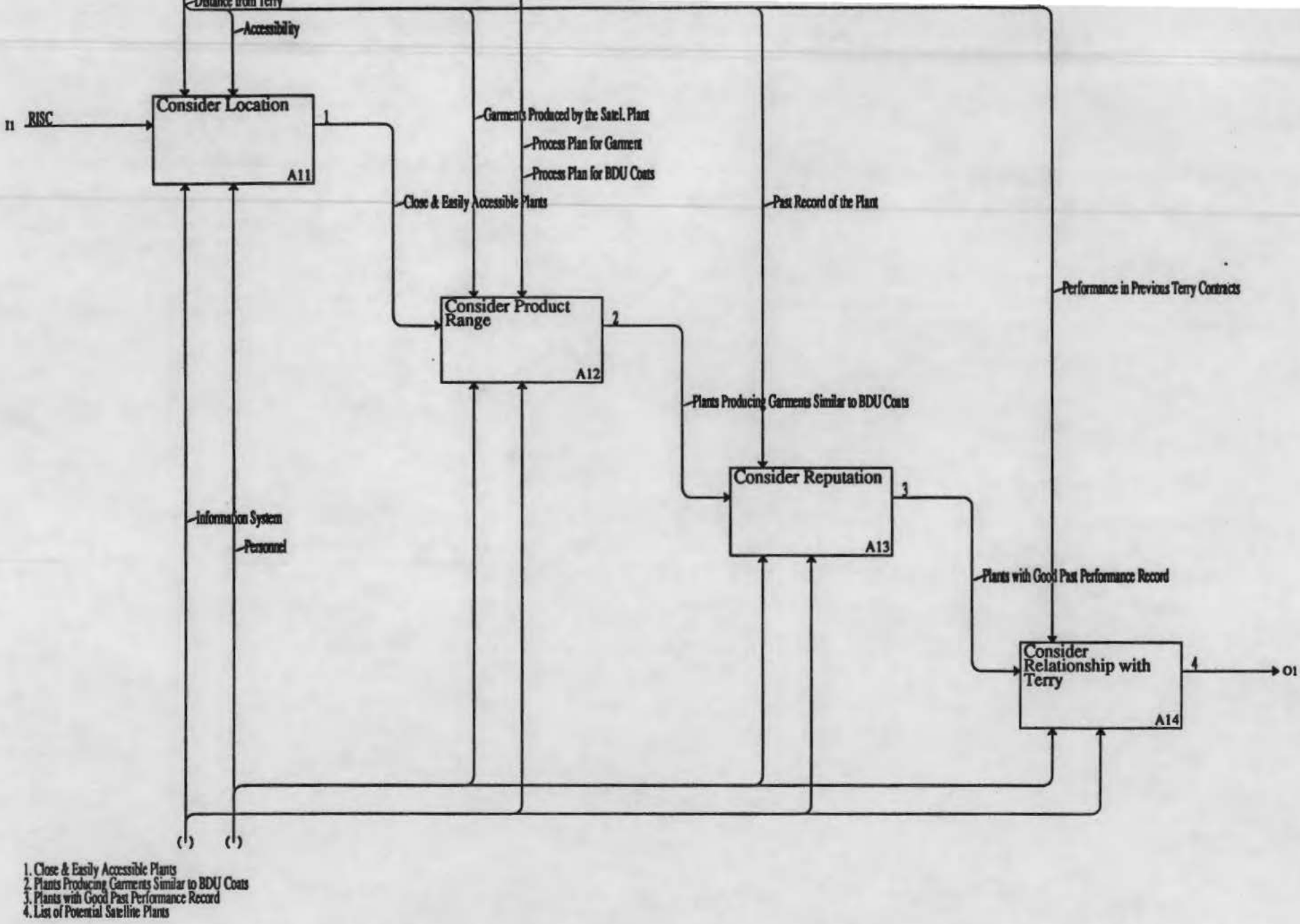


Figure 13. Details of the Function *Identify Potential Satellite Plants* (from TMA)

CONFIDENTIAL

FOR DLA USE ONLY

PLEASE DO NOT DISTRIBUTE

UTILIZATION OF APPAREL MANUFACTURING ARCHITECTURE

Volume II: Dowling Textiles: Case Study in Integrated Planning and Purchasing

Research Sponsored by:

U.S. Defense Logistics Agency
DLA-AQPOT
Cameron Station
Alexandria, Virginia 22304-6100

DLA Contract #: DLA900-87-D-0018/0015

Reported by:

Dr. Sundaresan Jayaraman
Principal Investigator

Georgia Tech Project #: E-27-618

Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, Georgia 30332

Tel: 404/894-2490
Fax: 404/894-8780

December 1993

SJ-TR-ARCH-9312

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	12/15/93	Final; 2/08/91 - 12/21/93

4. TITLE AND SUBTITLE
Utilization of Apparel Manufacturing Architecture Volume II: Dowling Textiles: Case Study in Integrated Planning and Purchasing

5. FUNDING NUMBERS
C

6. AUTHOR(S)
Jayaraman, Sundaresan; Srinivasan, K; Malhotra, Rajeev

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, GA 30332-0295

8. PERFORMING ORGANIZATION REPORT NUMBER
SJ-TR-ARCH-9312

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Defense Logistics Agency
DLA-AQPOT
Cameron Station
Alexandria, VA 22304-6100

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
LIMITED DISTRIBUTION

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Research has been carried out to demonstrate the role and importance of the Apparel Manufacturing Architecture (AMA) to the apparel industry through practical applications of AMA to specific tasks in two apparel plants -- Dowling Textiles and Terry Manufacturing. Working with Dowling personnel, an information system for integrated planning and purchasing was designed, developed and implemented at Dowling. Likewise, an information system for *shared production* was developed at Terry Manufacturing so that it would be capable of increasing its production (in response to DoD's surge requirements) by anywhere between 20 and 60%. Both the developed systems have been tested by plant personnel. The other objective of the effort, viz., transfer the developed technology and modeling know-how to the real-world has also been accomplished.

14. SUBJECT TERMS	15. NUMBER OF PAGES
CIM; Apparel Architecture; Information Systems; Plant Demonstration	75
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

CONFIDENTIAL

FOR DLA USE ONLY

PLEASE DO NOT DISTRIBUTE

UTILIZATION OF APPAREL MANUFACTURING ARCHITECTURE

Volume II: Dowling Textiles: Case Study in Integrated Planning and Purchasing

Research Sponsored by:

U.S. Defense Logistics Agency
DLA-AQPOT
Cameron Station
Alexandria, Virginia 22304-6100

DLA Contract #: DLA900-87-D-0018/0015

Reported by:

Dr. Sundaresan Jayaraman
Principal Investigator

Georgia Tech Project #: E-27-618

Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, Georgia 30332

Tel: 404/894-2490
Fax: 404/894-8780

December 1993

SJ-TR-ARCH-9312

Research Project Personnel

K. Srinivasan
Yin Zhou
Graduate Research Assistants

Dr. Rajeev Malhotra
Research Investigator

Dr. Sundaresan Jayaraman
Principal Investigator

ACKNOWLEDGMENTS

This research project was funded by the US Defense Logistics Agency (DLA) under contract number DLA-900-87-0018/0015. The authors would like to thank Mr. Donald F. O'Brien, Ms. Julie Tsao and Ms. Helen Kerlin of DLA for making this research endeavor possible.

Mr. Daniel Wright of Dowling Textiles deserves since appreciation and thanks for championing this project at Dowling. Ms. Ali Barr and Mr. Andrew Boyd from Dowling Textiles deserve thanks for their participation in the project.

Mr. Roy Terry of Terry Manufacturing championed and actively participated in the Terry project and deserves sincere thanks. Ms. Ruth Bedford, Mr. Sidney Johnson, Ms. Cheryl Pate and Mr. Rudolph Terry from Terry Manufacturing also deserve thanks for their time and input during the course of the project.

Finally, Mr. John Adams and Ms. Neysa Brown of AMTC provided the necessary administrative support during the project and their efforts are thankfully acknowledged.

* * *

Do Not Duplicate

This report contains proprietary information obtained from a company during the course of this research. Please do not duplicate or distribute any part of this report without the approval of:

Mr. Donald F. O'Brien
Chief, Technical Enterprise Team
US Defense Logistics Agency DLA-AQPOT
Cameron Station
Alexandria, Virginia 22304-6100

Tel: 703/274-6445
Fax: 703/274-9461

Table of Contents

Volume II

Executive Summary

1. The *As Is* Function Model

2. The *To Be* Function Model

3. The *To Be* Information Model

4. User Manual for Information System

Other Volumes

Volume I

		Page
1.	INTRODUCTION	1
1.1	Apparel Manufacturing Architecture	1
1.2	Research Objectives	2
2.	RESEARCH METHODOLOGY	2
2.1	Research Procedure	3
2.2	Dissemination of Research Results	5
3.	DOWLING TEXTILES: CASE STUDY IN PLANNING AND PURCHASING	6
4.	TERRY MANUFACTURING: CASE STUDY IN SHARED PRODUCTION	7
5.	CONCLUSIONS AND LESSONS LEARNED	8
References		13

Appendix I
Literature for Selection of Industry Partners

Appendix II
Paper Presented at the 20th International Apparel Research Conference

Volume III

Terry Manufacturing: Case Study in Shared Production
[*Contains Proprietary Information*]

Executive Summary

To stay competitive in the global market, the textile-apparel industrial complex must evaluate and deploy state-of-the-art manufacturing and information technologies. The vitality of this complex is also critical to the US Department of Defense (DoD) which relies on this industrial base to clothe its personnel and maintain a state of readiness. To enable the apparel industry to become competitive by adopting advanced techniques and tools, the US Defense Logistics Agency sponsored the development of an apparel manufacturing architecture (AMA) at Georgia Tech. AMA is a comprehensive set of specifications for implementing computer-integrated manufacturing in an apparel enterprise.

The primary objective of this research is to demonstrate the role and importance of AMA to the apparel industry through practical applications of AMA to specific tasks in apparel plants. Other objectives of the effort are to transfer the developed technology and modeling know-how to the real-world and to serve as a catalyst for similar modeling and process reengineering efforts in the industry.

Based on a set of defined evaluation criteria, Dowling Textiles in McDonough, Georgia, and Terry Manufacturing in Roanoke, Alabama, were selected as industry partners on the research effort. A research methodology was developed and used for carrying out the project. Working with Dowling personnel, an information system for integrated planning and purchasing was designed, developed and implemented at Dowling. The underlying objective was to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting. Likewise, an information system for shared production was developed at Terry Manufacturing. The objective here was to enable Terry Manufacturing to be capable of increasing its production (in response to DoD's surge requirements) by anywhere between 20 and 60%. Both the developed systems have been tested by plant personnel.

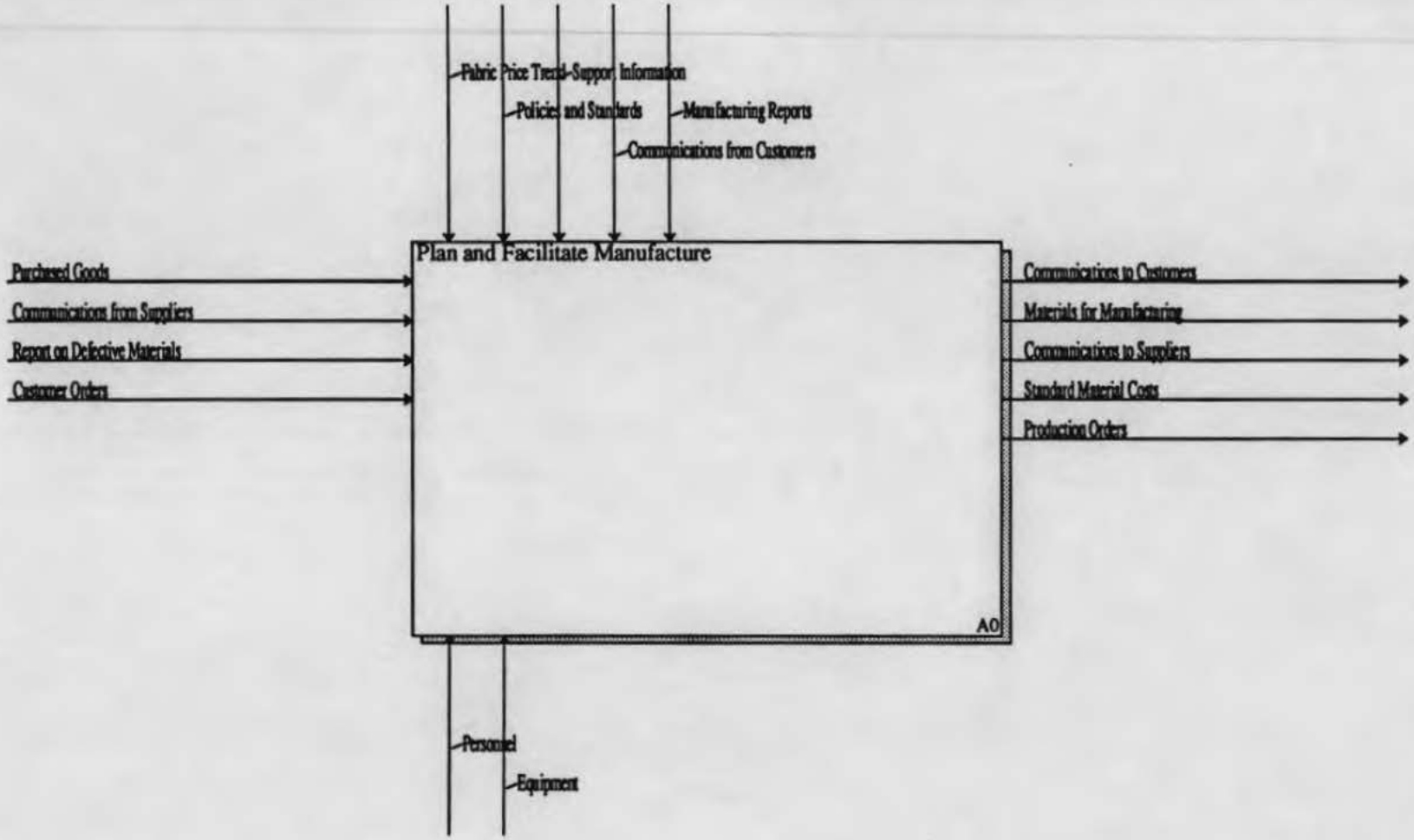
The following major lessons were learned from these efforts: AMA enabled the rapid development of the architectures for the two systems by serving as a *reference* architecture; moreover, AMA stands to be enriched by incorporation of the detailed specifications of certain functions from the two enterprise-specific models. Thus, there is a symbiotic relationship between the generic architecture for the domain of apparel manufacturing and the architecture for a specific enterprise. Very few *new* information entities had to be introduced in the enterprise-specific information models. Therefore, once a core set of information entities is carefully specified (as in AMA), the entities can be reused to support many new functions with little modification. Hence, a well-designed information system will be a catalyst for rapid changes in an enterprise as opposed to being one more impediment to them. Finally, the industry partners found the architectural approach and the research methodology to be understandable and easy to use. The research results and lessons learned have been presented at conferences.

* * *

The *As Is* Function Model

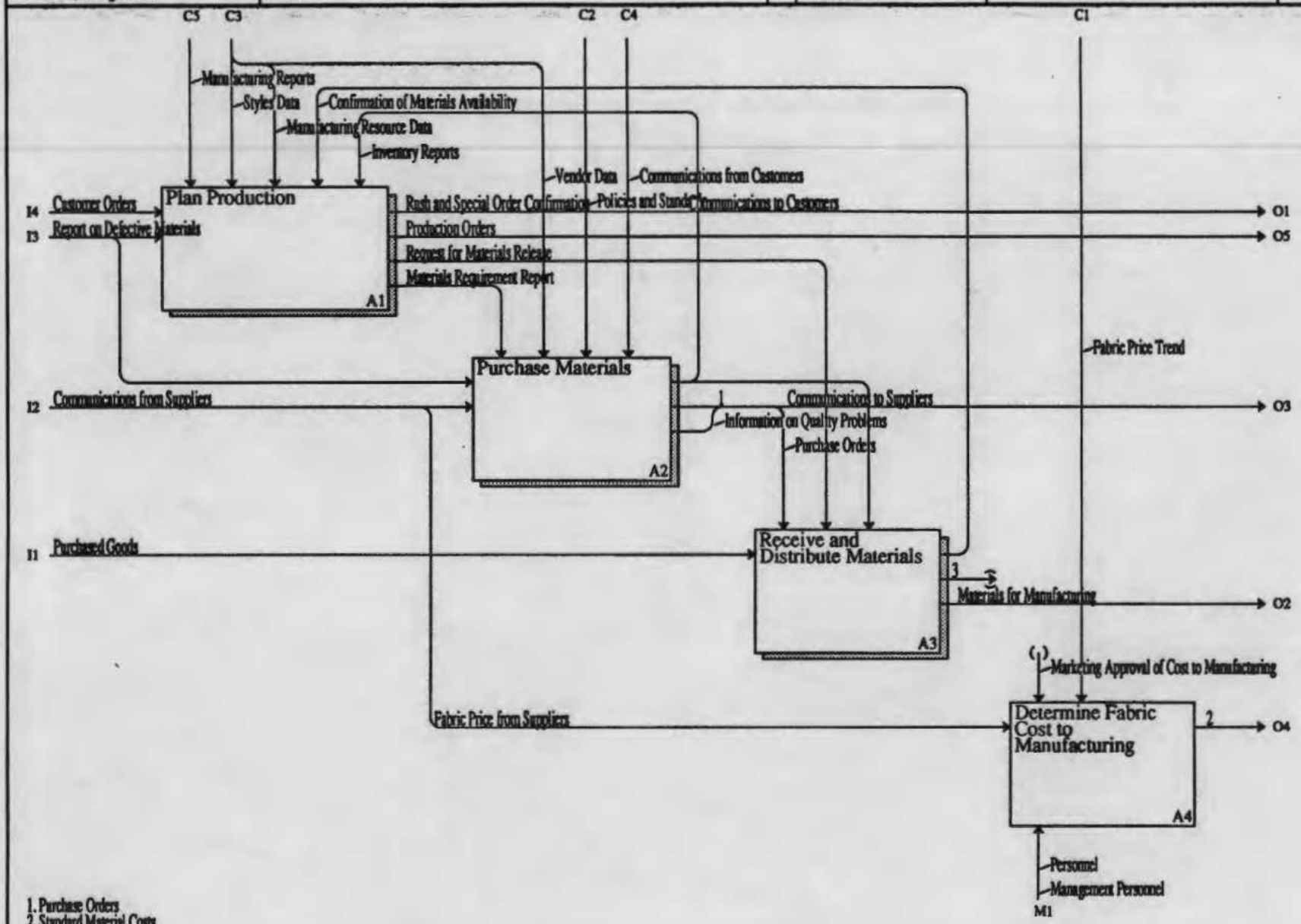
Used At:	Author: K. Srinivasan	Date: 11/17/1991			
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dowling	Rev:	Working	READER	DATE
	Notes: 1 2 3 4 5 6 7 8 9 10		Draft		
			Recommended		
			Publication		

Context



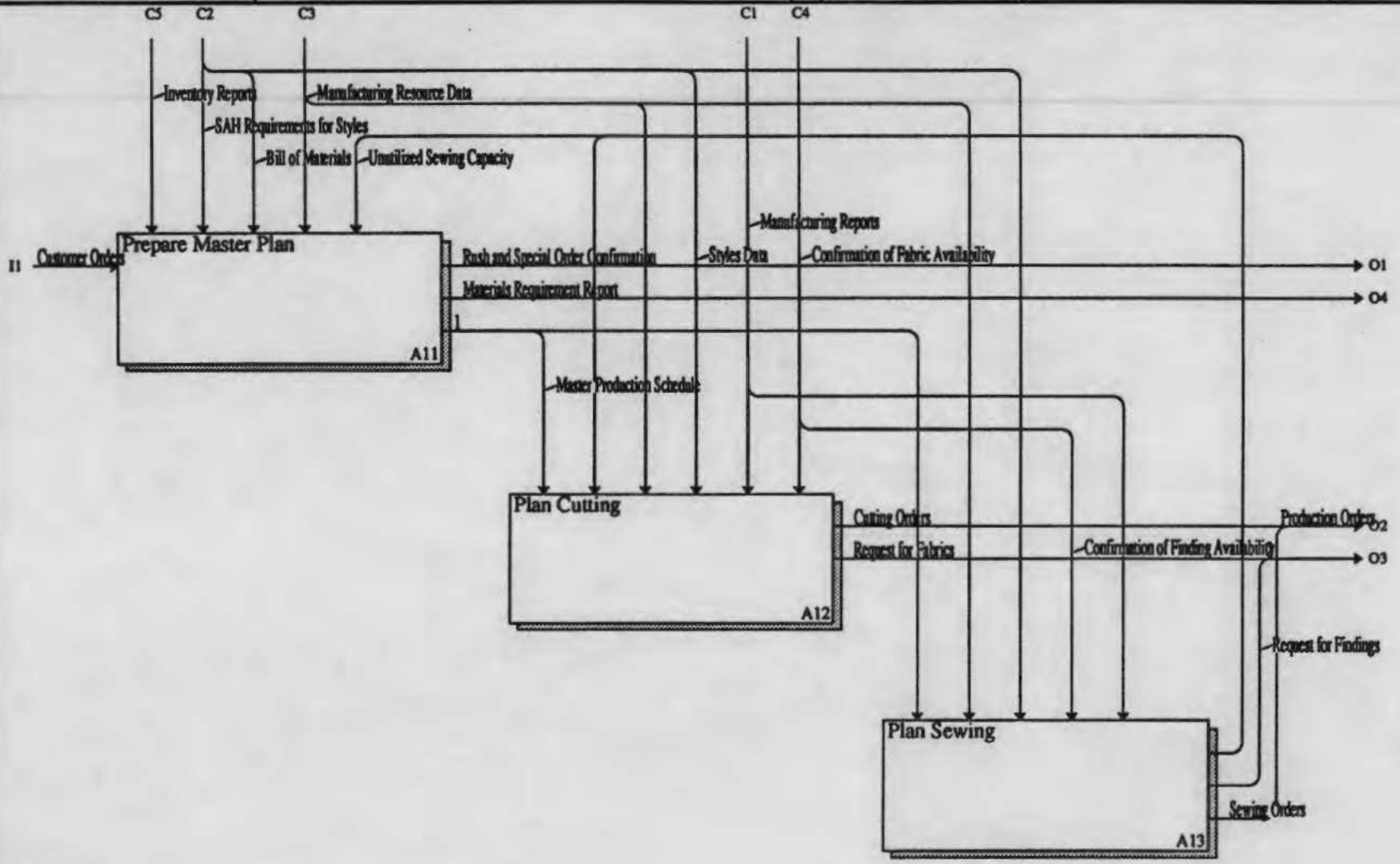
Node:A-0	Title:Plan and Facilitate Manufacture (Context)	Number:

Used At:	Author: K. Srinivasan	Date: 11/17/1991	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dowling	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



Node:A0	Title:Plan and Facilitate Manufacture	Number:

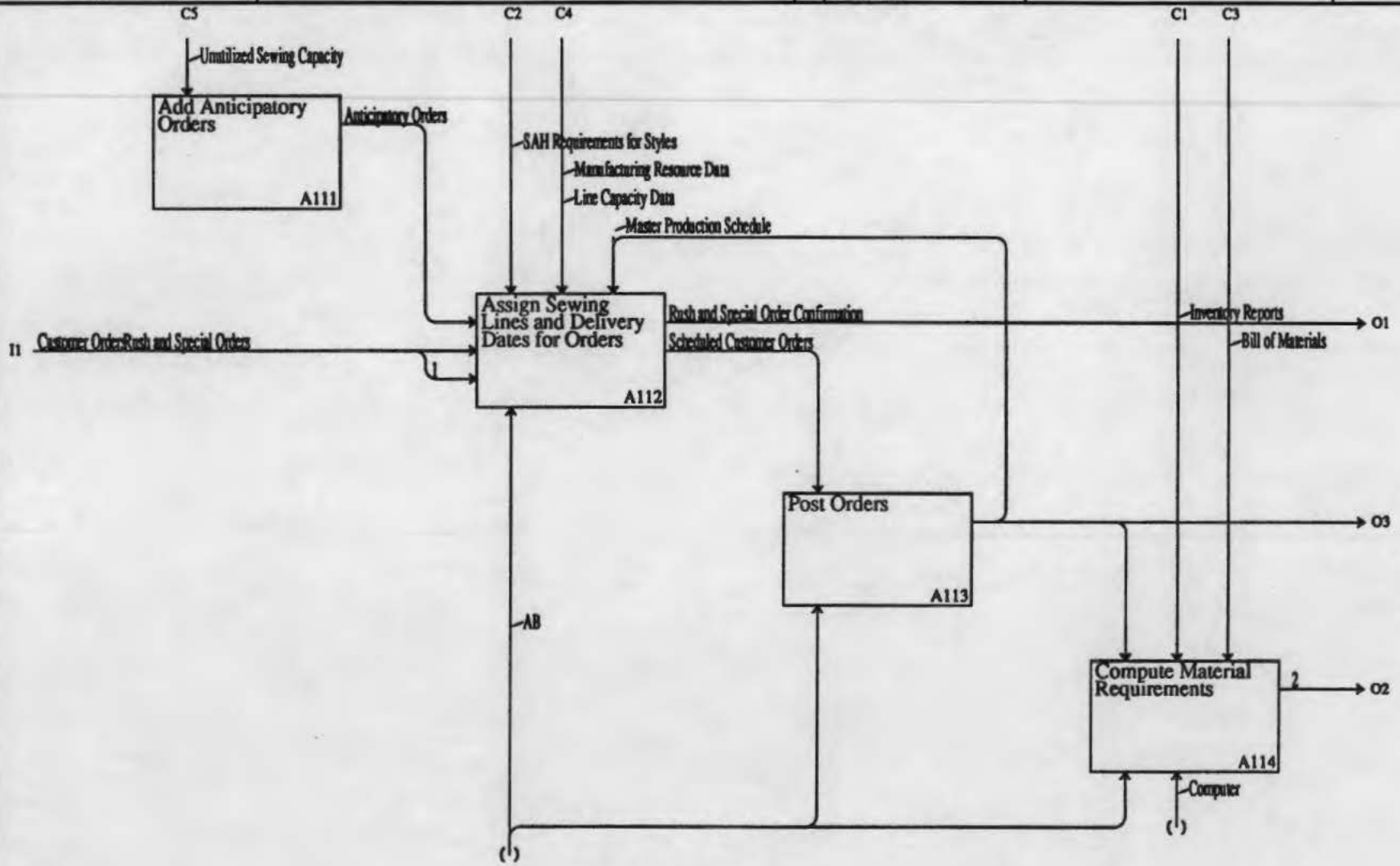
Used At:	Author: K. Srinivasan	Date: 11/17/1991		Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dowling	Rev:		Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10			Recommended			
				Publication			



1. Master Production Schedule
2. Request for Materials Release

Node:A1	Title:Plan Production	Number:

Used At:	Author: K. Srinivasan	Date: 11/17/1991	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dowling	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



1. Stock Orders
2. Materials Requirement Report

Node:A11	Title:Prepare Master Plan	Number:

School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Project: Dowling

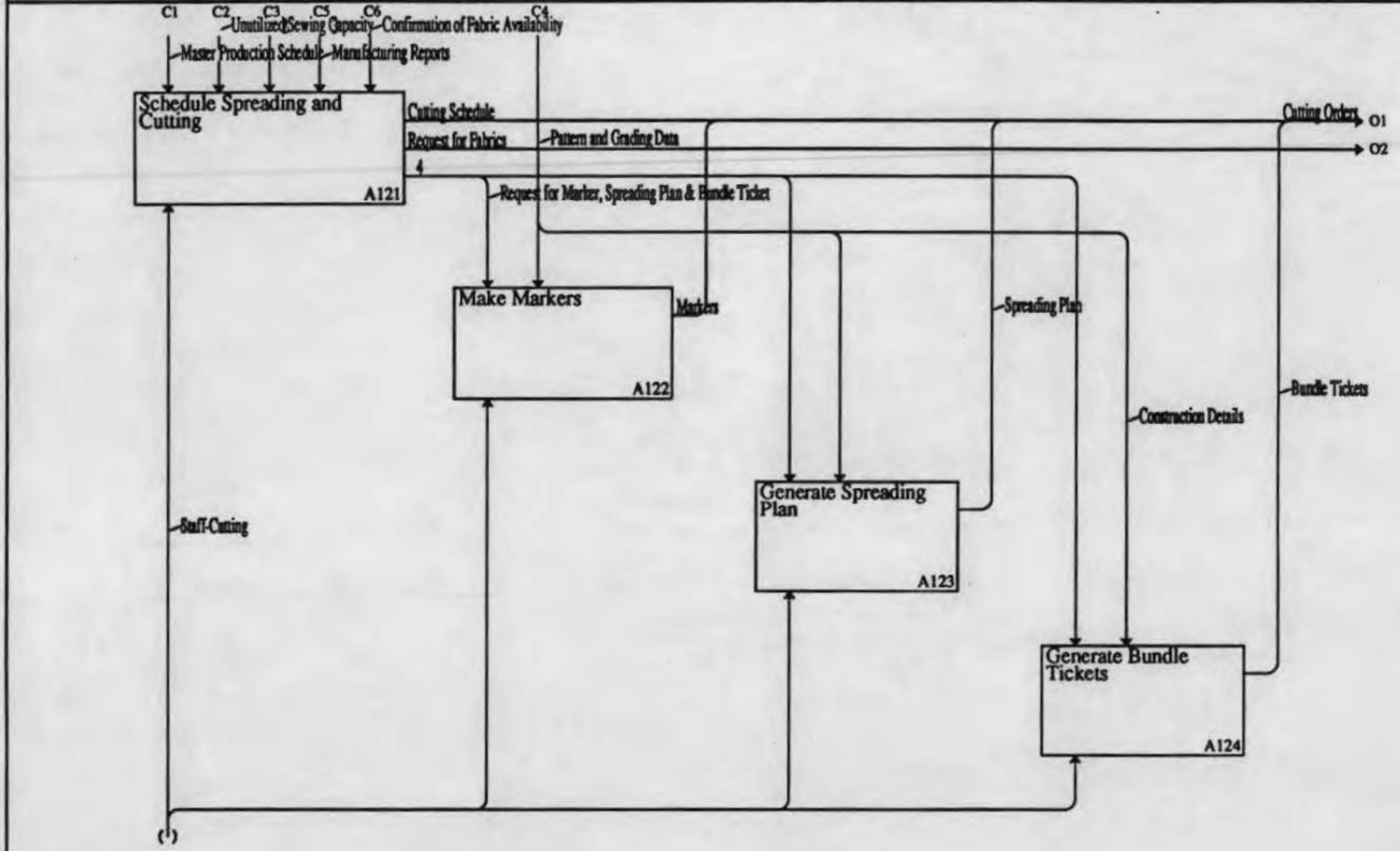
Notes: 1 2 3 4 5 6 7 8 9 10

Date: 11/17/1991

Rev:

	Working	READER	DATE
	Draft		
	Recommended		
	Publication		

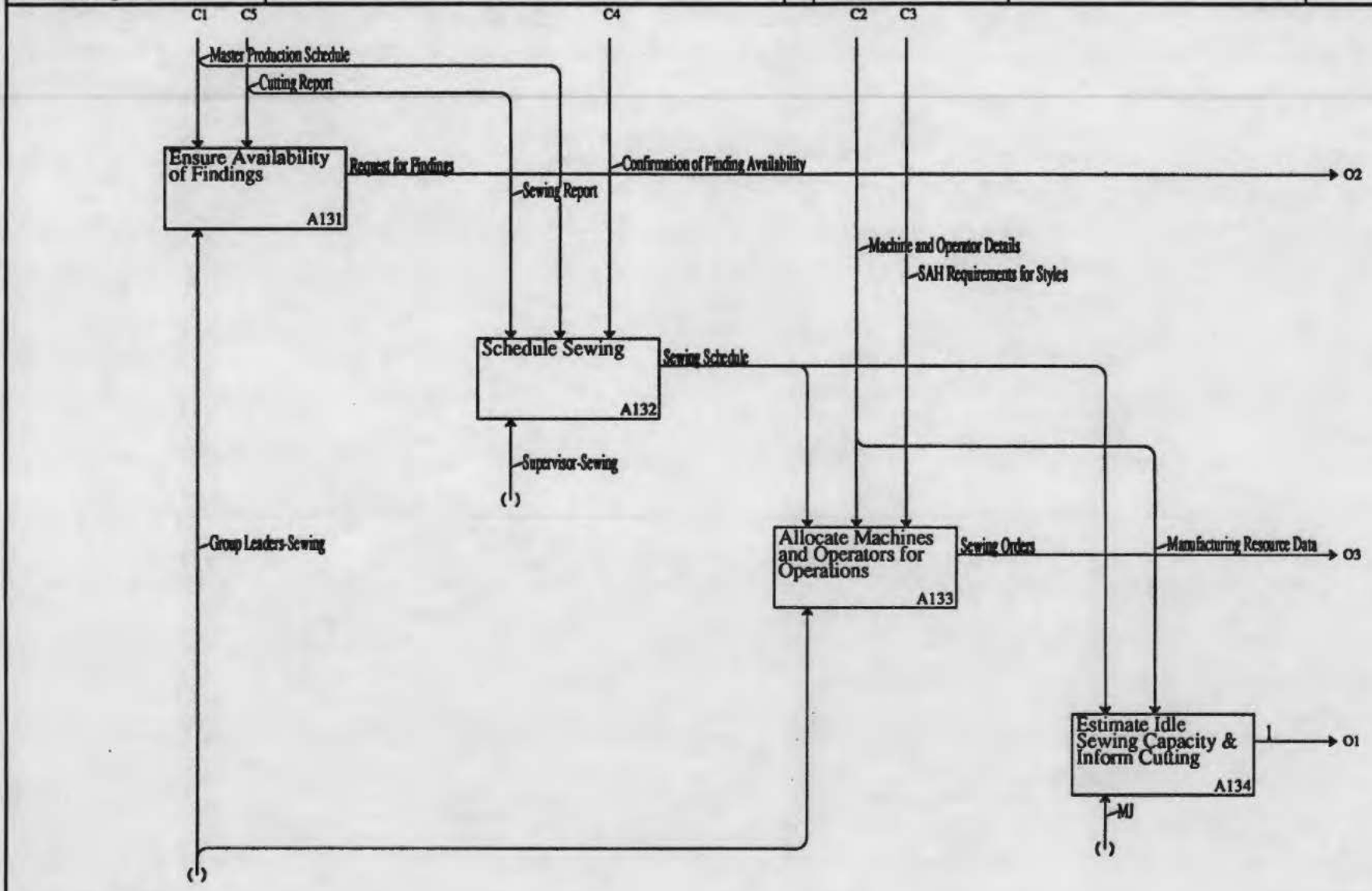
Context



1. Manufacturing Resource Data
2. Spreading and Cutting Capacity
3. Cutting Report
4. Request for Marker, Spreading Plan & Bundle Ticket

Node:A12	Title:Plan Cutting	Number:

Used At:	Author: K. Srinivasan	Date: 11/17/1991	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dowling	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			

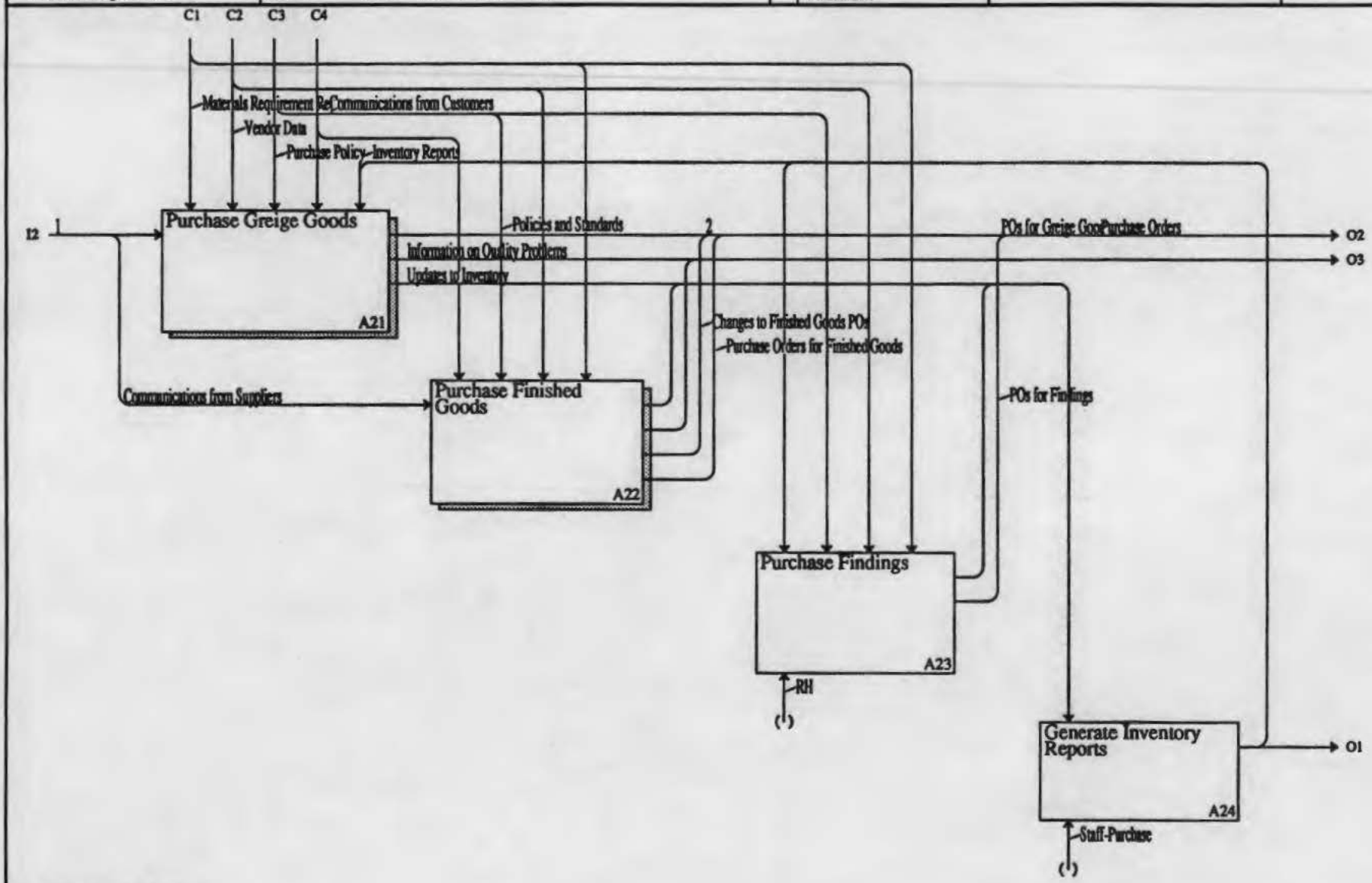


1. Unutilized Sewing Capacity

Node:A13	Title:Plan Sewing	Number:

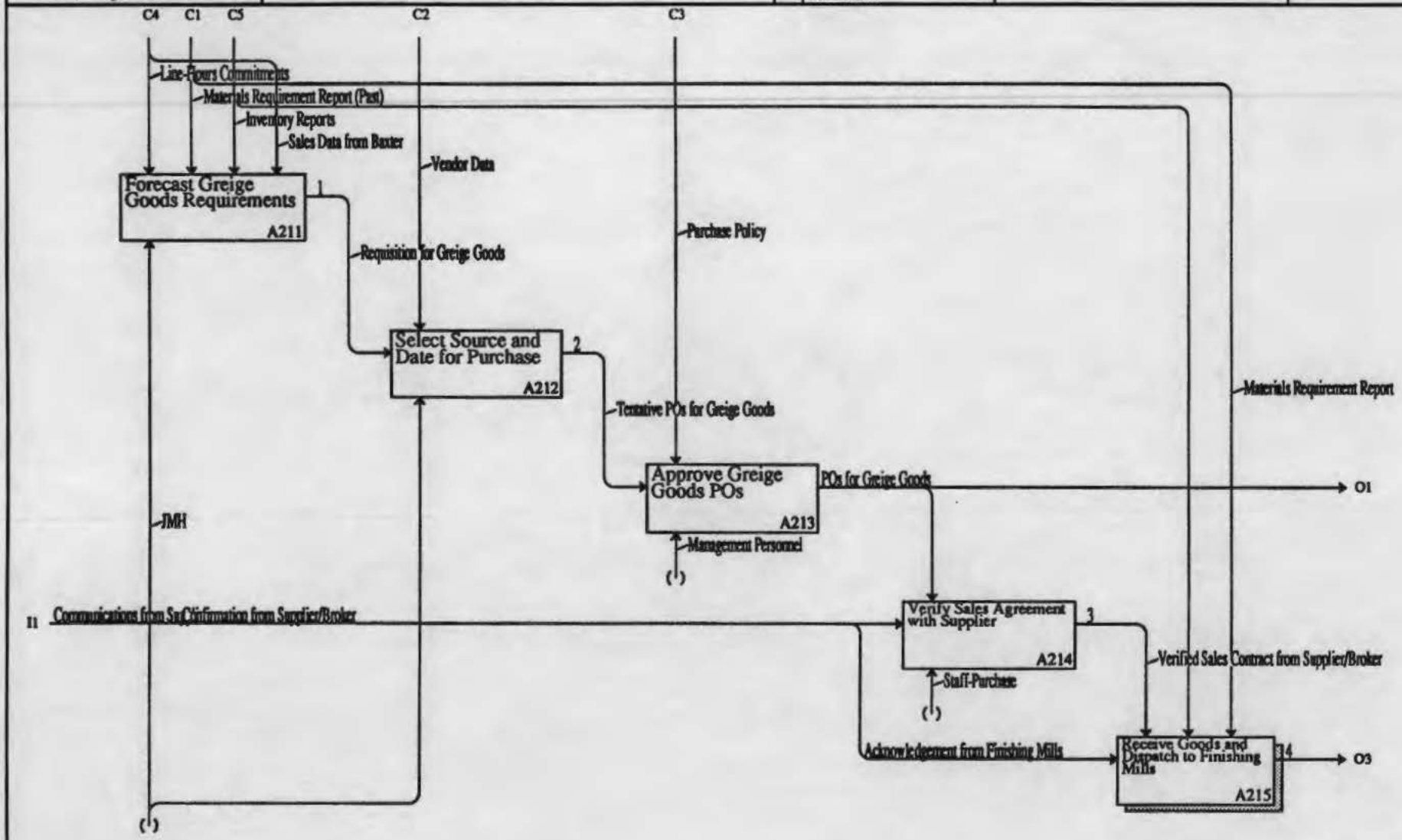
Used At:	Author: K. Srinivasan	Date: 11/17/1991			
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dowling	Rev:	Working	READER	DATE
	Notes: 1 2 3 4 5 6 7 8 9 10		Draft		
			Recommended		
			Publication		

Context



Node:A2	Title:Purchase Materials	Number:

Used At:	Author: K. Srinivasan	Date: 11/17/1991		Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dowling	Rev:		Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10			Recommended			
				Publication			



1. Requisition for Greige Goods
2. Tentative POs for Greige Goods
3. Verified Sales Contract from Supplier/Broker
4. Updates to Inventory

Node:A21	Title:Purchase Greige Goods	Number:

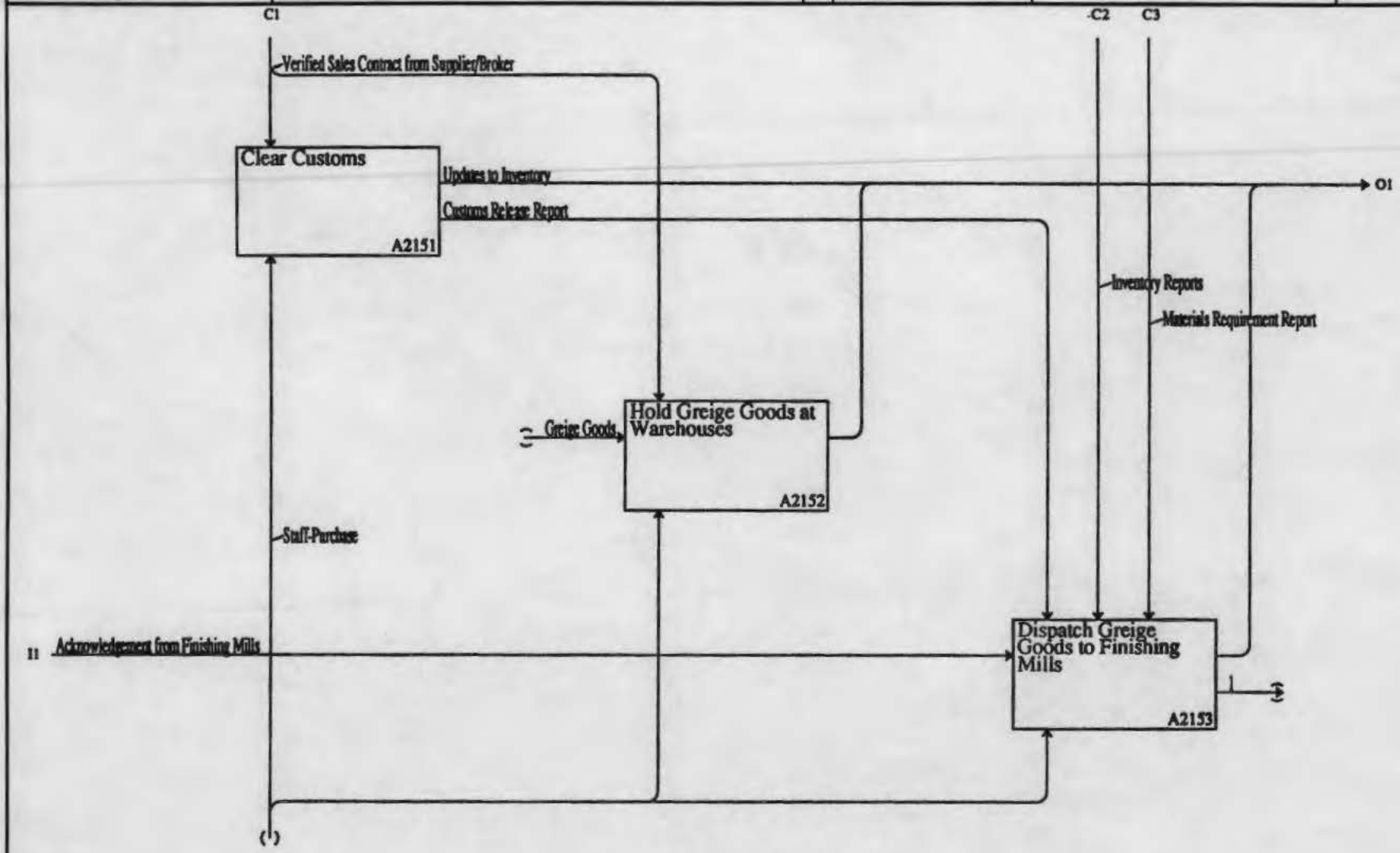
School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Project: Dowling
Notes: 1 2 3 4 5 6 7 8 9 10

Date: 11/17/1991
Rev:

	Working	READER	DATE
	Draft		
	Recommended		
	Publication		

Context



1. Greige Goods for Finishing

Node:A215	Title:Receive Goods and Dispatch to Finishing Mills	Number:

School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Project: Dowling

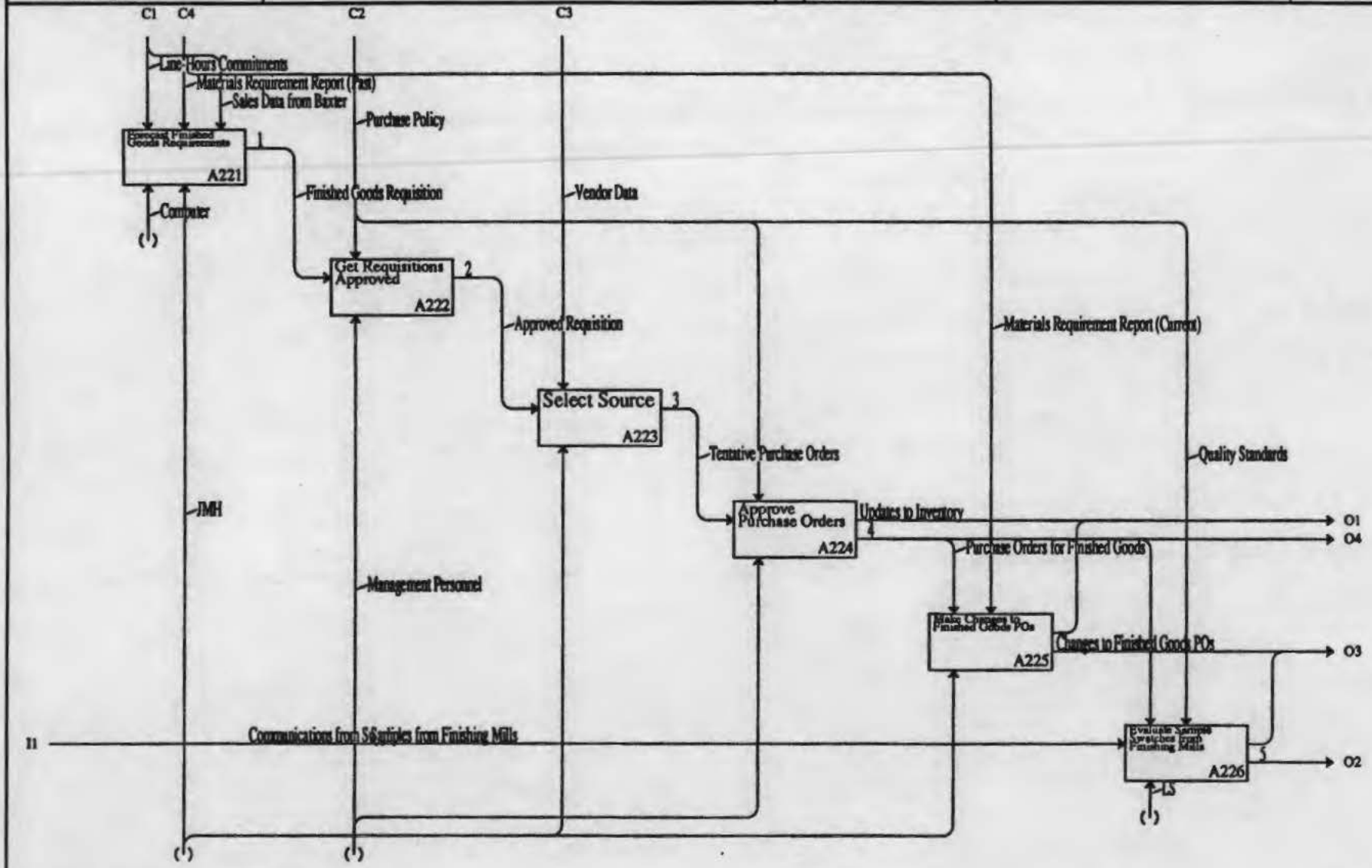
Notes: 1 2 3 4 5 6 7 8 9 10

Date: 11/17/1991

Rev:

Working	READER	DATE
Draft		
Recommended		
Publication		

Context

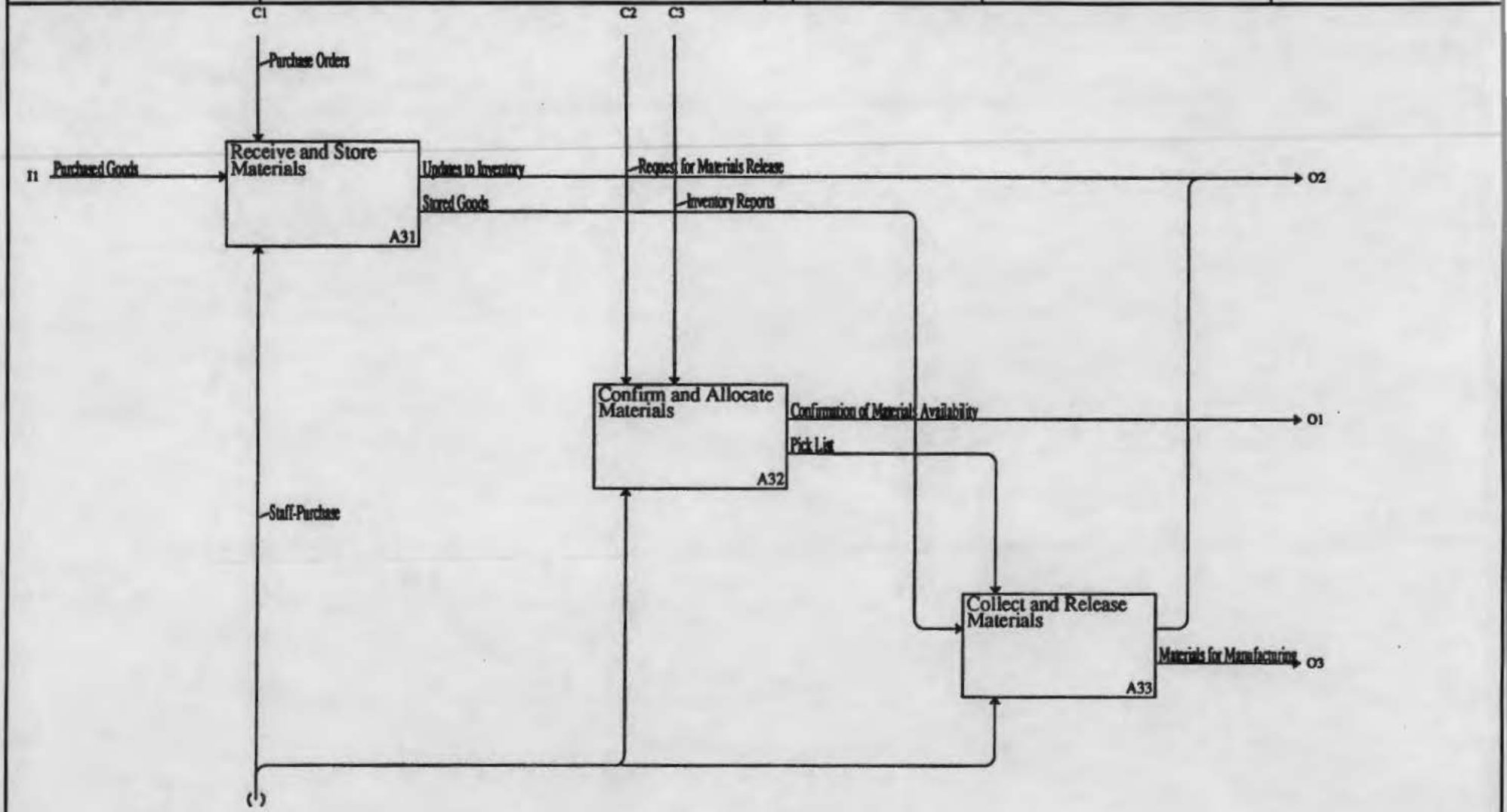


1. Finished Goods Requisition
2. Approved Requisition
3. Tentative Purchase Orders
4. Purchase Orders for Finished Goods
5. Information on Quality Problems

Node:A22	Title:Purchase Finished Goods	Number:

Used At:	Author: K. Srinivasan	Date: 11/17/1991			
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dowling	Rev:	Working	READER	DATE
	Notes: 1 2 3 4 5 6 7 8 9 10		Draft		
			Recommended		
			Publication		

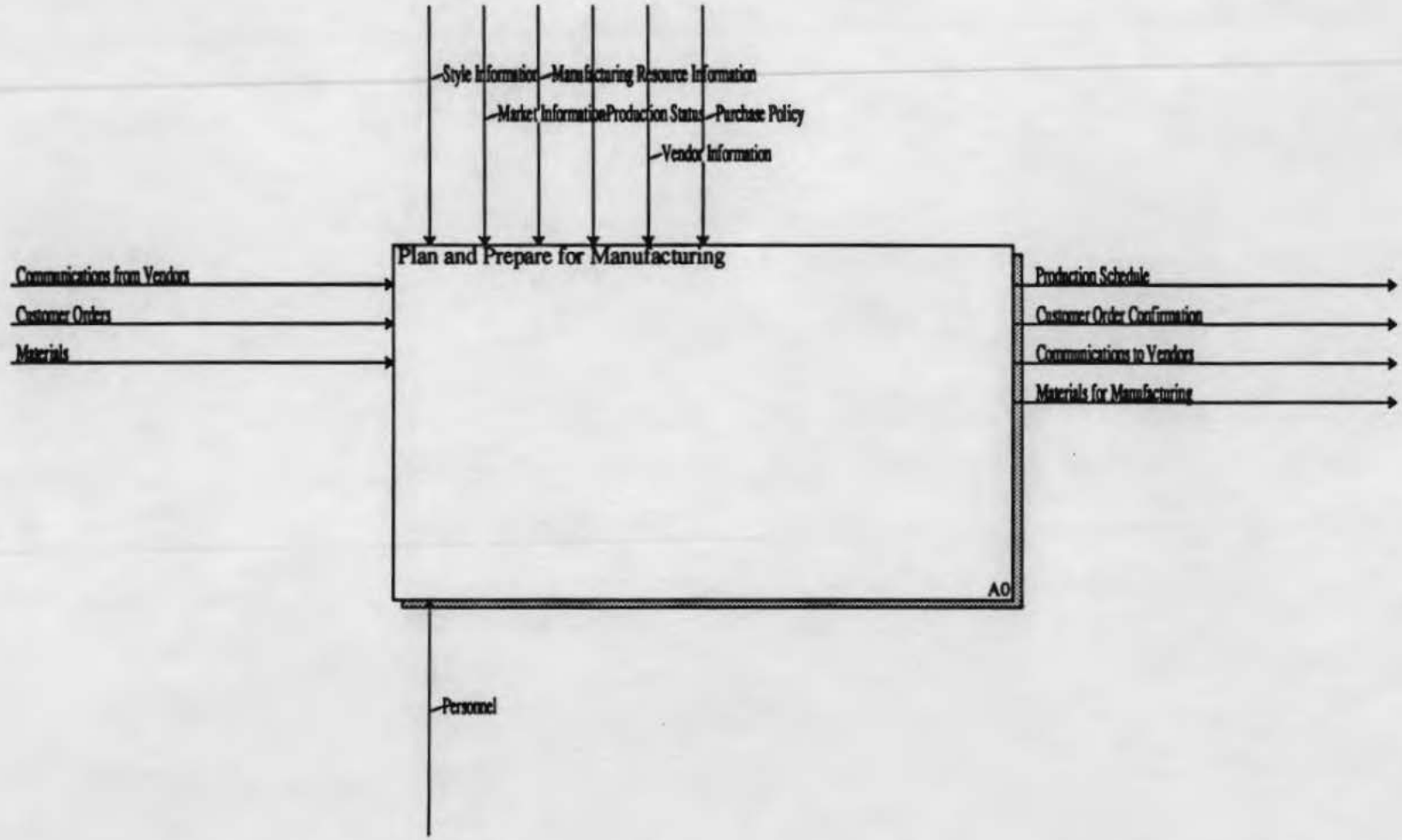
Context



Node:A3	Title:Receive and Distribute Materials	Number:

The *To Be* Function Model

Used At:	Author: Rajeev Malhotra	Date: 2/10/1992	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dwigtobs	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



Node:A-0	Title:Plan and Prepare for Manufacturing (Context)	Number:

School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Project: Dwlgtobs

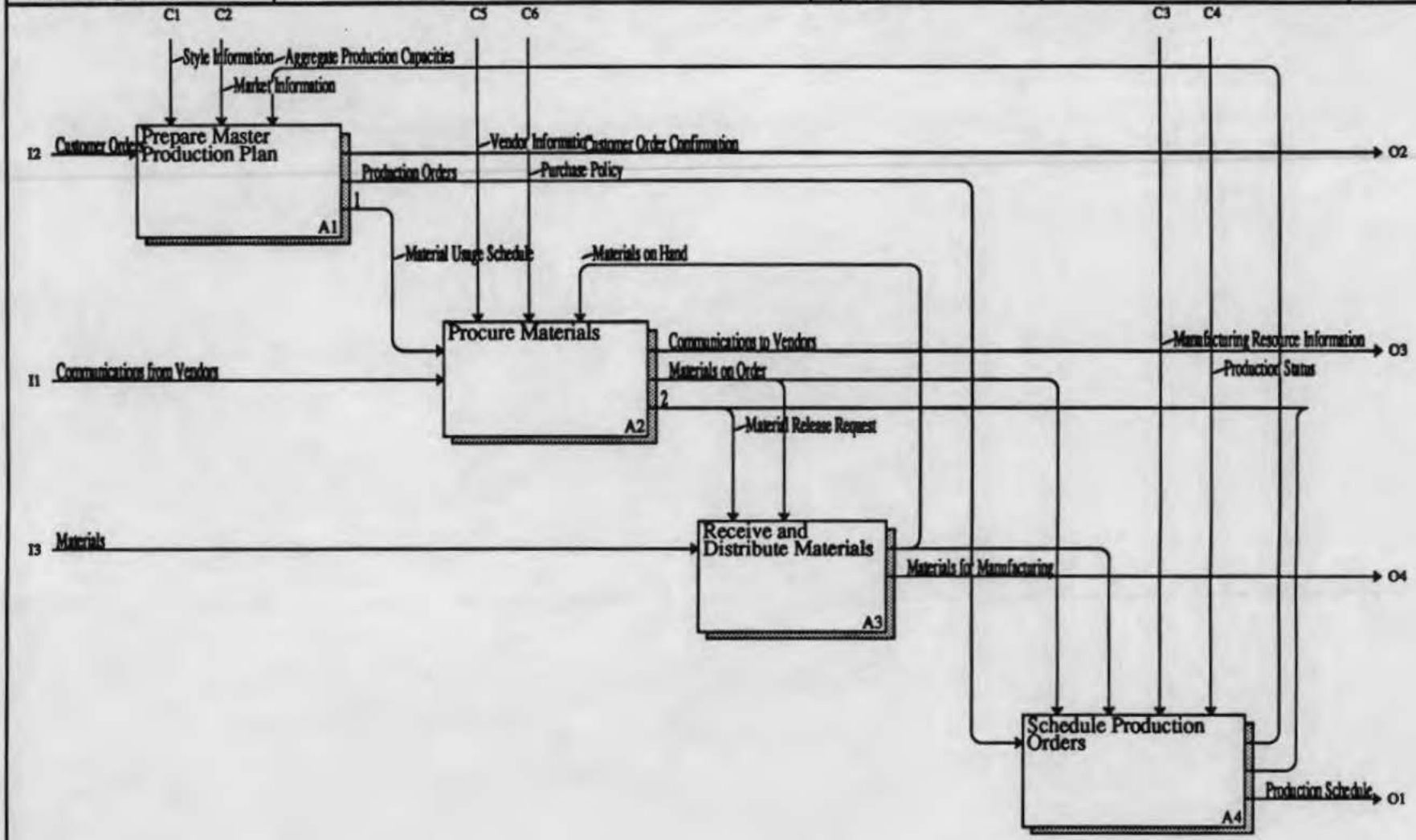
Notes: 1 2 3 4 5 6 7 8 9 10

Date: 4/10/1992

Rev:

	Working	READER	DATE
	Draft		
	Recommended		
	Publication		

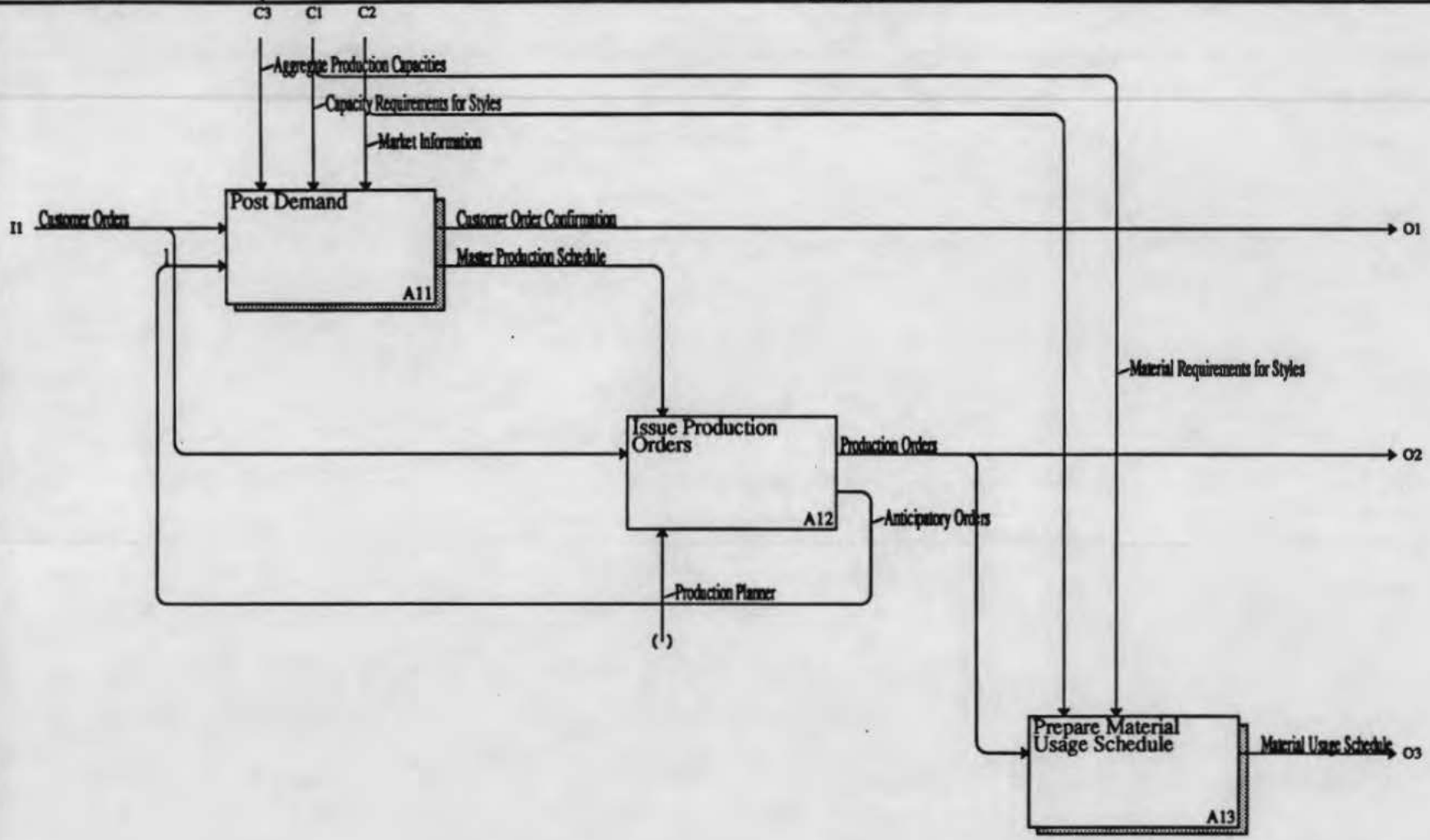
Context



1. Material Usage Schedule
2. Material Release Request

Node:A0	Title:Plan and Prepare for Manufacturing	Number:

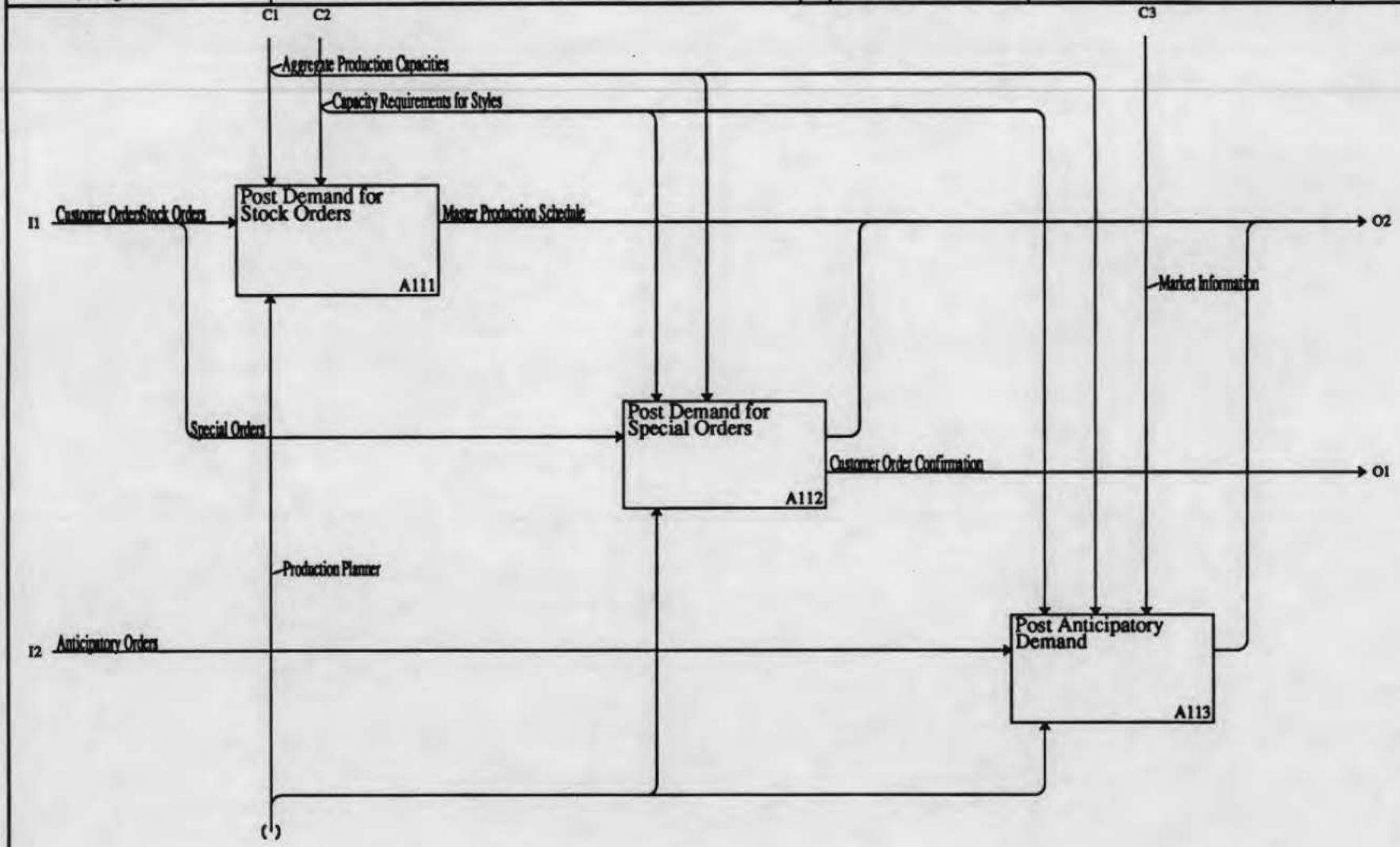
Used At:	Author: Rajeev Malhotra	Date: 2/10/1992	Working	READER	DATE	Context
School of Textile & Fiber Engineering	Project: Dwlgtobs	Rev:	Draft			
Georgia Institute of Technology			Recommended			
Atlanta, Georgia 30332	Notes: 1 2 3 4 5 6 7 8 9 10		Publication			



1. Anticipatory Orders

Node:A1	Title:Prepare Master Production Plan	Number:

Used At:	Author: Rajeev Malhotra	Date: 2/10/1992		READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dwlgtobe	Rev:	Working Draft Recommended Publication			
	Notes: 1 2 3 4 5 6 7 8 9 10					



Node:A11	Title:Post Demand	Number:

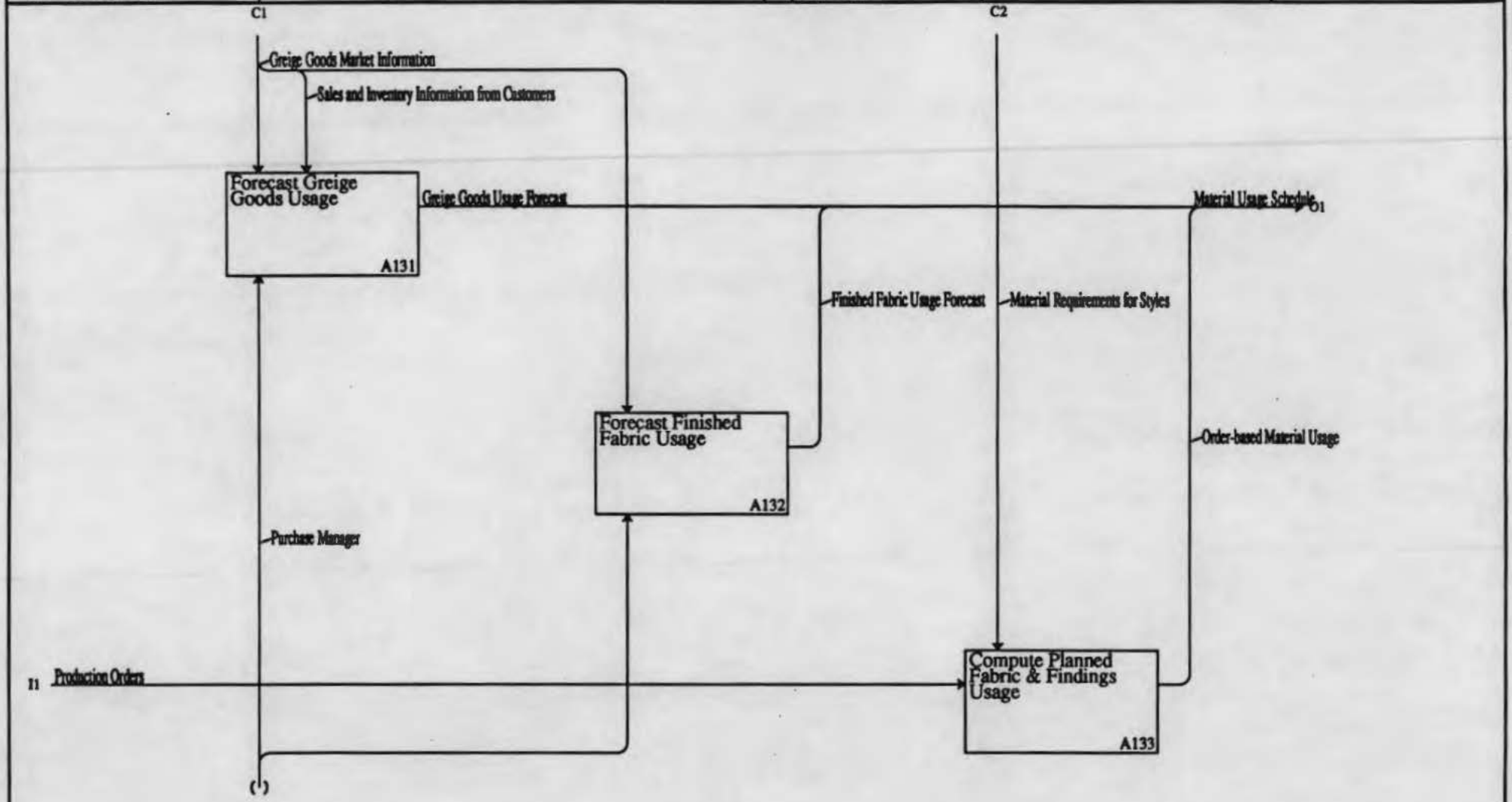
School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Project: Dwigtobe

Rev:

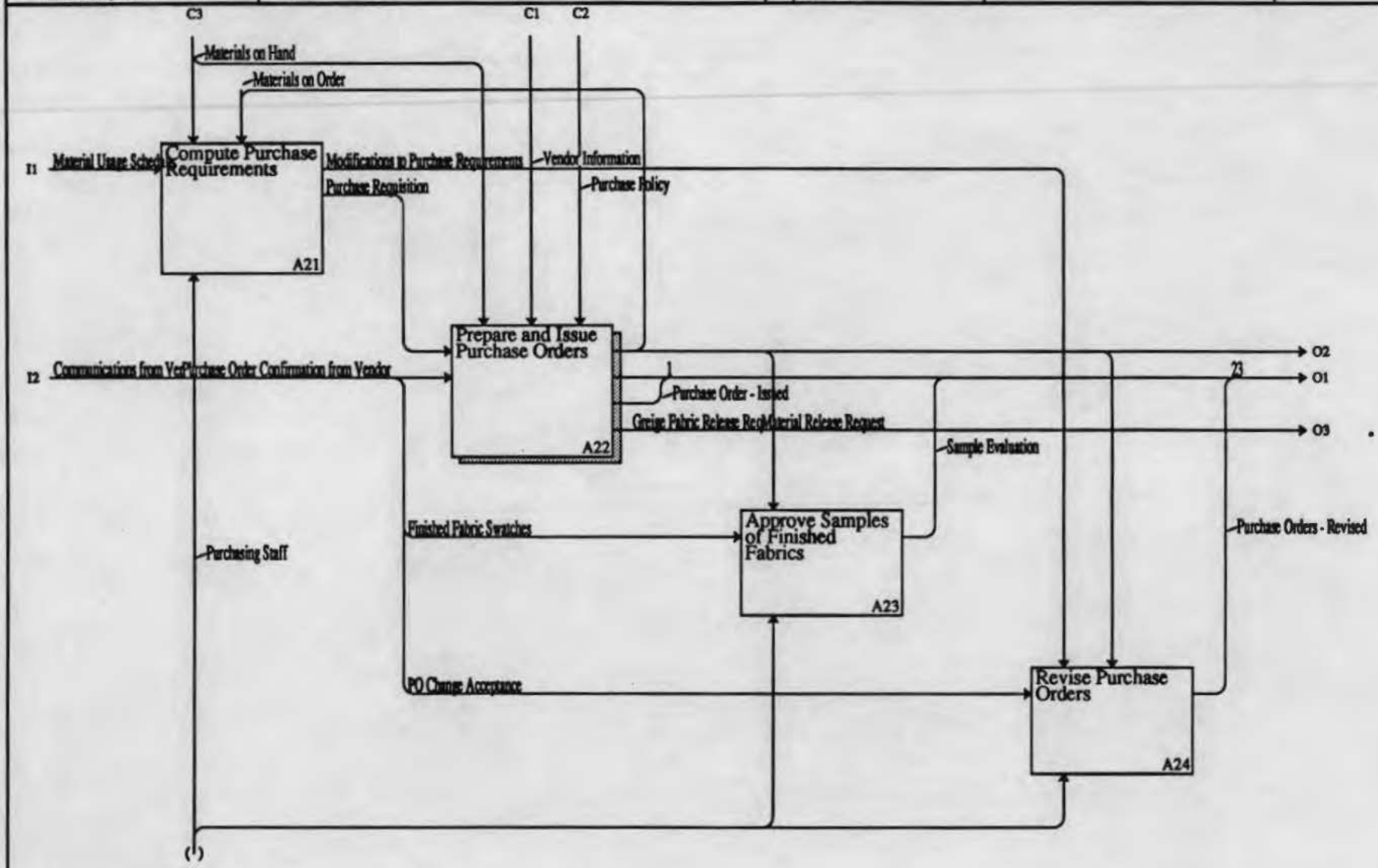
Notes: 1 2 3 4 5 6 7 8 9 10

	READER	DATE
Working		
Draft		
Recommended		
Publication		



Node:A13	Title:Prepare Material Usage Schedule	Number:

Used At:	Author: Rajeev Malhotra	Date: 2/10/1992	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dwlgtobs	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



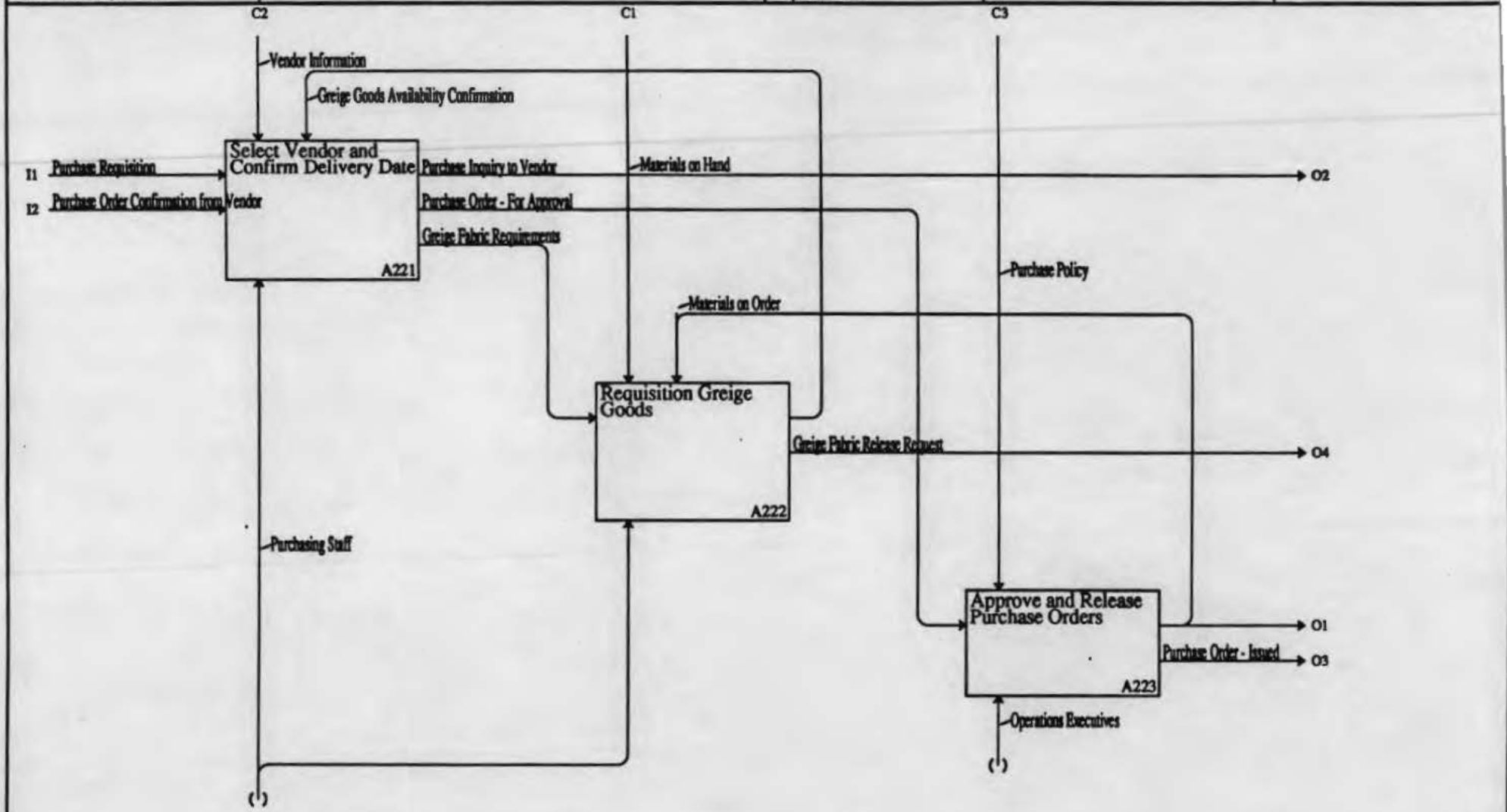
Node:A2	Title:Procure Materials	Number:

School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Author: Rajeev Malhotra Date: 2/10/1992
Project: Dwigtobe Rev:
Notes: 1 2 3 4 5 6 7 8 9 10

	READER	DATE
Working		
Draft		
Recommended		
Publication		

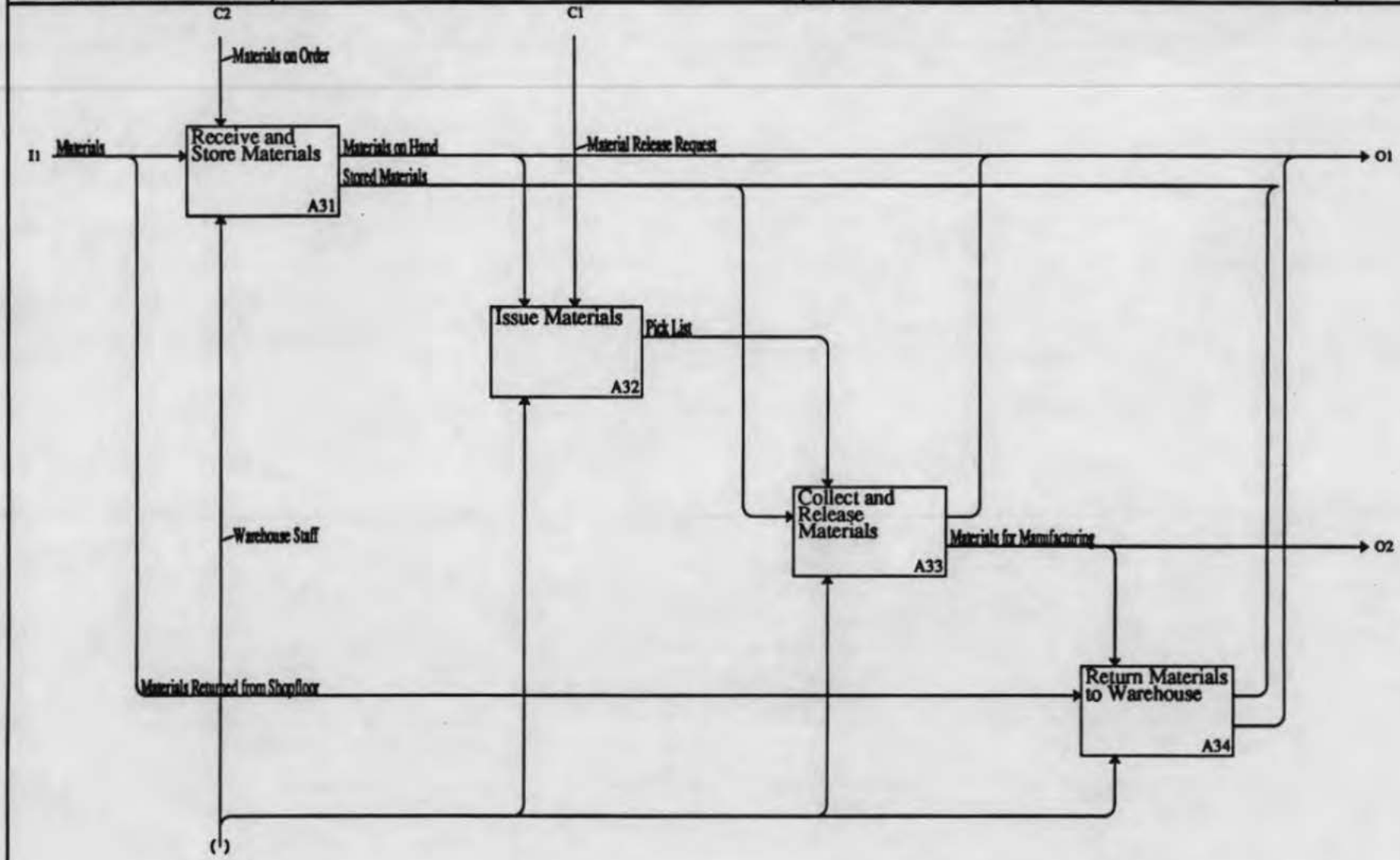
Context



Node:A22	Title:Prepare and Issue Purchase Orders	Number:

Used At:	Author: Rajeev Malhotra	Date: 2/10/1992			
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dwlgtobe	Rev:	Working Draft Recommended Publication	READER	DATE
	Notes: 1 2 3 4 5 6 7 8 9 10				

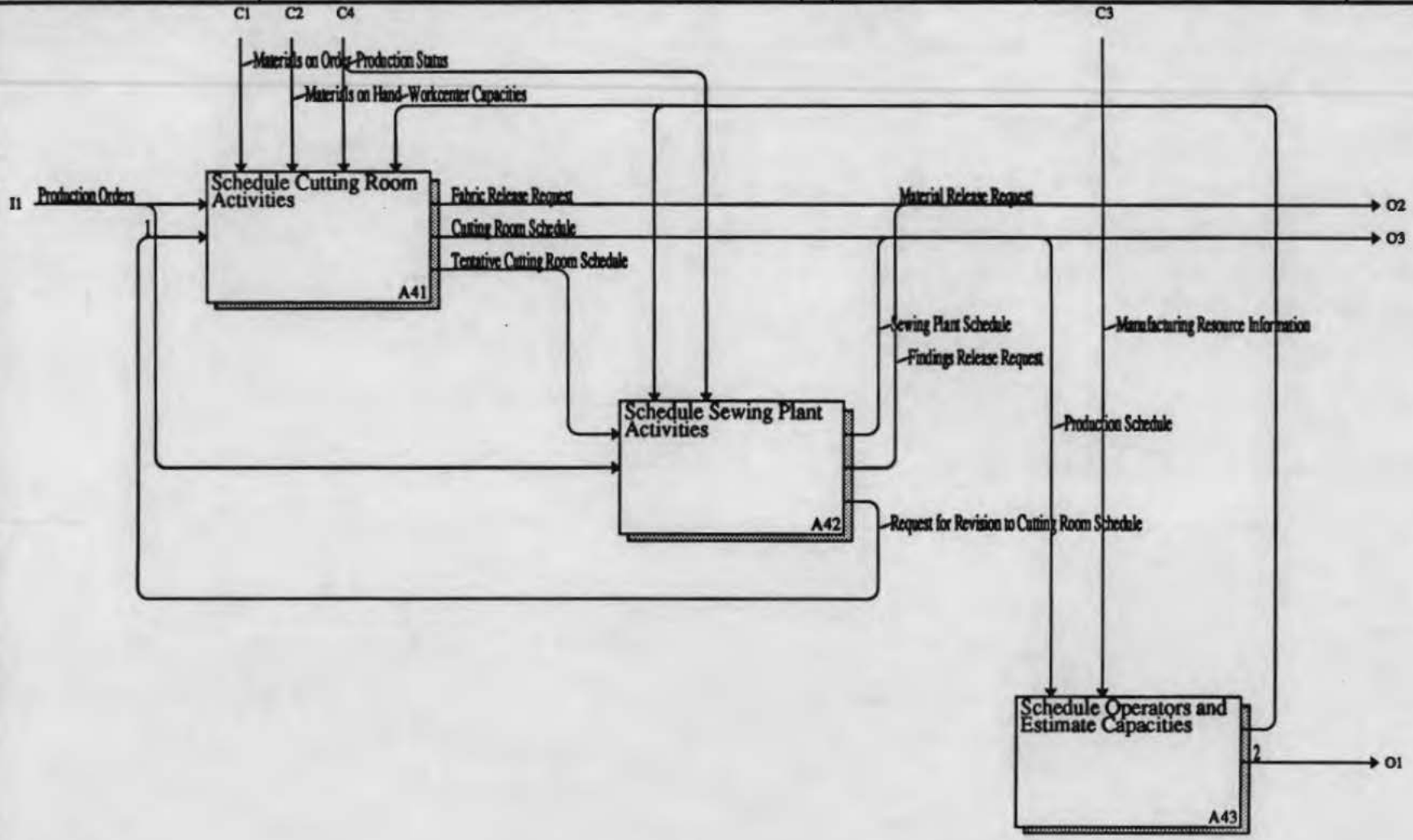
Context



1. Materials from Vendors

Node:A3	Title:Receive and Distribute Materials	Number:

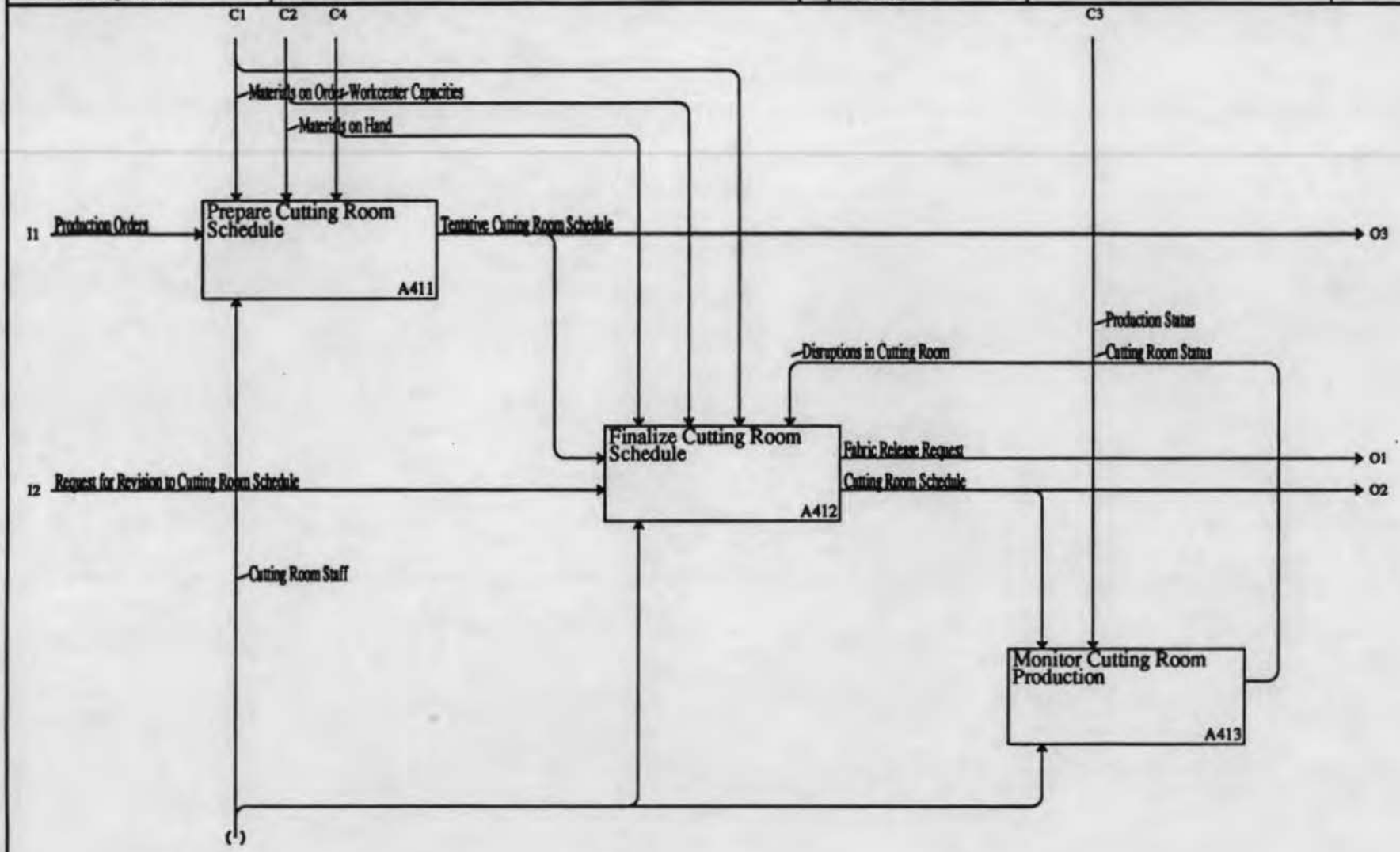
Used At:	Author: Rajeev Malhotra	Date: 2/10/1992		Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dwigoba	Rev:		Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10			Recommended			
				Publication			



1. Request for Revision to Cutting Room Schedule
2. Aggregate Production Capacities

Node:A4	Title:Schedule Production Orders	Number:

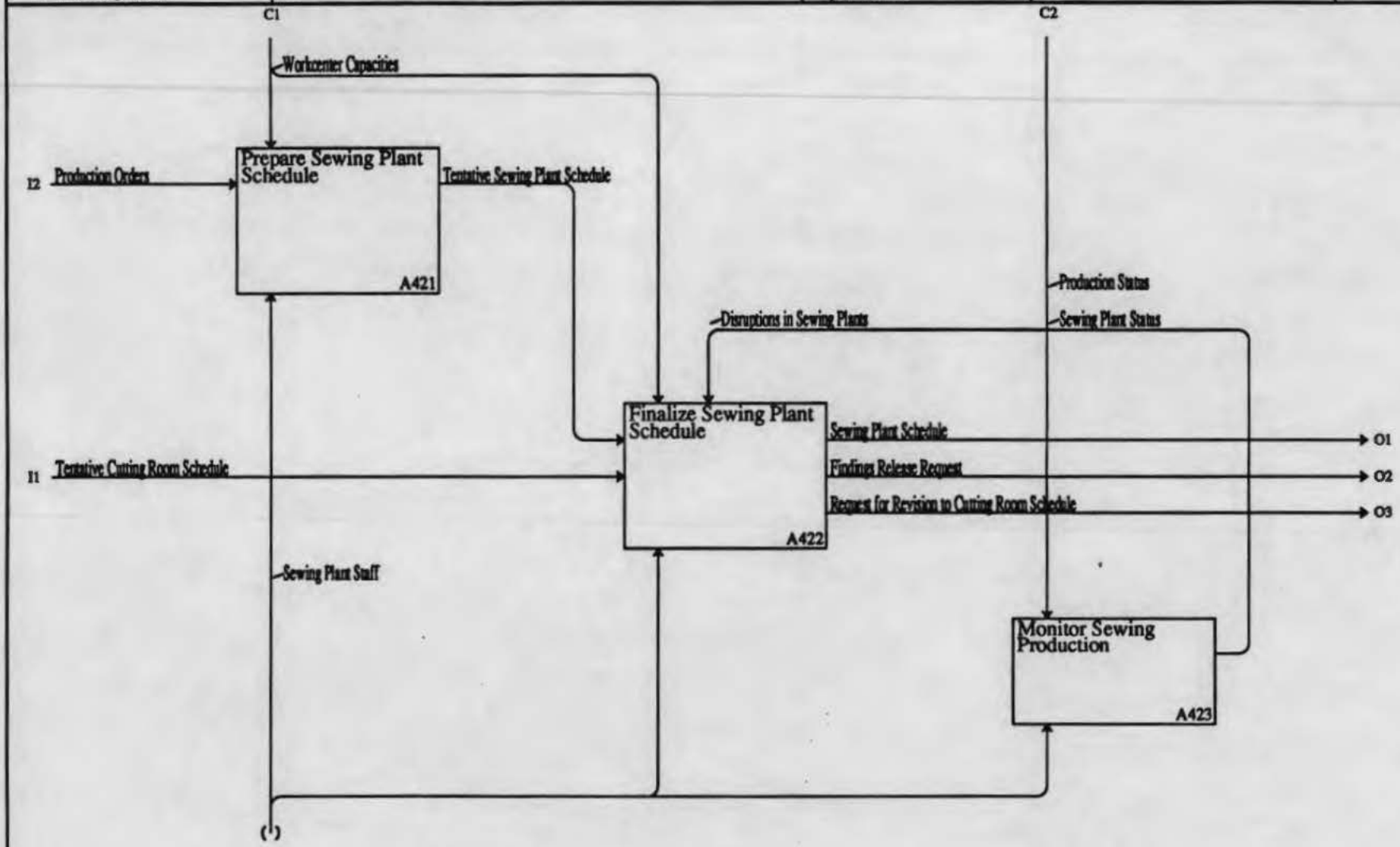
Used At:	Author: Rajeev Malhotra	Date: 2/10/1992	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dwlgsobe	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



Node:A41	Title:Schedule Cutting Room Activities	Number:

Used At:	Author: Rajeev Malhotra	Date: 2/10/1992			
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dwigtobs	Rev:	Working	READER	DATE
	Notes: 1 2 3 4 5 6 7 8 9 10		Draft		
			Recommended		
			Publication		

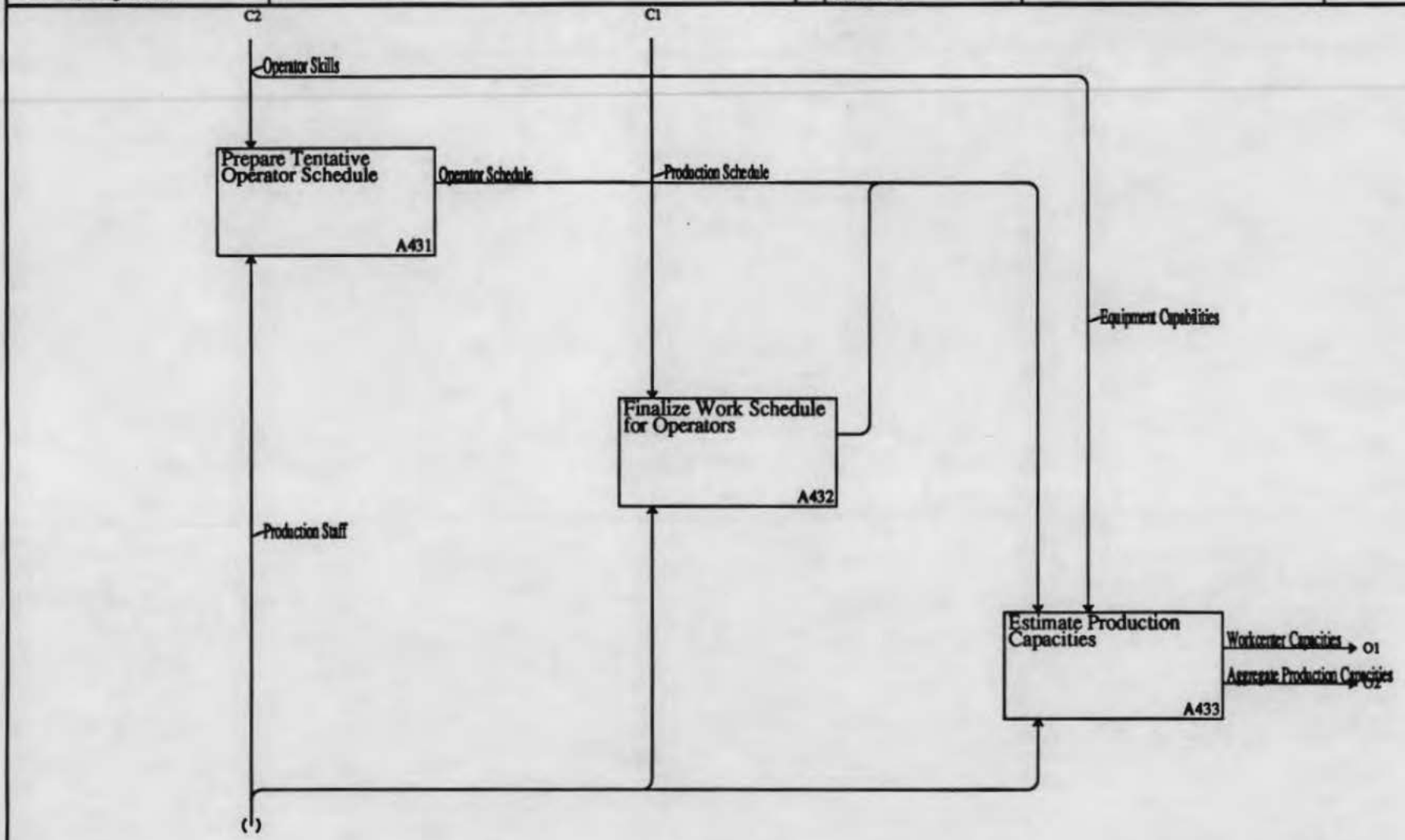
Context



Node:A42	Title:Schedule Sewing Plant Activities	Number:

Used At:	Author: Rajeev Malhotra	Date: 2/10/1992			
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Dwigtobe	Rev:	Working	READER	DATE
	Notes: 1 2 3 4 5 6 7 8 9 10		Draft		
			Recommended		
			Publication		

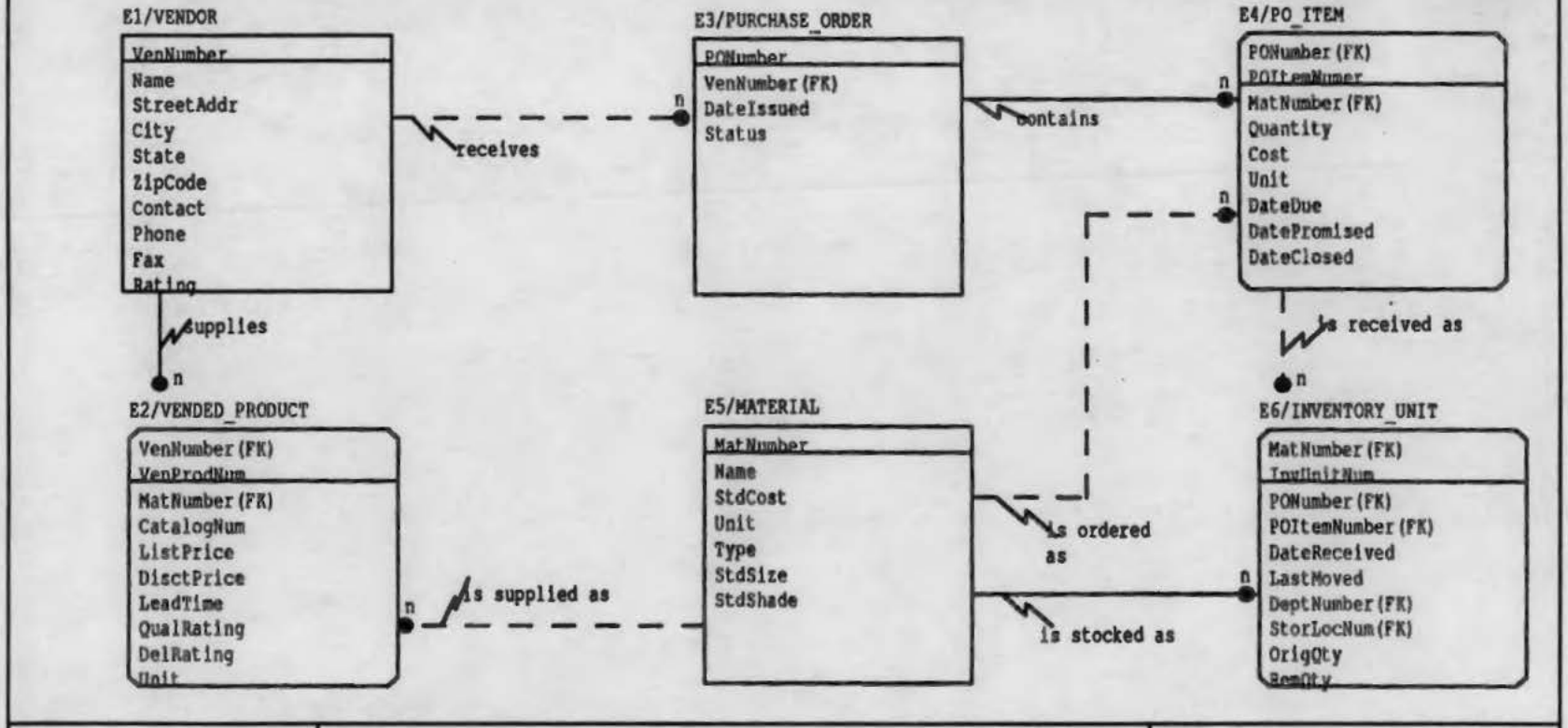
Context



Node:A43	Title:Schedule Operators and Estimate Capacities	Number:

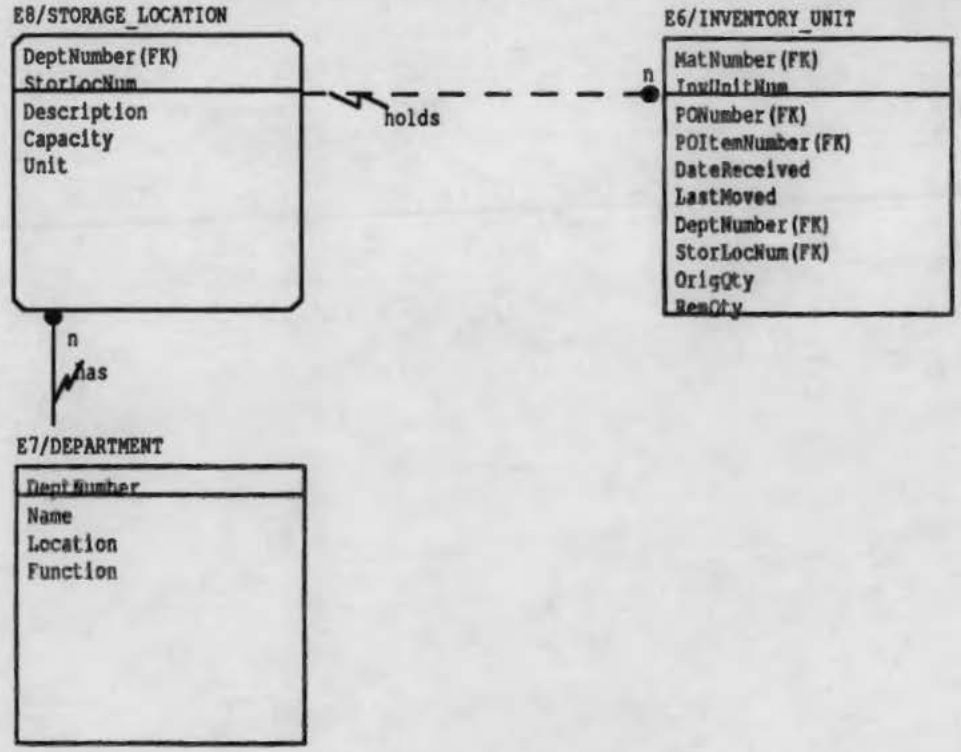
The *To Be* Information Model

USED AT:	AUTHOR : K. Srinivasan	DATE: 18/12/91	X	WORKING	READER DATE	CONTEXT:
	PROJECT: ama	REV.: 30/1/92		DRAFT		
	COMPANY: GEORGIA TECH.			RECOMMENDED		
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION		



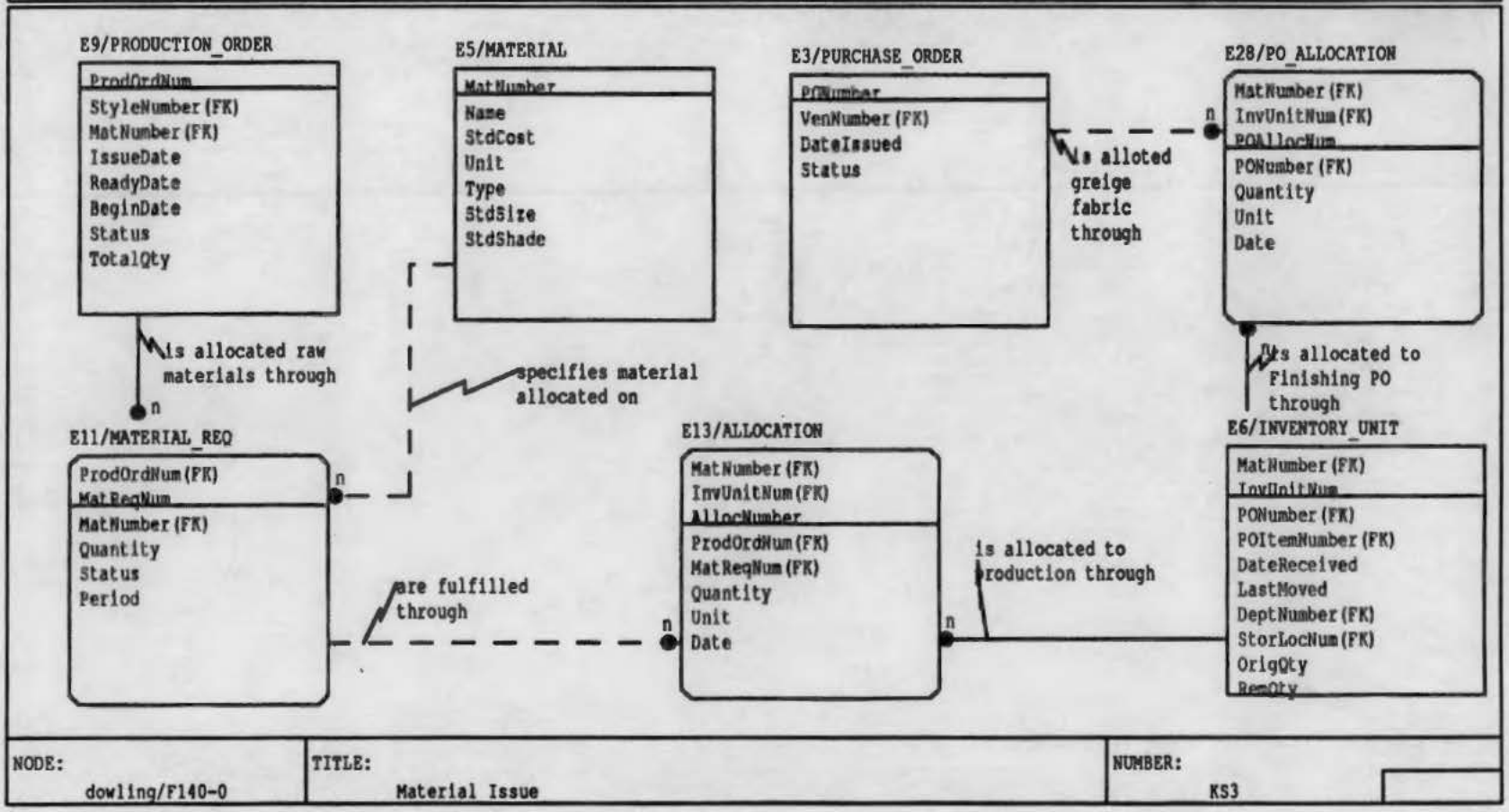
NODE:	TITLE:	NUMBER:
dowling/F100-0	Material Procurement	KS1

USED AT:	AUTHOR : K. Srinivasan	DATE: 18/12/91	X	WORKING	READER DATE	CONTEXT:
	PROJECT: ama	REV.: 30/1/92		DRAFT		
	COMPANY: GEORGIA TECH.			RECOMMENDED		
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION		



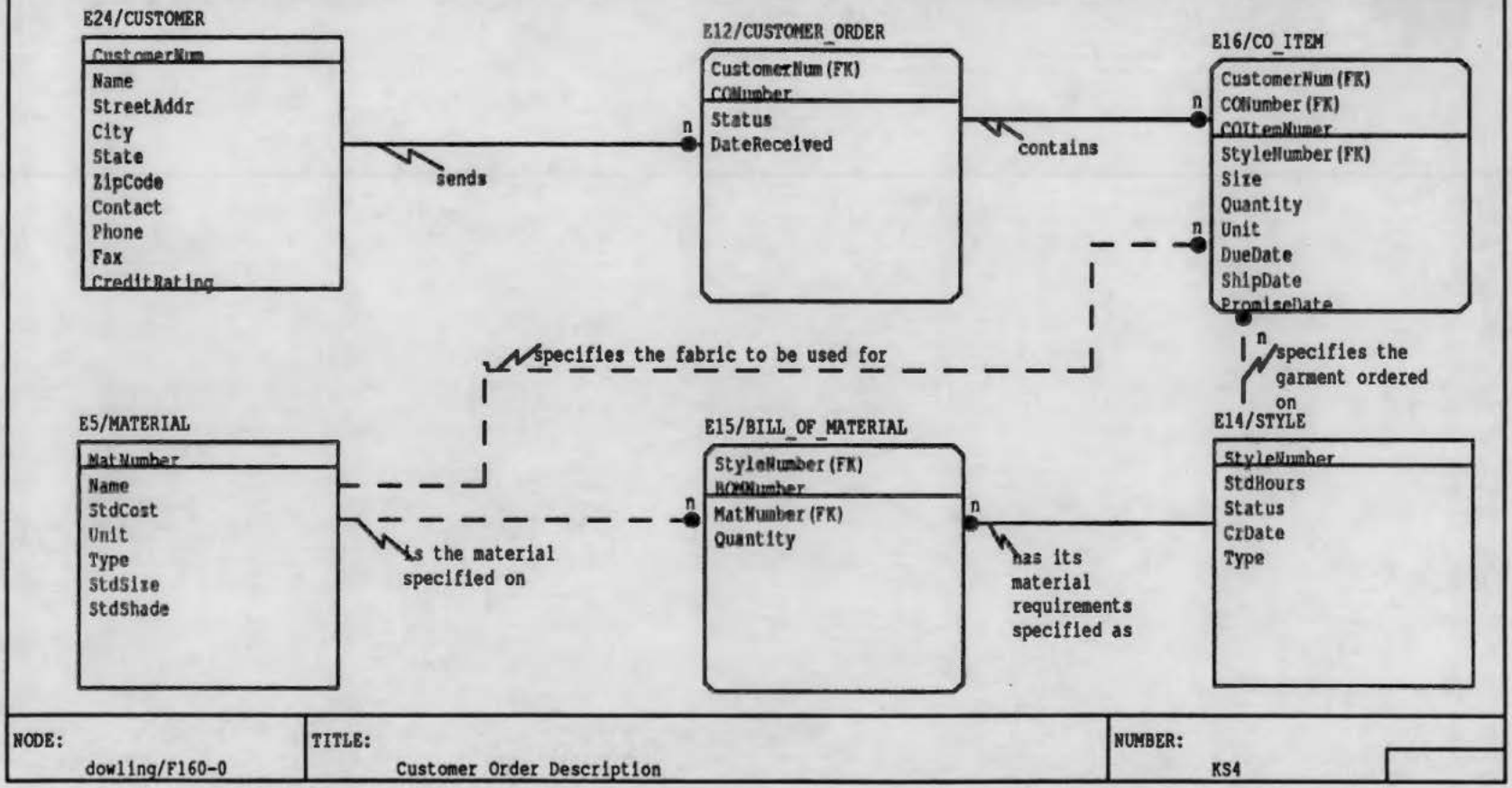
NODE:	TITLE:	NUMBER:
dowling/F120-0	Material Warehousing	KS2

USED AT:	AUTHOR : K. Srinivasan	DATE: 18/12/91	X	WORKING	READER	DATE	CONTEXT:
	PROJECT: ama	REV.: 11/2/92		DRAFT			
	COMPANY: GEORGIA TECH.			RECOMMENDED			
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION			



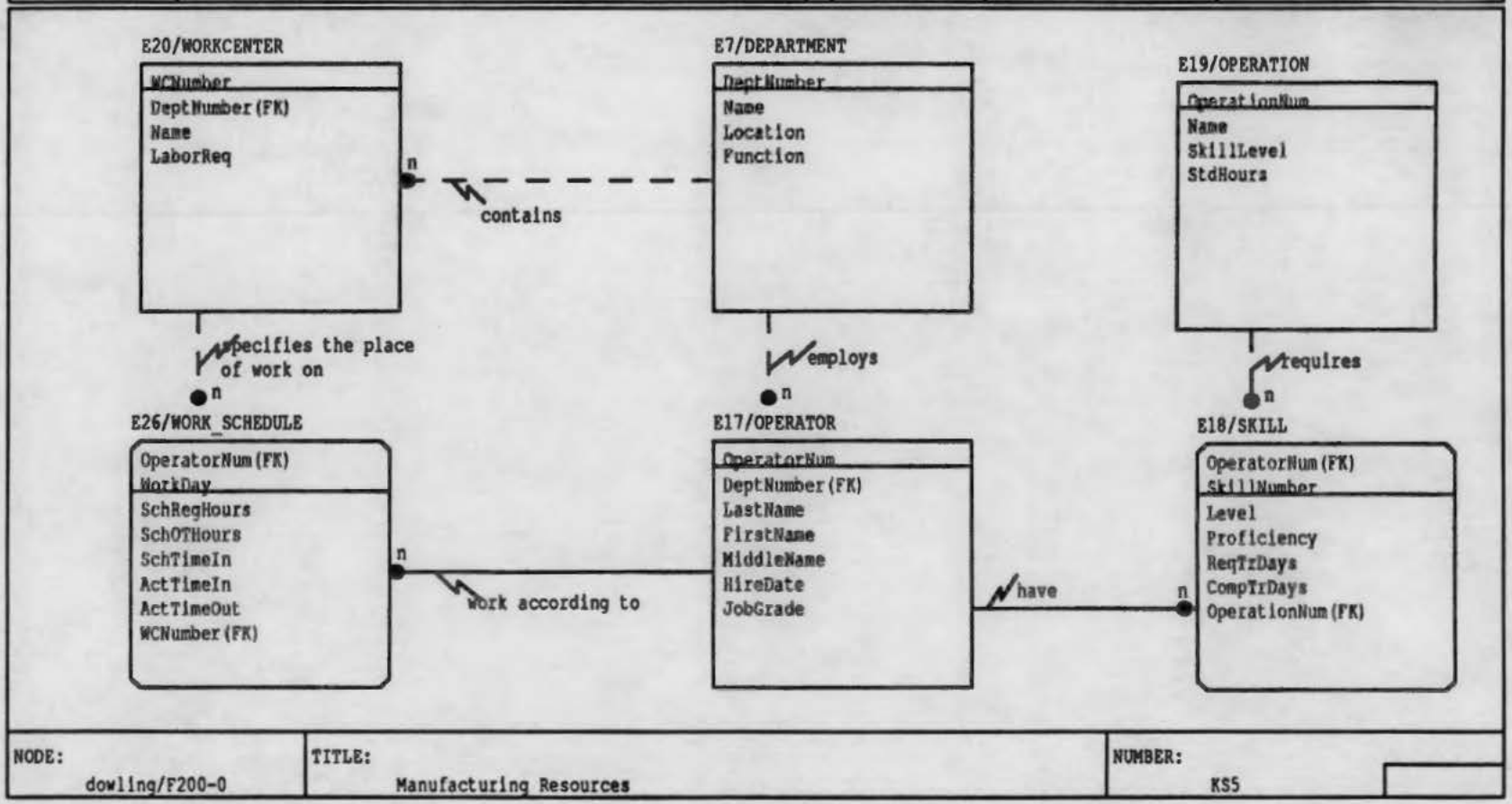
NODE: dowling/F140-0	TITLE: Material Issue	NUMBER: KS3

USED AT:	AUTHOR : K. Srinivasan	DATE: 19/12/91	X	WORKING	READER	DATE	CONTEXT:
	PROJECT: ama	REV.: 8/2/92		DRAFT			
	COMPANY: GEORGIA TECH.			RECOMMENDED			
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION			



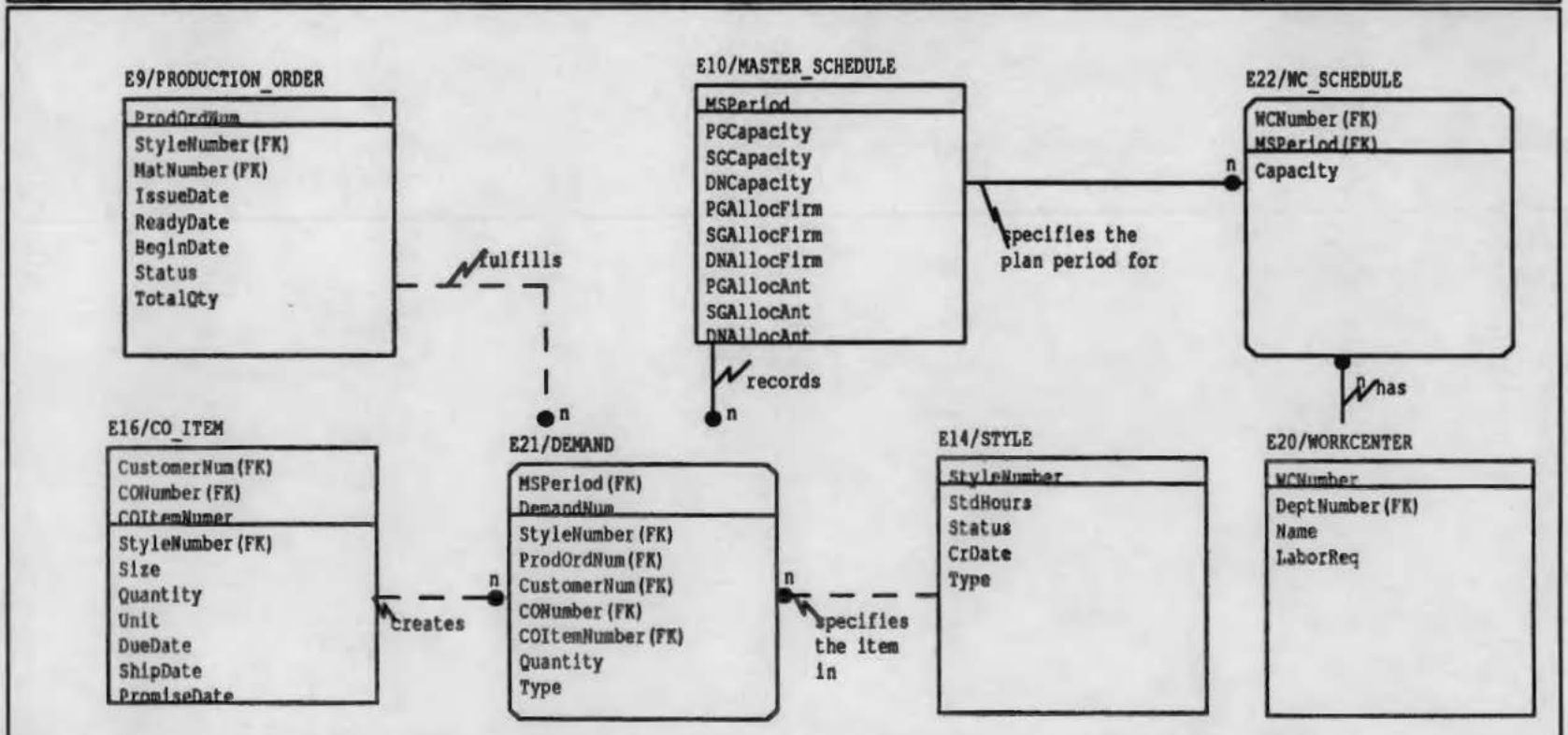
NODE:	TITLE:	NUMBER:
dowling/F160-0	Customer Order Description	KS4

USED AT:	AUTHOR : K. Srinivasan	DATE: 19/12/91	X	WORKING	READER DATE	CONTEXT:
	PROJECT: ama	REV.: 7/2/92		DRAFT		
	COMPANY: GEORGIA TECH.			RECOMMENDED		
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION		



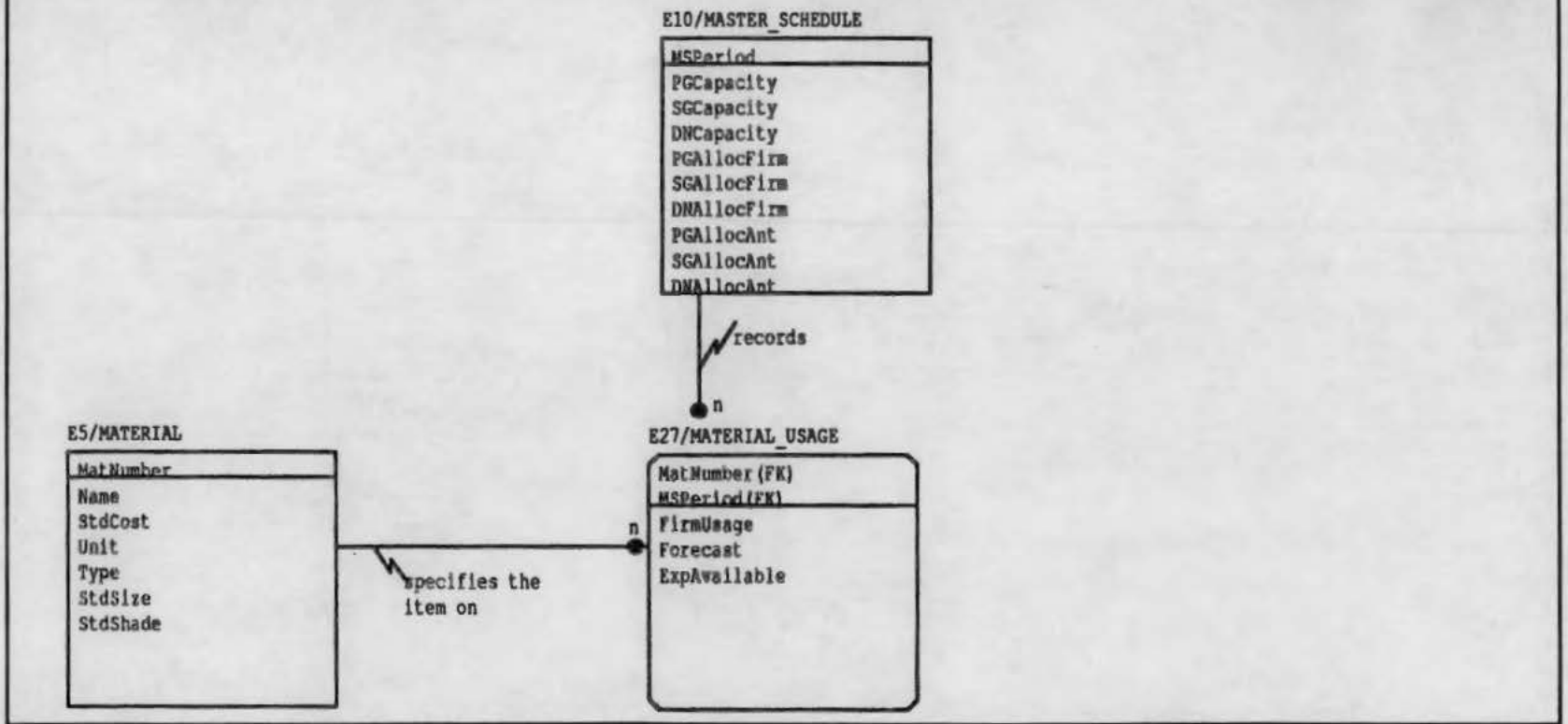
NODE:	TITLE:	NUMBER:
dowling/F200-0	Manufacturing Resources	KS5

USED AT:	AUTHOR : K. Srinivasan	DATE: 19/12/91	X	WORKING	READER	DATE	CONTEXT:
	PROJECT: ama	REV.: 31/1/92		DRAFT			
	COMPANY: GEORGIA TECH.			RECOMMENDED			
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION			



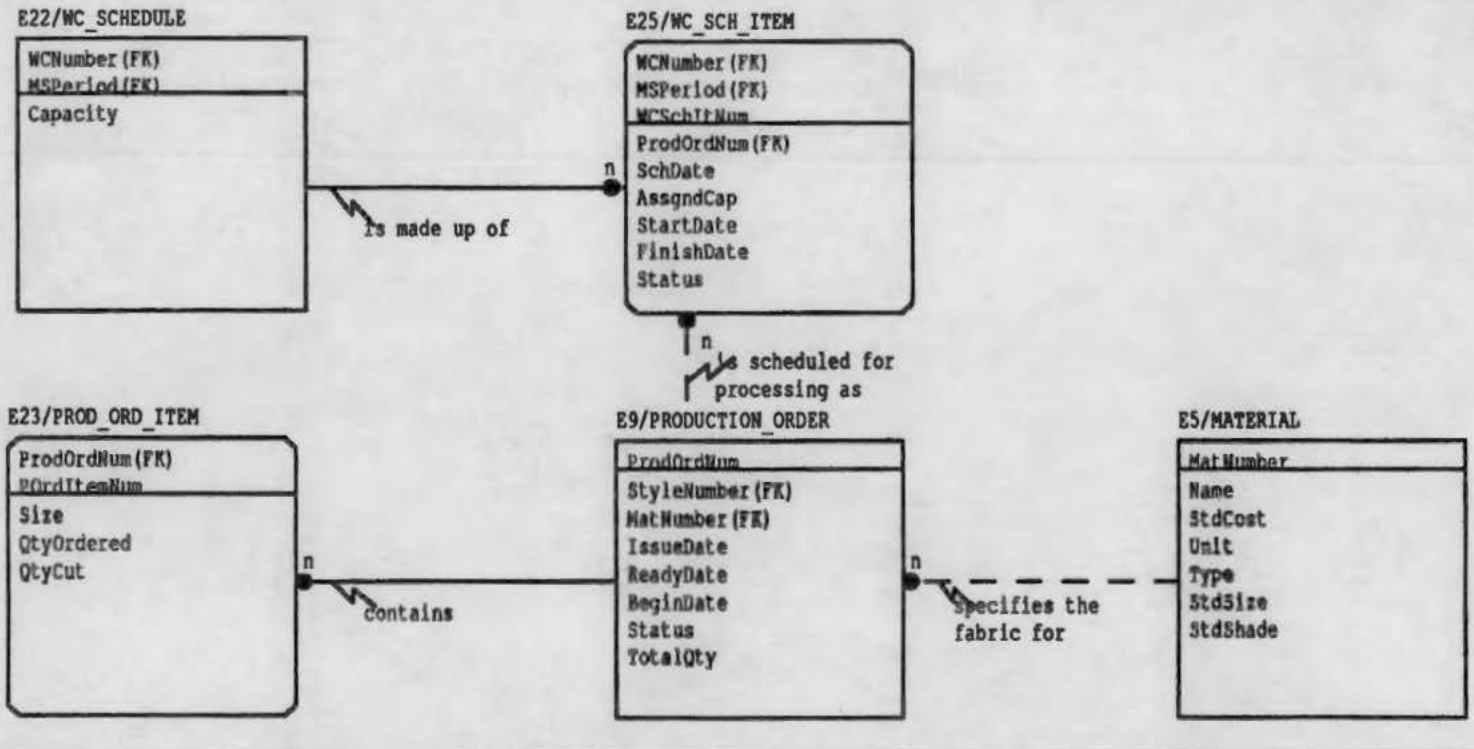
NODE:	TITLE:	NUMBER:
dowling/F220-0	Master Production Planning	KS6

USED AT:	AUTHOR : K. Srinivasan	DATE: 19/12/91	X	WORKING	READER DATE	CONTEXT: [redacted]
	PROJECT: ama	REV.: 31/1/92		DRAFT		
	COMPANY: GEORGIA TECH.			RECOMMENDED		
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION		



NODE:	TITLE:	NUMBER:
dowling/F240-0	Material Requirements Planning	KS7

USED AT:	AUTHOR : K. Srinivasan	DATE: 31/1/92	X	WORKING	READER	DATE	CONTEXT: [redacted]
	PROJECT: ama	REV.: 7/2/92		DRAFT			
	COMPANY: GEORGIA TECH.			RECOMMENDED			
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION			

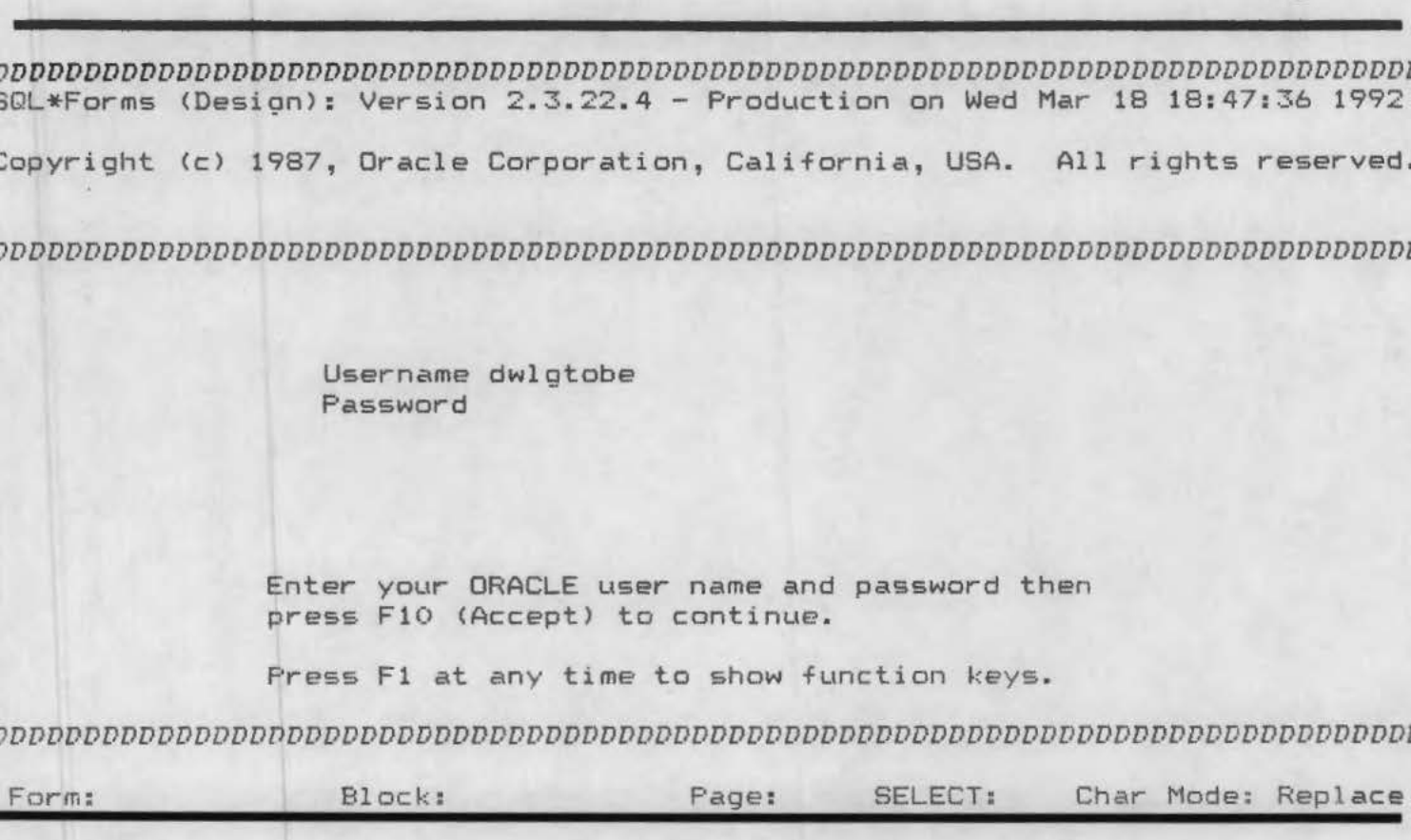


NODE: dowling/F260-0	TITLE: Production Order Scheduling	NUMBER: KS8

User Manual for Information System

INTEGRATED PLANNING AND PURCHASING SYSTEM
for
DOWLING TEXTILES

Rajeev Malhotra
K.Srinivasan
Sundaresan Jayaraman
Andrew Boyd
Ali Barr



SIGN-ON SCREEN

Start the database by typing ORACLE at the DOS command line

Type RUNFORM followed by the form name after the database is started

Type the username and password

Press ENTER to log on into the system

Username is DWLGTOBE

FUNCTION	KEYSTROKE(S)	FUNCTION	KEYSTROKE(S)
Right	-> Arrow	Clear Record	Shift-F4
Scroll Right	Ctrl ->	Clear Block	Shift-F5
Next Field	Tab	Clear Form/Rollback	Shift-F7
	Enter	Delete Record	Shift-F6
Next Primary Key Fld	Shift-F3	Create Record	F6
Next Record	PgDn	Duplicate Field	F3
Down	Down Arrow	Duplicate Record	F4
Scroll Down	Ctrl-Enter	Enter Query	F7
Next Set of Records	Ctrl-N	Count Query Hits	Shift-F2
Next Block	Ctrl-PgDn	Execute Query	F8
Left	<- Arrow	Commit Transaction	F10
Scroll Left	Ctrl <-	Exit/Cancel	Shift-F10
Previous Field	Back Tab		Esc
Previous Record	PgUp	Print	Shift-F8
Up	Up Arrow	Redisplay Page	Shift-F9
Scroll Up	Ctrl-Backspace	Help	F2
Previous Block	Ctrl-PgUp	List Field Values	F9
Insert/Replace	Ins	Display Error	Shift-F1
Delete Character	Del	Block Menu	F5
Delete Backward	Backspace	Show Function Keys	F1
Clear Field	Ctrl-End		

Press any function key to return to form.

HELP SCREEN

Help screen showing the definitions of the function keys can be recalled from anywhere by pressing function key **F1.**

See the screen above for function key definitions.

Main Keys:

Ctrl-PgDn	Go to next block
Ctrl-PgUp	Go to previous block
PgDn	Go to next record
PgUp	Go to previous record
TAB/ENTER	Go to next field
Shift-TAB	Go to previous field
F7	Enter Query
F8	Execute Query
F9	Show a list of choices for a field if available
F10	Commit changes to the database
Shift-F5	Clear Block
Shift-F6	Delete Record
Shift-F10	Exit Screen

There is rarely a need for using keys other than the ones listed above.

AUXILIARY SCREENS

The following auxiliary screens are used to enter data about vendors, styles, materials, etc.

New data can be entered into the system by going to each applicable field and typing in the desired value.

Previously entered information can be looked up by setting up and executing a query.

Information retrieved by a query can be updated by going to the fields and entering typing new values.

Newly entered or updated information does is not permanantly recorded in the database until it is commited.

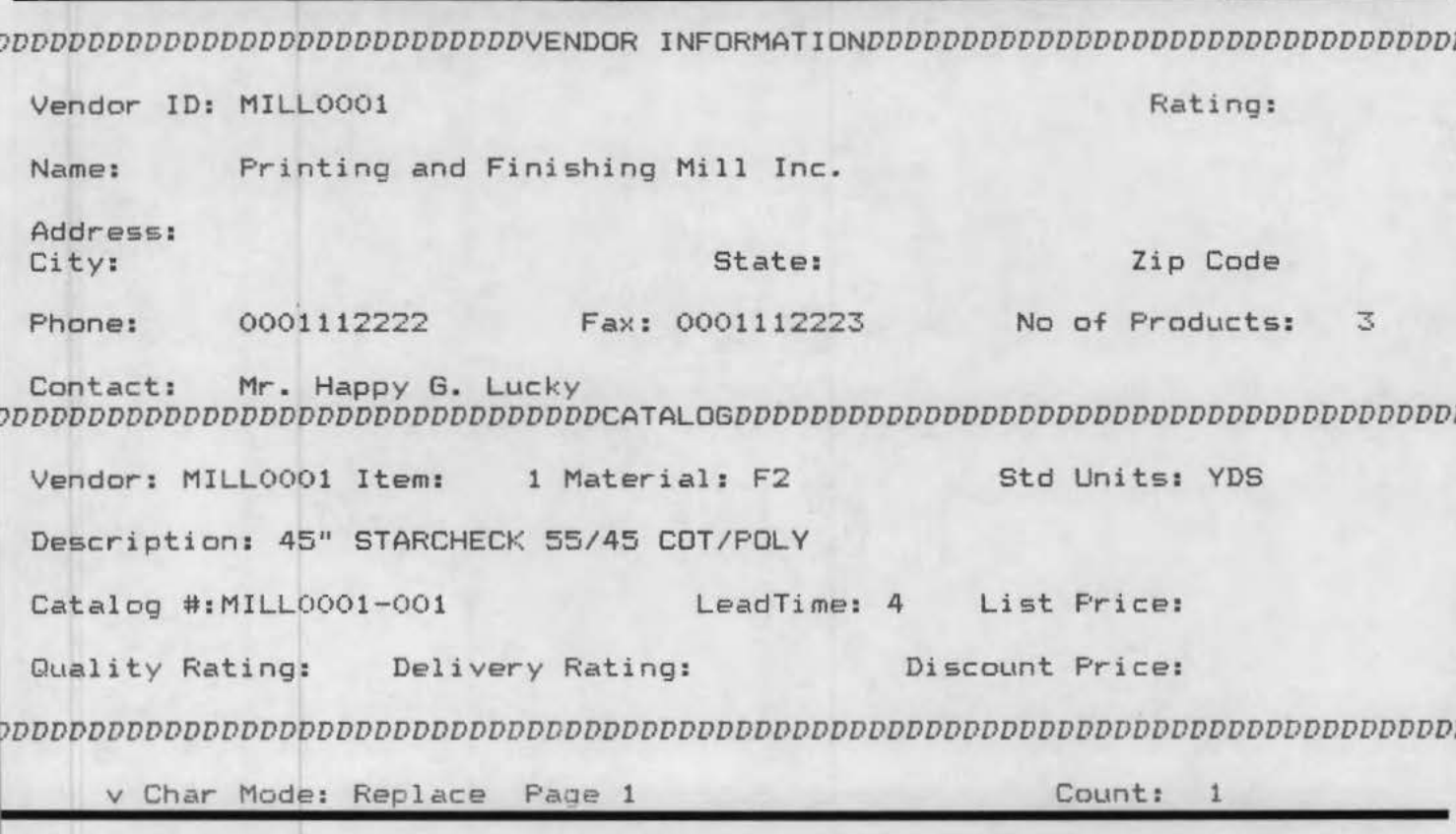
```
DDDDDDDDDDDDDDDDDDDDDDDDDDDDMATERIAL DEFINITIONSDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD?
                                                                                3
     Material ID: F1                                                            3
                                                                                3
     Type:        FIN_FABRIC    (FIN_FABRIC, GRE_FABRIC, FINDING)               3
                                                                                3
     Description: 45" Pink Broadcloth 50/50 Polyester/Cotton                    3
                                                                                3
     Std Units:   YDS                                                           3
                                                                                3
     Std Unit Cost:                                                             3
                                                                                3
     Std Size:       45                                                         3
                                                                                3
     Std Shade:      PINK0000                                                   3
                                                                                3
                                                                                3
     Inventory Count:      0                                                    3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY

     v Char Mode: Replace  Page 1                          Count:  1
```

MATERIAL

This screen is used to define greige fabrics, finished fabrics and finding.

Materials must be defined before vendor and catalogs are defined.



VENDOR

This screen is used to define vendors and the products they supply.

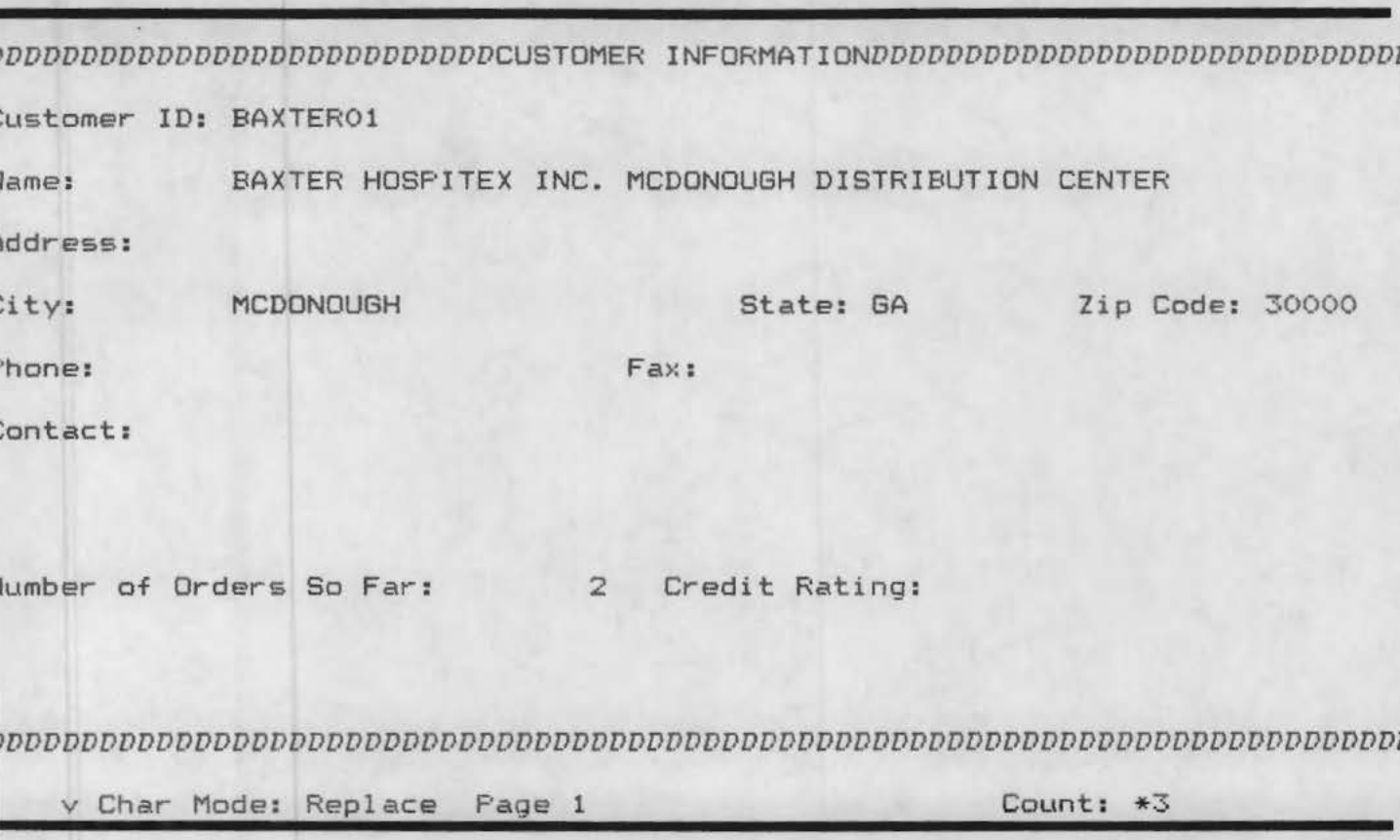
```
ZDDDDDDDDDDDDDDDDDDDDSTYLE AND BILL OF MATERIAL INFORMATIONDDDDDDDDDDDDDDDDDDDD?
3                                                                              3
3                                                                              3
3        Style ID: SG000001                    Product Type: SG (SG, PG, DN)   3
3                                                                              3
3 Standard Hours:      .11                          Status:  A                 3
3                                                                              3
3    Date Created: 11-JAN-92                       BOM Size:                   3
3                                                                              3
3    Description:  STANDARD SERGE PRODUCT                                      3
CDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
3 Style     Item Material ID  Material Description              Quantity Size  3
3 SG000001     1 F2           45" STARCHECK 55/45 COT/POLY            2        3
3 SG000001     2 P1           STANDARD POCKET                         2        3
3 SG000001     3 W1           STANDARD WAISTBAND FOR PANTS            1        3
3 SG000001     4 Z1           STANDARD ZIPPER FOR PANTS               1        3
3 SG000001     5 B2           STANDARD BUTTONS FOR PANTS              6        3
3                                                                              3
3                                                                              3
3                                                                              3
3                                                                              3
3                                                                              3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY

        Char Mode: Replace  Page 1                        Count: *5
```

STYLE

This screen is used to define styles and their bills of materials.

The Size field in BOM definitions is used if the BOM entry is specific to a particular garment size; it is left blank otherwise.

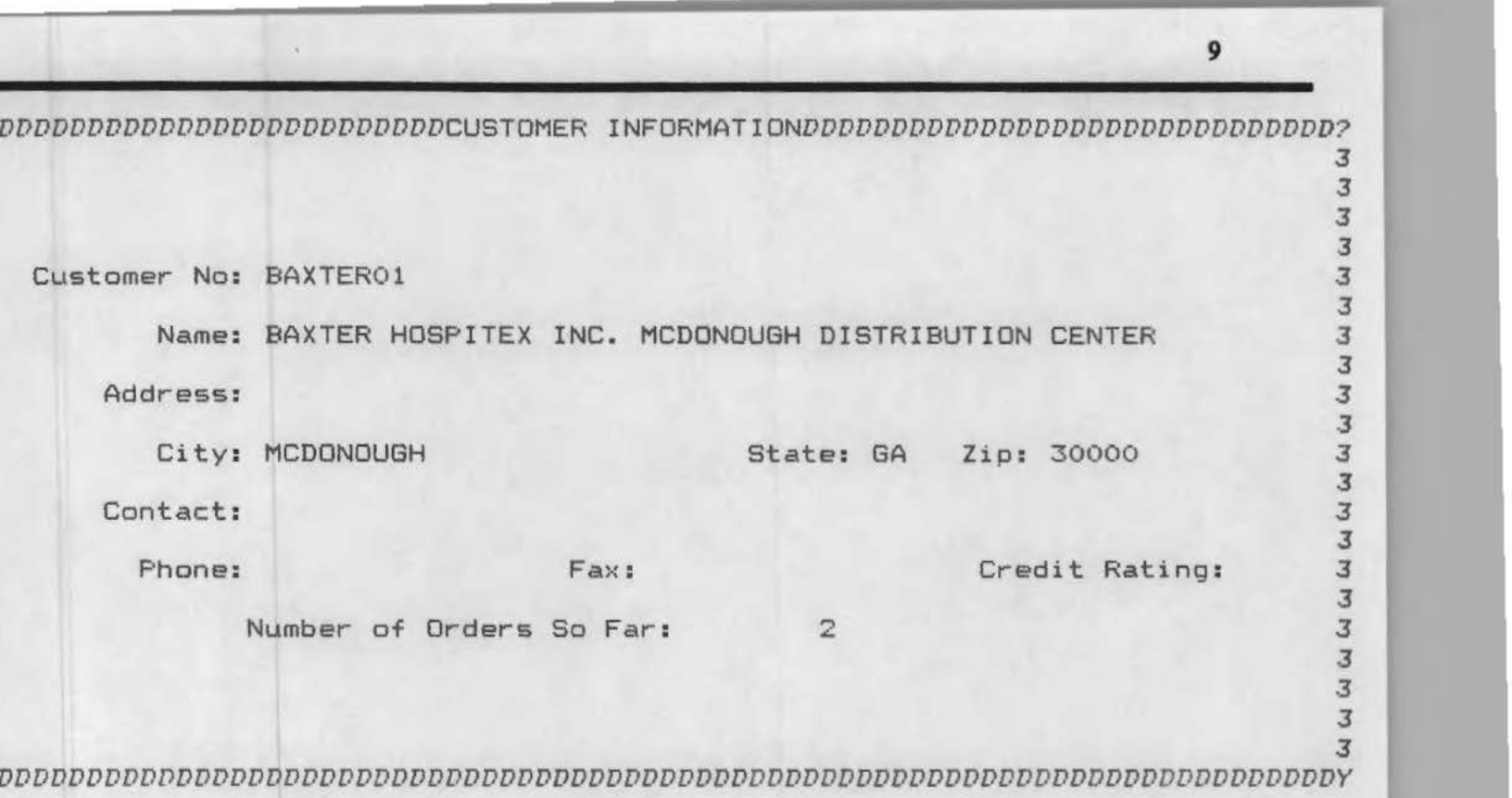


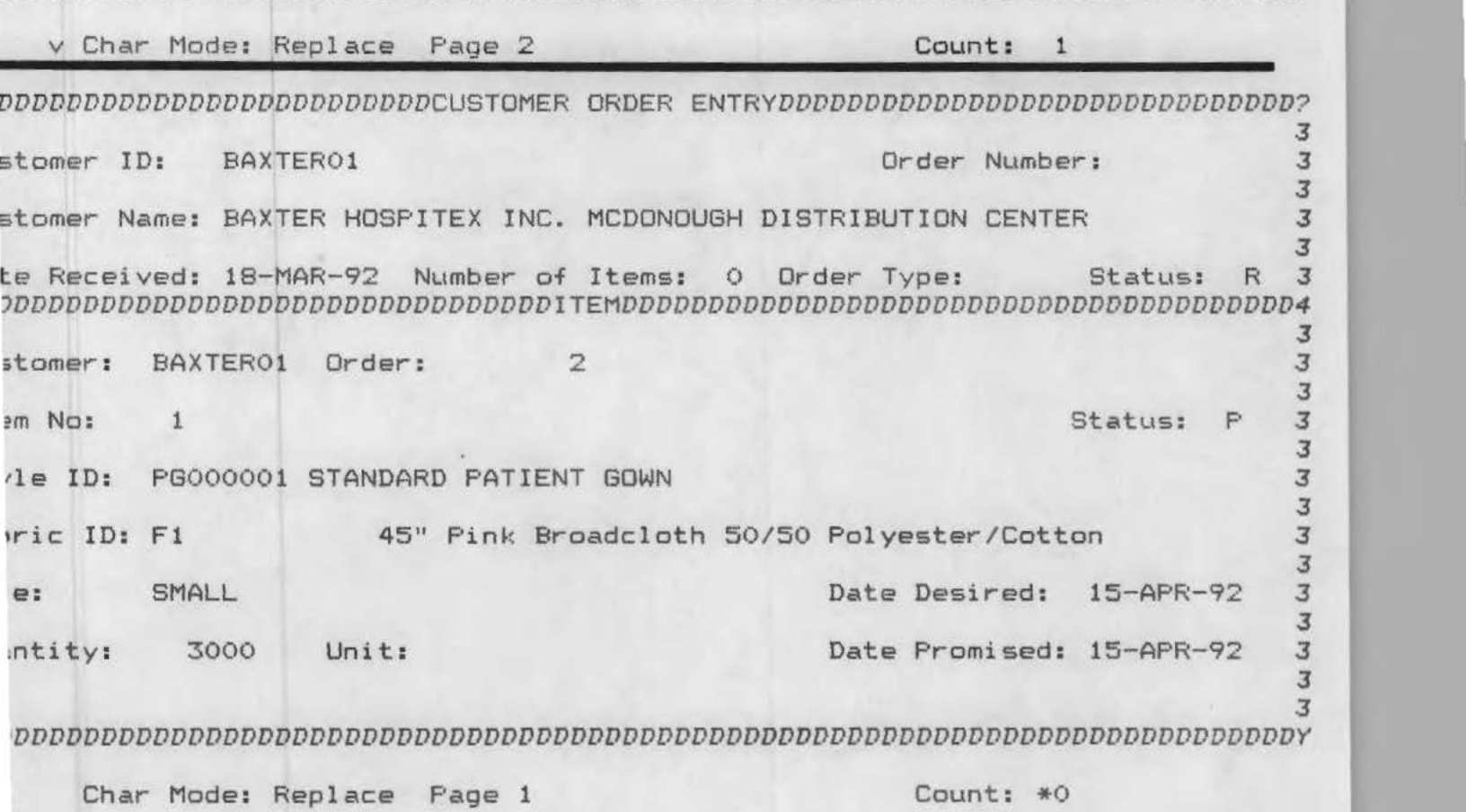
CUSTOMER

This screen is used to enter customer information.

Orders from a customer can be entered only after entering customer information.

Customer information can also be added from within the ORDERS screen.





ORDERS

Screen for entering customer orders

```
DDDDDDDDDDDDDDDDDDDDDDDDDDEPARTMENT INFORMATIONDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD?
                                                                                3
  Dept ID: CT00 Function: CUT      Location:   McDonough                       3
                                                                                3
  Name     Central Cutting Facility at McDonough, GA                            3
DDDDDDDDDDDDDDDDDDDDDDDDDSTORAGE AREASDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                                3
  Dept ID: CT00                                Storage Area ID: 2               3
                                                                                3
  Descrip: Storage area for cut fabric parts                                    3
                                                                                3
  Capacity:    1000                        Storage Units:   CUBIC FEET          3
DDDDDDDDDDDDDDDDDDDDDWORKCENTERS (LINES & MODULES)DDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                                3
  Workcenter ID: SP01                                      Dept ID: CT00        3
                                                                                3
  Description: 60" x 50' spreading table                                        3
                                                                                3
                          Operators Required for Optimal Operation: 2           3
                                                                                3
                                                                                3
                                                                                3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY

     v Char Mode: Replace  Page 1                        Count:  3
```

DEPT

Screen for defining departments, storage areas within departments and workcenters.

A department is a functional unit, e.g., cutting department in McDonough.

All warehouse locations are also defined as departments in the system.

```
DDDDDDDDDDDDDDDDDDDDDDDDDDDDOPERATION DEFINITIONSDDDDDDDDDDDDDDDDDDDDDDDDDDDD?
                                                                              3
 Operation ID:                                                                3
                                                                              3
 Description:                                                                 3
                                                                              3
 Standard Hrs:          Required Operator Skill Level:                        3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
                                                                              3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY
ery caused no records to be retrieved.
      Char Mode: Replace  Page 1                          Count: *0
```

OPERATION

Screen to define unit operations in the system.

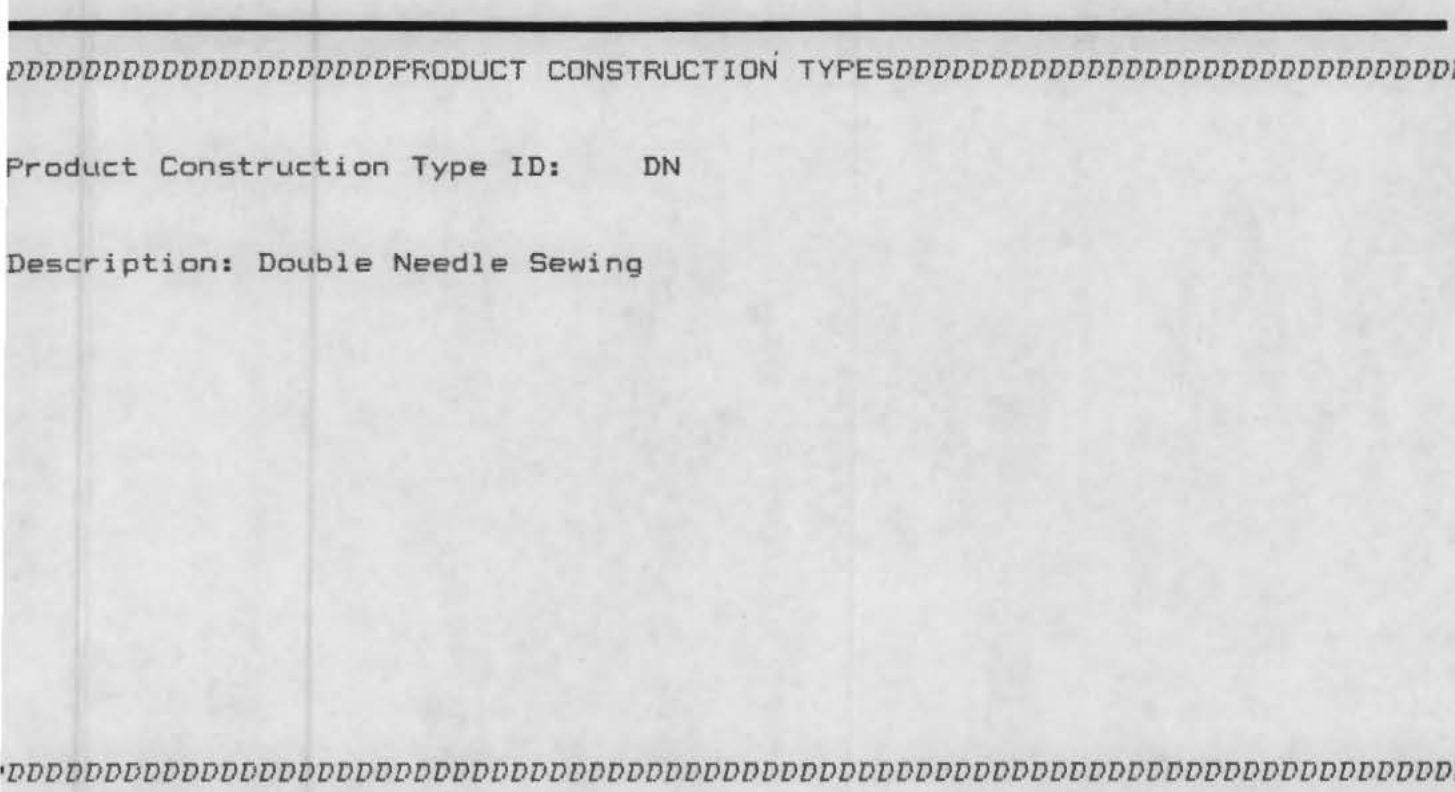
An operator is skilled to perform one or more operations.

```
DDDDDDDDDDDDDDDDDDDDDDDDDOPERATOR INFORMATIONDDDDDDDDDDDDDDDDDDDDDDDDDDDDD?
                                                                          3
 Operator ID: 1                                                           3
                                                                          3
 Name:        Smith                  Ann      Mary                        3
              Last                   Middle   First                       3
                                                                          3
 Department:  SEW1  Skills        Job Grade: 5  Date Hired: 01-JAN-89      3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDSKILLSDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                    DDDDaysDDDD           3
 Operator ID  No   Operation ID Description          Reqd  Comp  %    Lvl 3
 1                                                                        3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY
ery caused no records to be retrieved.
      Char Mode: Replace  Page 1                        Count: *0
```

OPERATOR

Screen for defining operators and their skills.

Operations must be defined prior to skills.

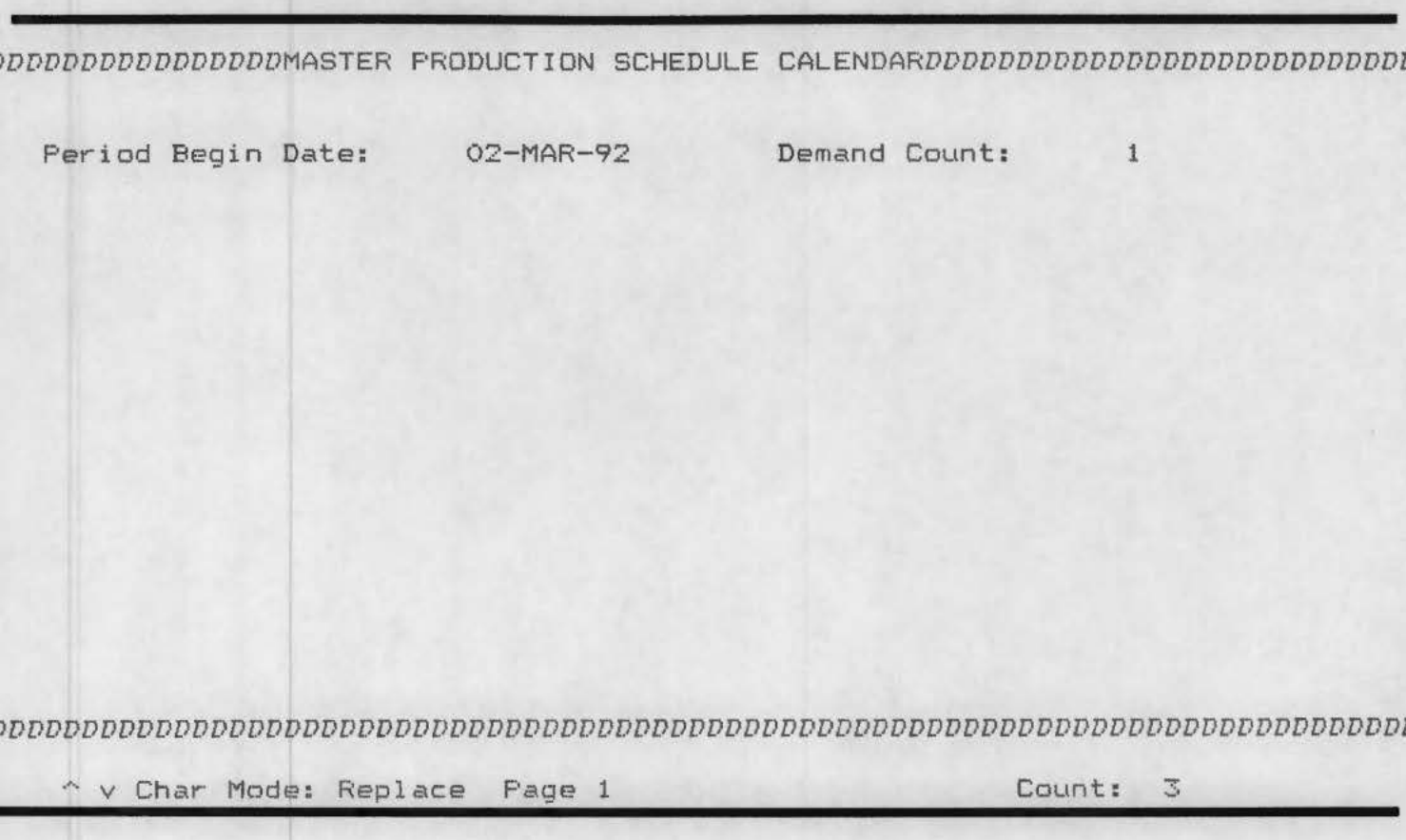


PRODTYPE

Screen used to define categories into which products and operations are divided.

For example styles are categorized into serge, double needle and patient gown.

```
ZDDDDDDDDDDDDDWORKCENTER (LINE & MODULE) DEFINITIONSDDDDDDDDDDDDDDDDDDDDDDDDDDDD?
3                                                                               3
3  Worcenter ID: SP01                                                           3
3                                                                               3
3                                                                               3
3   Description: 60" x 50' spreading table                                      3
3                                                                               3
3                                                                               3
3    Department: CT00 Central Cutting Facility at McDonough, GA                 3
3                                                                               3
3                                                                               3
3    Number of Operators Required: 2                                            3
3                                                                               3
3                                                                               3
3                                                                               
```



MPS

Screen for defining master production schedule periods.

A period is identified by its starting date.

Schedule periods must be defined before any planning functions are performed.

FUNCTION SCREENS

Screens for performing the planning and purchasing functions modeled in the TO BE model.

The names of the screens correspond to the node names of the functions.

The screens are divided into blocks enclosed within rectangular boxes. In general, the block at the top is for displaying the inputs or controls to a function, e.g., customer order information to the Post Demand function. Relevant inputs are retrieved by executing a query.

To retrieve information, press **F7**, enter query conditions and Press **F8**. Simply press **F8** to retrieve all relevant records.

The block(s) at the bottom is where the user enters the relevant information. Only those fields, where data must be entered, are accessible to the user. The entered information must be committed to the database after it has been entered and checked.

To commit changes, press **F10**. IF there is any error no changes are committed.

At present, functions A412, A413, A422, A423 and A432 are not implemented.

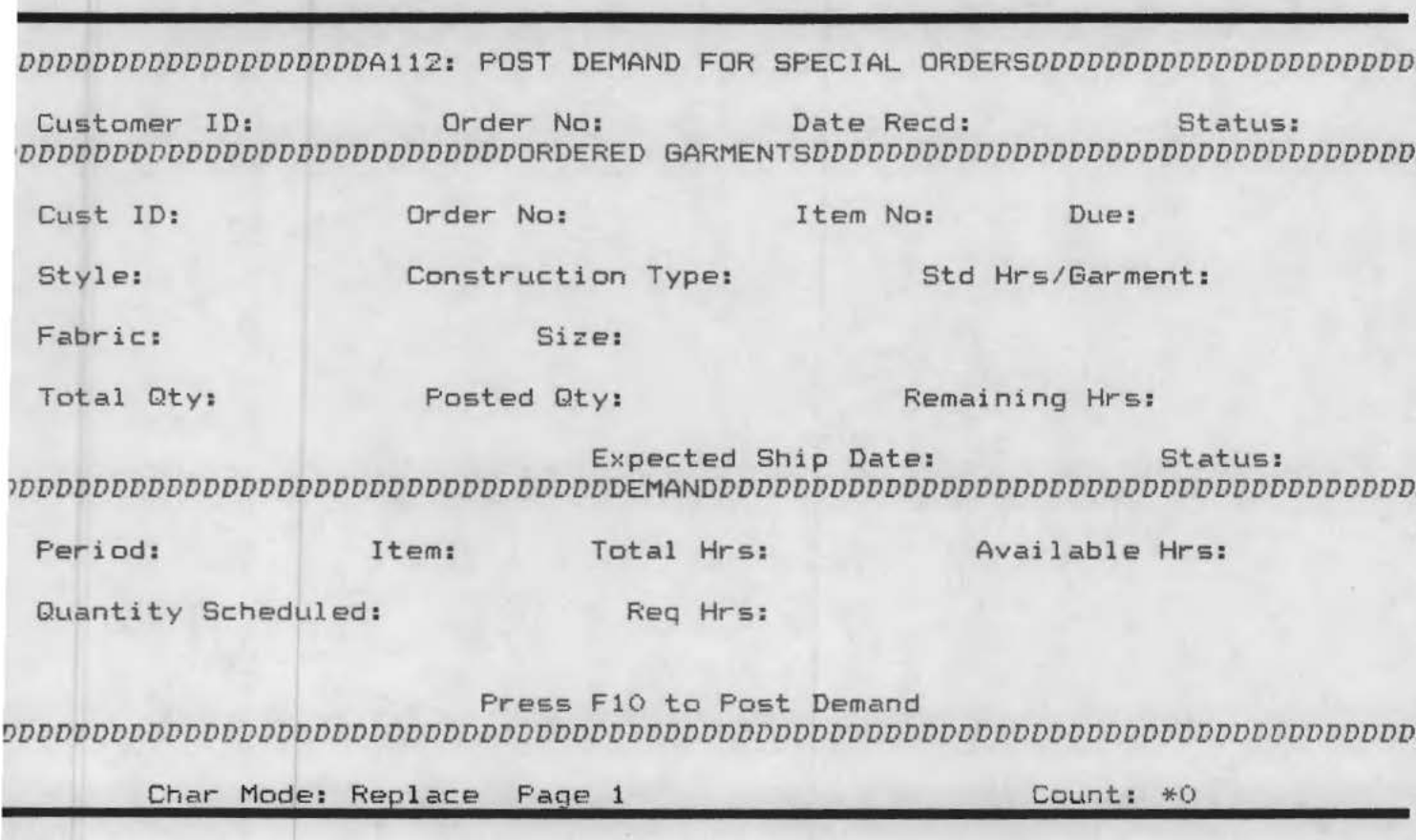
```
DDDDDDDDDDDDDDDDDDDA111: POST DEMAND FOR STOCK ORDERSDDDDDDDDDDDDDDDDDDDDDDDD?
                                                                              3
 Customer ID: TEMP0001 Order No:        2 Date Recd: 13-MAR-92 Status: R      3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDORDERED GARMENTSDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                              3
 Cust ID:  TEMP0001  Order No:        2   Item No:  1    Due:  01-APR-92       3
                                                                              3
 Style:    DN000000  Construction Type: DN       Std Hrs/Garment:    .45       3
                                                                              3
 Fabric:   F61              Size: MEDIUM                                       3
                                                                              3
 Total Qty:    3500   Posted Qty:               Remaining Hrs:      1575       3
                                                                              3
                                  Expected Ship Date:            Status:  R     3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDEMANDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                              3
 Period:           Item:       Total Hrs:          Available Hrs:             3
                                                                              3
 Quantity Scheduled:            Req Hrs:                                      3
                                                                              3
                                                                              3
                         Press F10 to Post Demand                             3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY
ery caused no records to be retrieved.
      Char Mode: Replace  Page 1                          Count: *0
```

A111: POST DEMAND FOR STOCK ORDERS

Execute query to retrieve customer order information in top two blocks.

In the bottom block, enter the demand resulting from each order item. Demand from an order item can be posted in multiple periods.

Change the status of the Customer order items for which demand has been posted to 'P'.



A112: POST DEMAND FOR SPECIAL ORDERS

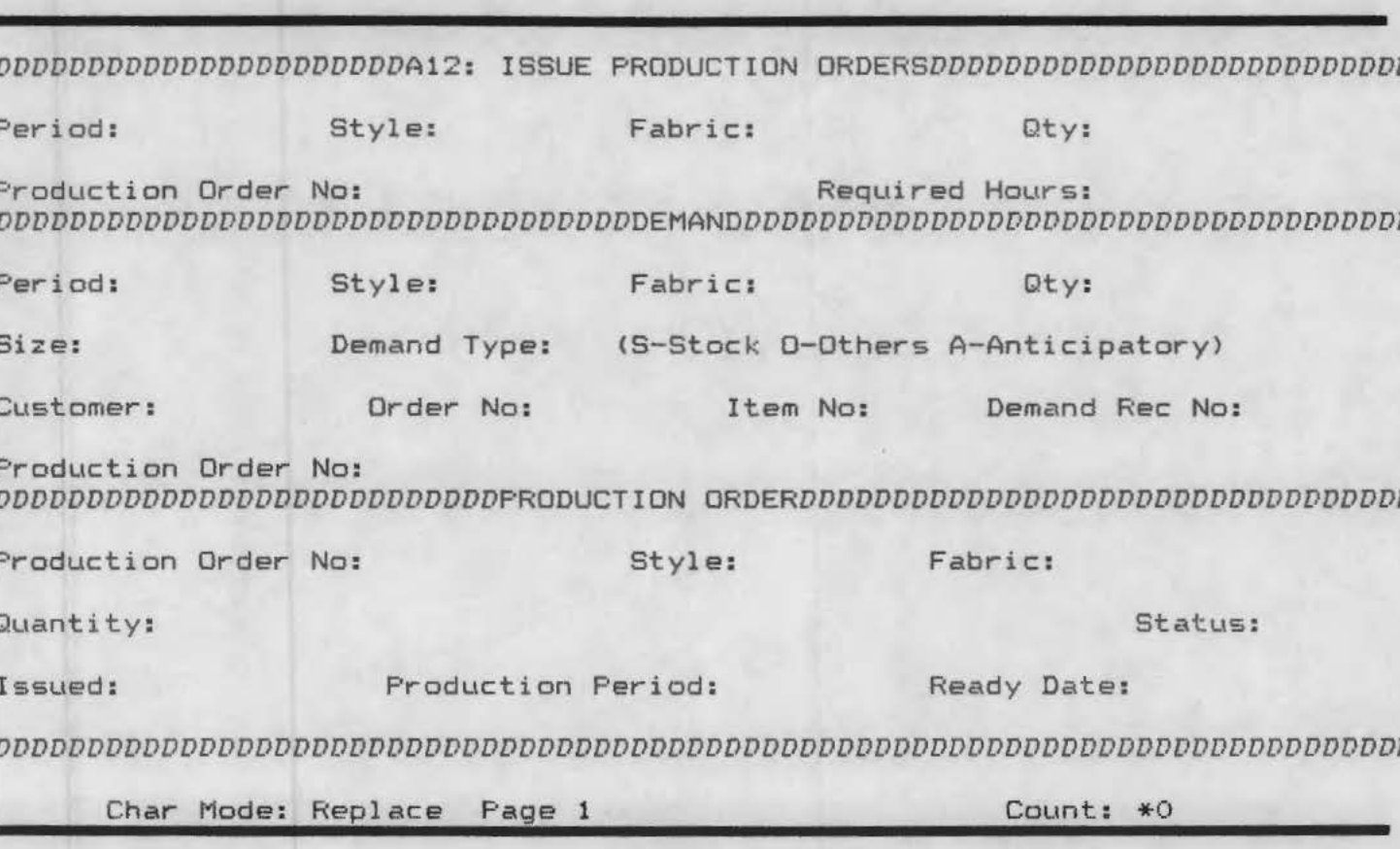
Execute query to retrieve customer order information in top two blocks.

In the bottom block, enter the demand resulting from each order item. Demand from an order item can be posted in multiple periods.

Confirm due dates for each item with the customer and enter the confirmed due date in the second block.

Change the status of the Customer order items for which demand has been posted to 'P'.

```
DDDDDDDDDDDDDDDDDDA113: POST ANTICIPATORY DEMANDDDDDDDDDDDDDDDDD
```



A12: ISSUE PRODUCTION ORDERS

Retrieve demand for the period for which production orders are to be issued. The top block provides the summary of demand.

Enter a production order number in the top block for each demand summary record. The system checks the number and warns you if it is an existing production order.

Move to the second block where demand details are retrieved. Enter a production order number for each demand record. The production order number entered in the top block can be copied here by pressing **F9** when the cursor is in the *Production Order No* field.

Commit after assigning production order numbers to demand record.

Move to the bottom block where production order information is displayed. Change quantity if some margin is to be given for defective or damaged production. Assign the ready date to the order.

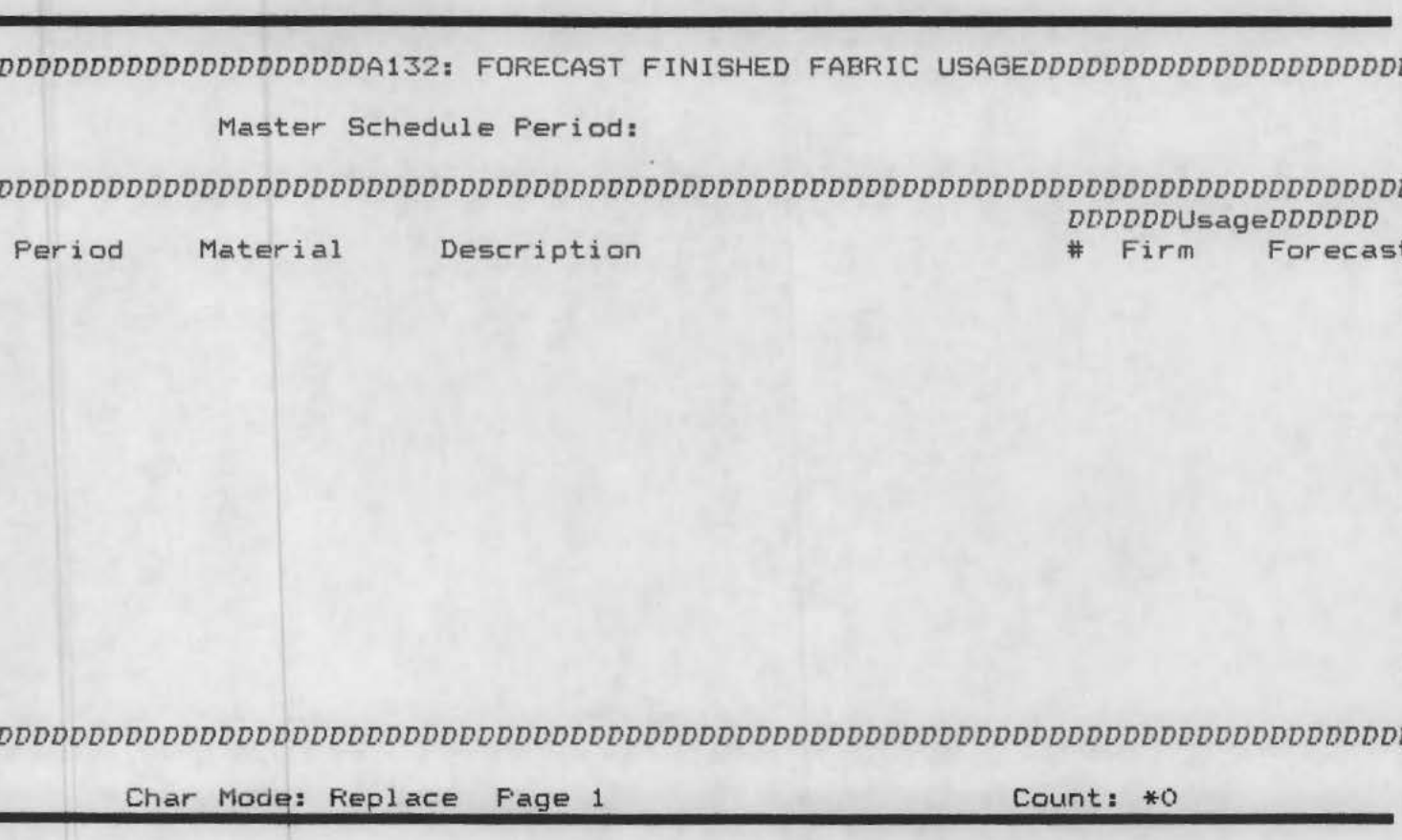
The status O (Open) is assigned to all newly created orders. Change the status to I (issued) when the order is finalized and commit.

```
DDDDDDDDDDDDDDDDDDDDA131: FORECAST GREIGE FABRIC USAGEDDDDDDDDDDDDDDDDDDDDD?
3                                                                           3
3            Master Schedule Period:                                        3
3                                                                           3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                          DDDDDDUsageDDDDDD  3
  Period    Material     Description                      #   Firm   Forecast3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY
       Char Mode: Replace  Page 1                          Count: *0
```

A131: FORECAST GREIGE FABRIC USAGE

Select period for which the forecast is to be added.

Move to the bottom block and add forecast for each greige fabric for this period.



A132: FORECAST FINISHED FABRIC USAGE

Select period for which the forecast is to be added.

Move to the bottom block and add forecast for each finished fabric for this period.

```
DDDDDDDDDDDDDDDDDDDDA133: COMPUTE PLANNED MATERIAL USAGEDDDDDDDDDDDDDDDDDDDD?
                                                                            3
  Production Order:              Style:          Fabric:                    3
                                                                            3
  Production Period:             Issued:          Ready By:                 3
                                                                            3
  Quantity:                                                    Status:      3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDBILL OF MATERIALSDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                            3
 Style:          Item:      Material:                Qty/Unit:              3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDMATERIAL REQUIREMENTSDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                            3
 Material:               Name:                                              3
                                                                            3
 Period:              Production Order:              Item No:     Status:    3
                                                                            3
 Quantity:                                                                  3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
                                                                            3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY
       Char Mode: Replace  Page 1                        Count: *0
```

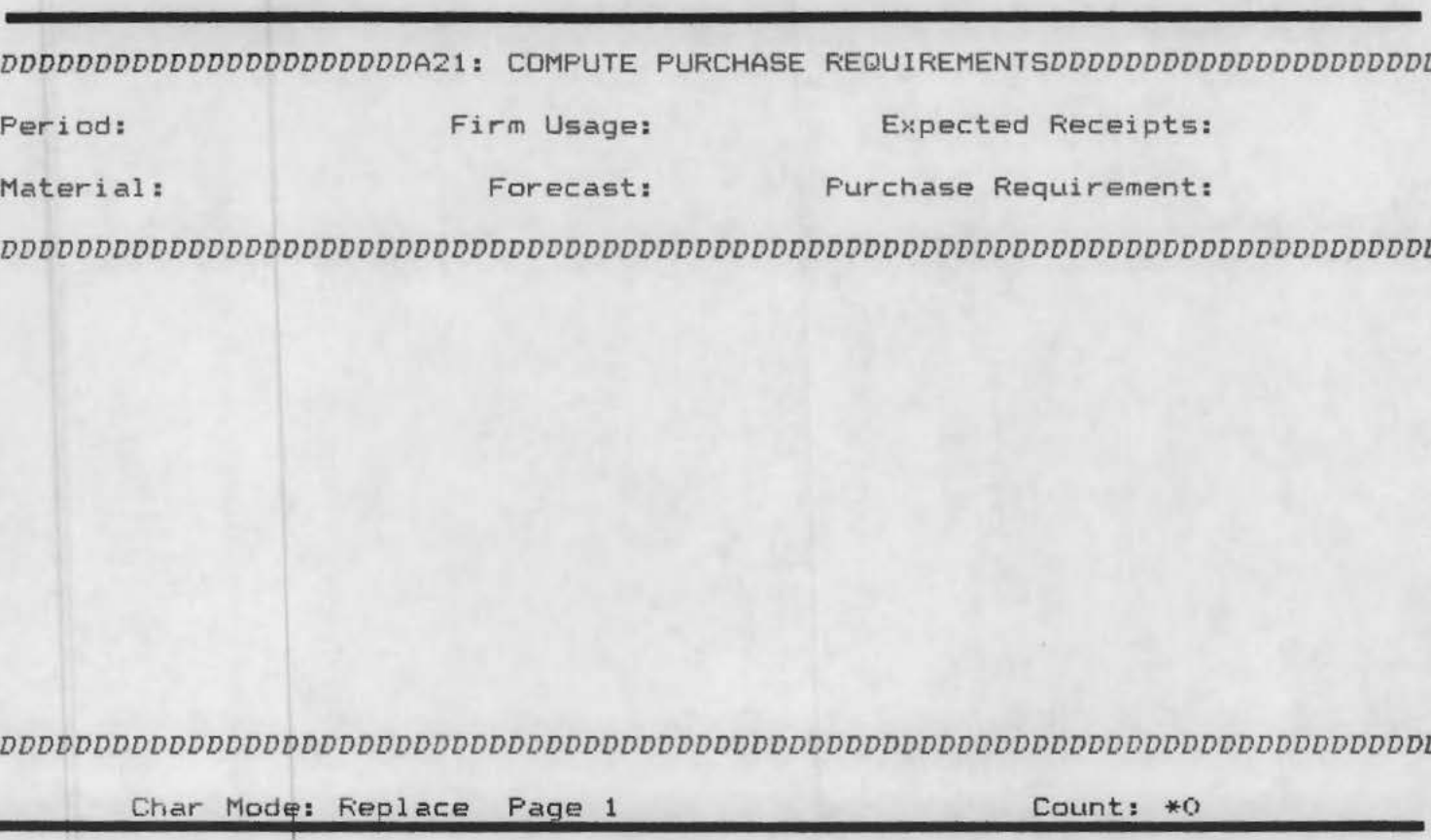
A133: COMPUTE PLANNED MATERIAL USAGE

Retrieve issued production orders in the top block.

The bill of materials for the style to be produced is retrieved in the second block.

For each required material, enter requirements in the bottom block. The quantity is automatically added but it may be alter to provide for waste. A material itself may be substituted for another. For example, the fabric specified on the BOM may need to be replaced by the fabric specified on the production ordered if both are not same.

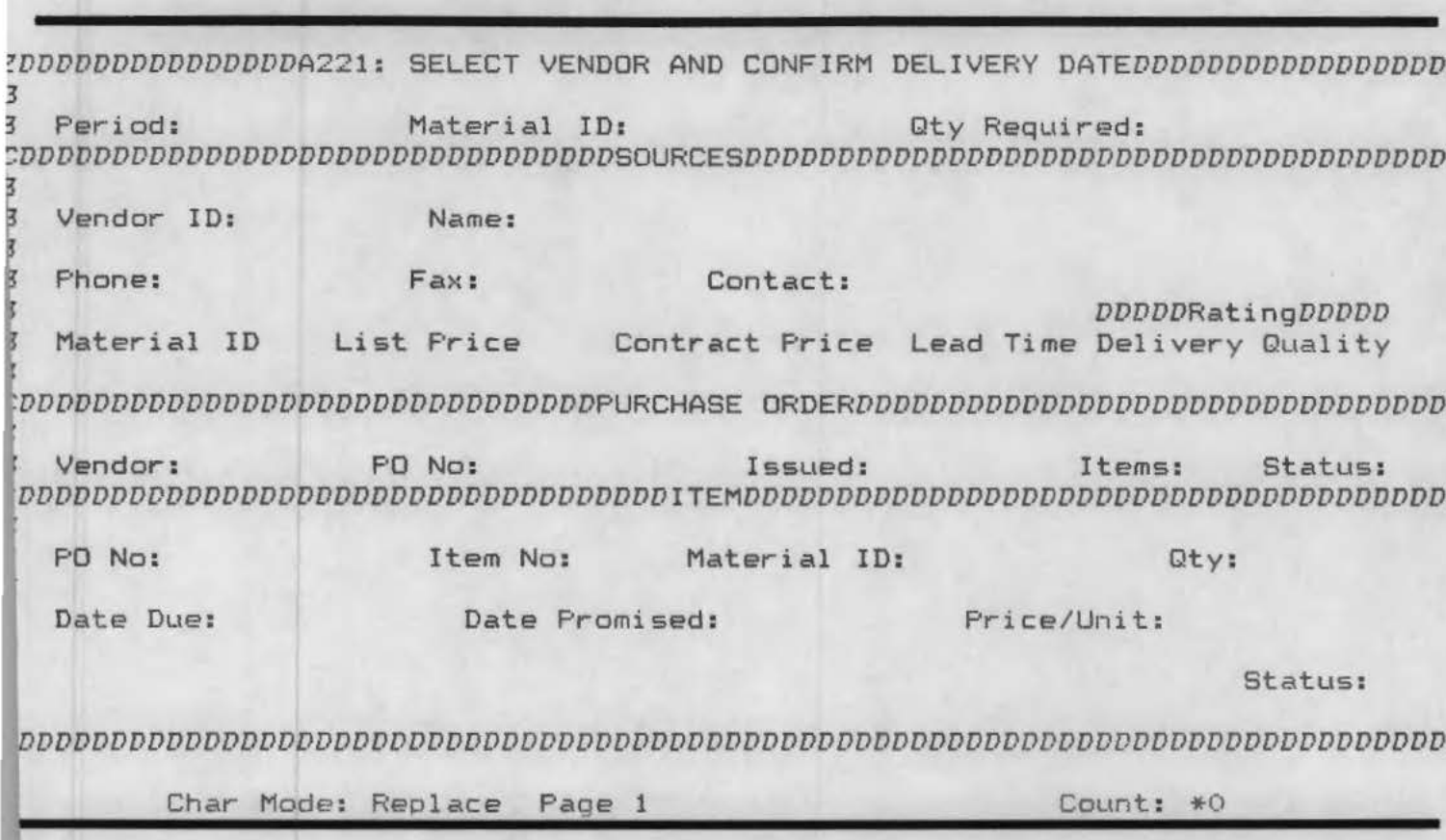
After posting material usage for the entire order, change the status of the order to posited and commit.



A21: COMPUTE PURCHASE REQUIREMENTS

Retrieve the usage information for the period for which material is to be purchased.

Enter purchase requirements based on the firm or forecast demand.



A221: SELECT VENDOR AND CONFIRM DELIVERY DATE

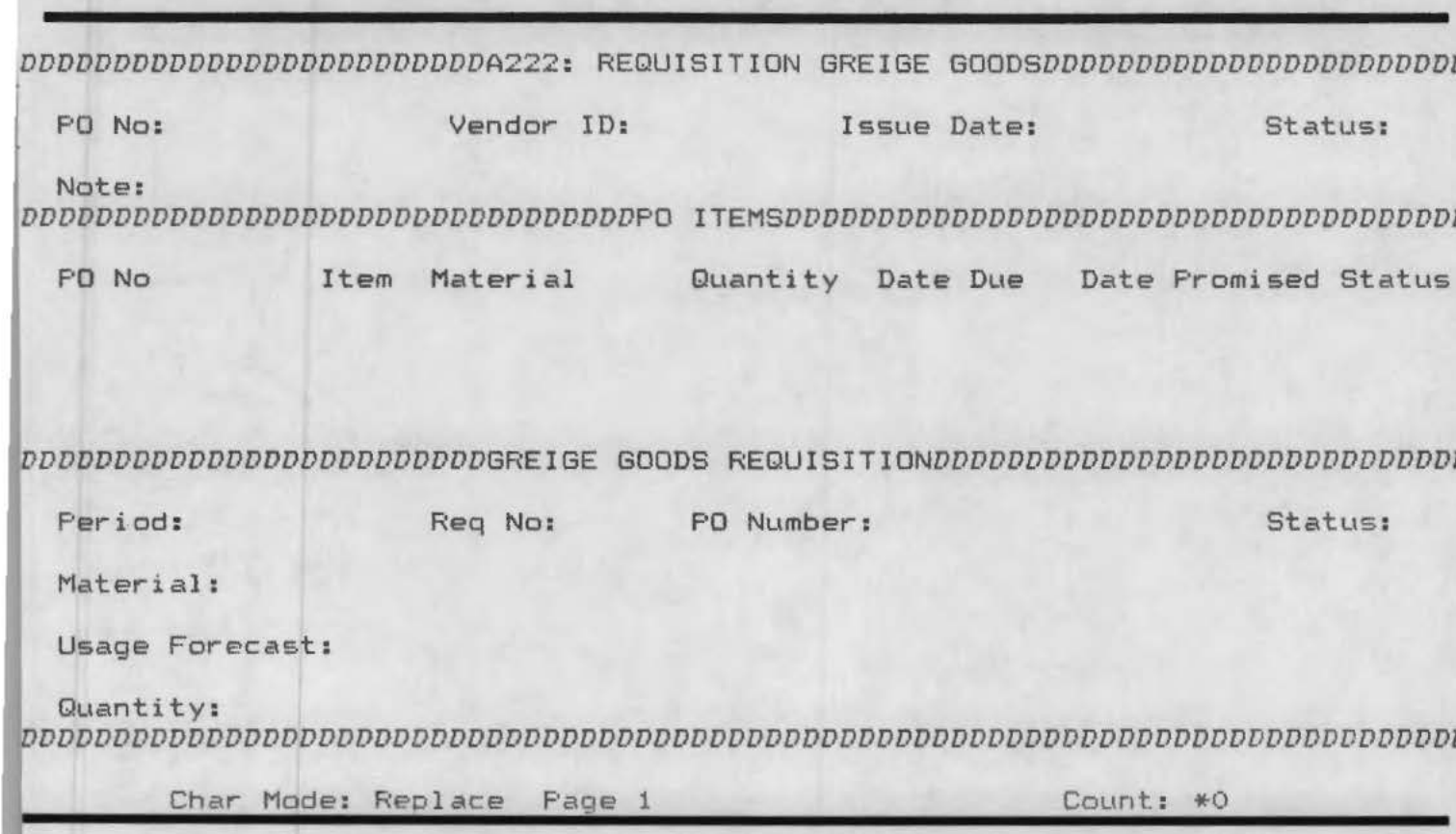
Retrieve purchase requirements for the period and material to be purchased.

Look up the sources for the material in the second block and select one.

In the third block, retrieve any open purchase orders that may be there for this vendor. If none exist add a new purchase order.

Add a purchase order item record in the bottom block to fulfill the purchase requirement.

A purchase order is assigned a status opine to let you work with it. Once an order is ready and finalized, change its status to I(Issued).



A222:REQUISITION GREIGE GOODS

Retrieve the issued purchase orders and details in the top two blocks.

Create a greige fabric requisition for each order in the bottom block.

```
DDDDDDDDDDDDDDDDDA223: APPROVE AND RELEASE PURCHASE ORDERSDDDDDDDDDDDDDDDDDDD?
                                                                                3
 PO No:                 Vendor ID:            Issue Date:            Status:     3
                                                                                3
 Note:                                                                          3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDPO ITEMSDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                                3
 PO No          Item  Material      Quantity  Date Due   Promised   Price/Unit3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                Total Amount:                   3
                                                                                3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY

      Char Mode: Replace  Page 1                          Count: *0
```

A223: APPROVE AND RELEASE PURCHASE ORDERS

Look up the issued purchase orders.

After getting the approval for these orders change their status to released.

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍA23: APPROVE SAMPLES OF FINISHED FABRICSÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
                                                                              º
 Vendor ID:            Purchase Order No:                 Issued:             º
                                                                              º
 Comment:                                                                     º
                                                                              º
 Status:                                                                      º
ÇÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
```

```
ZDDDDDDDDDDDDDDDDDDDDDDDA24: REVIEW & REVISE PURCHASE ORDERSDDDDDDDDDDDDDDDDDDD?
3                                                                              3
3 Period:                  Firm Usage:            Expected Receipts:          3
3                                                                              3
3 Material:                  Forecast:         Purchase Requirement:          3
3                                                                              3
CDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDMATERIALS ON ORDERDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
3                                                                              3
3 Material:                 Due Date:            PO No:                Item:   3
3                                                                              3
3 Vendor:                                                                      3
3                                                                              3
3 Contact:                                                                     3
3                                                                              3
3 Phone:              Fax:                                                     3
3                                                                              3
3 Quantity:         Date Delivery Promised:                          Status:   3
3                                                                              3
3                                                                              3
3                                                                              3
3                                                                              3
3                                                                              3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY

        Char Mode: Replace  Page 1                        Count: *0
```

A24: REVIEW & REVISE PURCHASE ORDERS

When the PO change deadline arrives, lookup the relevant material usage information in the top block.

If the purchase requirements posted earlier are off the mark, make adjustments to the quantities and delivery dates on the purchase order items in the bottom block after consulting with the vendor.

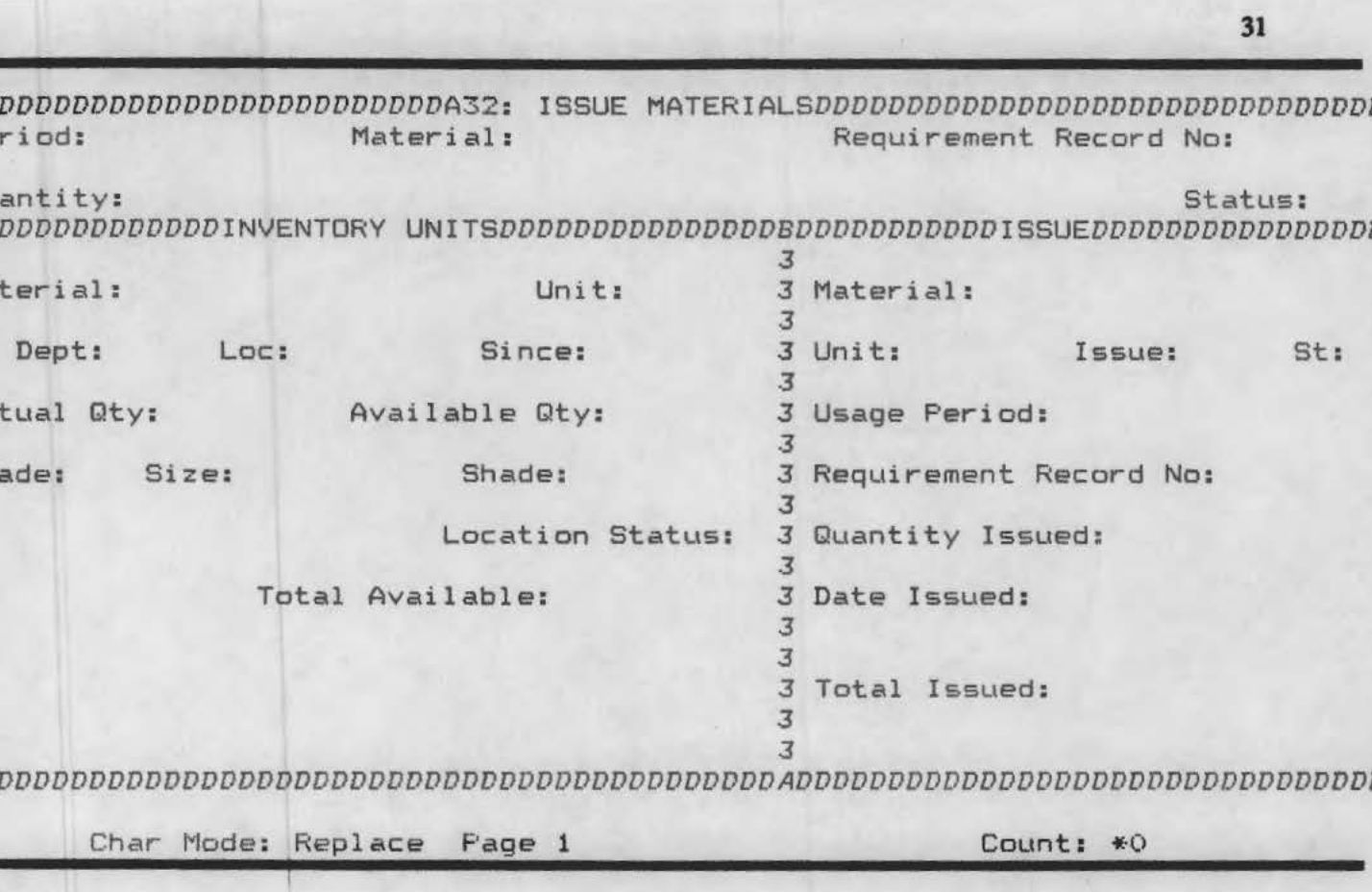
```
DDDDDDDDDDDDDDDDDDDDDDA31: RECEIVE AND STORE MATERIALSDDDDDDDDDDDDDDDDDDDDDDDD?
                                                                                3
  PO Number:                          Item:            Material:                3
                                                                                3
  Vendor:                                                  Quantity:            3
                                                                                3
  Date Due:              Promised:              Delivered:              Status:  3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDINVENTORYDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                                3
  Material:                Inv Unit No:           Date Received:                3
                                                                                3
  PO Number:                      Item:             No of Allocations:          3
                                                                                3
  Quantity Received:                              Size Received:                3
                                                                                3
  Qty Physically Present:                         Shade Received:               3
                                                                                3
  Qty Available for Alloc:                        Grade Received:               3
                                                                                3
                                                                                3
  Stored in Dept:      at Location:           on Date:            Status:       3
                                                                                3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY

        Char Mode: Replace  Page 1                          Count: *0
```

A31: RECEIVE AND STORE MATERIALS

Look up the PO item detail for the received material.

Add a record for each unit received in the bottom block and assign it a storage location.



A32: ISSUE MATERIALS

Retrieve the material requisitions released for issue in the top block.

Look up the available inventory for the requisitioned material in the bottom left block.

Issue material from the inventory for the requisitions.

Adjust the status of the inventory units from which material is issued to M(To be Moved).

Reduce the available quantity on the unit by the issued quantity.

```
DDDDDDDDDDDDDDDDA33: COLLECT AND RELEASE MATERIALSDDDDDDDDDDDDDDDDDDDDDDDDDD?
                                                                          3
Material:                  Inventory Unit:                Issue No:       3
                                                                          3
Usage Period:              Requirement Record No:          Status:        3
                                          Prod Order       PO              3
Qty Issued:                Issued to:                   or                3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDINVENTORYDUNITSDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                          3
Material:                Inventory Unit:                    Status:        3
                                                                          3
                                                                          3
                                                                          3
Department:               Storage Area:          Since Date:                3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
                                                                          3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY

     Char Mode: Replace  Page 1                        Count: *0
```

A33: COLLECT AND RELEASE MATERIALS

Look up the materials issued in the top block.

Look up the details of inventory units from which the materials are issued in the bottom block.

After retrieving these units assign them the destination locations and change their status to I(In transit).

```
DDDDDDDDDDDDDDDDA34: RETURN MATERIALS TO WAREHOUSE DDDDDDDDDDDDDDDDDDDDDDDDD?
                                                                                3
Material:                    Inventory Unit:                 Issue No:          3
                                                                                3
Usage Period:                Requirement Record No:            Status:          3
     Issued     Used                          Prod Order       PO               3
Qty:                              Issued to:                 or                 3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDINVENTORYDUNITSDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                                3
Material:                   Inventory Unit:                     Status:         3
                                                                                3
                                                                                3
                                                                                3
Department:                  Storage Area:            Since Date:               3
                                                                                3
                                                                                3
                                                                                3
Remaining Qty:               Available Qty:                                     3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY

     Char Mode: Replace  Page 1                          Count: *0
```

A34: RETURN MATERIALS TO WAREHOUSE

Look up the issue records for the returned materials and the materials that have been used.

Change the status of these issues to A(archived).

Adjust the remaining quantities on the material units to account for the material actually consumed.

```
DDDDDDDDDDDDDDDDDDDDA411: PREPARE CUTTING ROOM SCHEDULEDDDDDDDDDDDDDDDDDDDDDD?
                                                                                3
 Prod Order No:                Production Period:          Qty:                3
                                                                                3
 Style:                Fabric:                Status:   Ready by:               3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDMATERIAL RECEIPTSDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                                                3
 PO No:                Item:      Material:                  Qty:               3
                                                                                3
 Due:                Exp Delivery:           Received:           Status:        3
DDDDDDDDDDDDDDDDDDDDDDDDDDDWORKCENTER SCHEDULEDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
                                                          Total    Assigned     3
 Wcntr:      Period:            Prod Type:    Capacity:                        3
                                                                                3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD4
 WCntr Period    PT Item Prod. Order  Hours    Begin Date          Status     3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
                                                                                3
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY

      Char Mode: Replace  Page 1                        Count: *0
```

A411: PREPARE CUTTING ROOM SCHEDULE

Retrieve production orders to be scheduled.

Look up the availability information for the fabric in the second block.

Look up workcenter capability and capacity information in the third block.

After selecting a suitable workcenter, schedule the order for a processing step in the bottom block.

```
ÚÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄA421: PREPARE SEWING PLANT SCHEDULEÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ¿
³                                                                          3
³  Prod Order No:              Production Period:          Qty:            3
³                                                                          3
³  Style:                Fabric:              Status:   Ready by:         3
ÃÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄMATERIAL RECEIPTSÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ´4
³                                                                          3
³  PO No:              Item:      Material:                 Qty:            3
³                                                                          3
³  Due:              Exp Delivery:          Received:          Status:      3
ÃÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄWORKCENTER SCHEDULEÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ´4
³                                                    Total    Assigned     3
³  Wcntr:      Period:           Prod Type:    Capacity:                    3
³                                                                          3
ÃÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ´4
³  WCntr Period    PT Item Prod. Order  Hours    Begin Date          Status   3
³                                                                          3
³                                                                          3
³                                                                          3
³                                                                          3
³                                                                          3
³                                                                          3
ÀÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÙ

       Char Mode: Replace  Page 1                          Count: *0
```

A421: PREPARE SEWING PLANT SCHEDULE

Retrieve production orders to be scheduled.

Look up workcenter capability and capacity information in the third block.

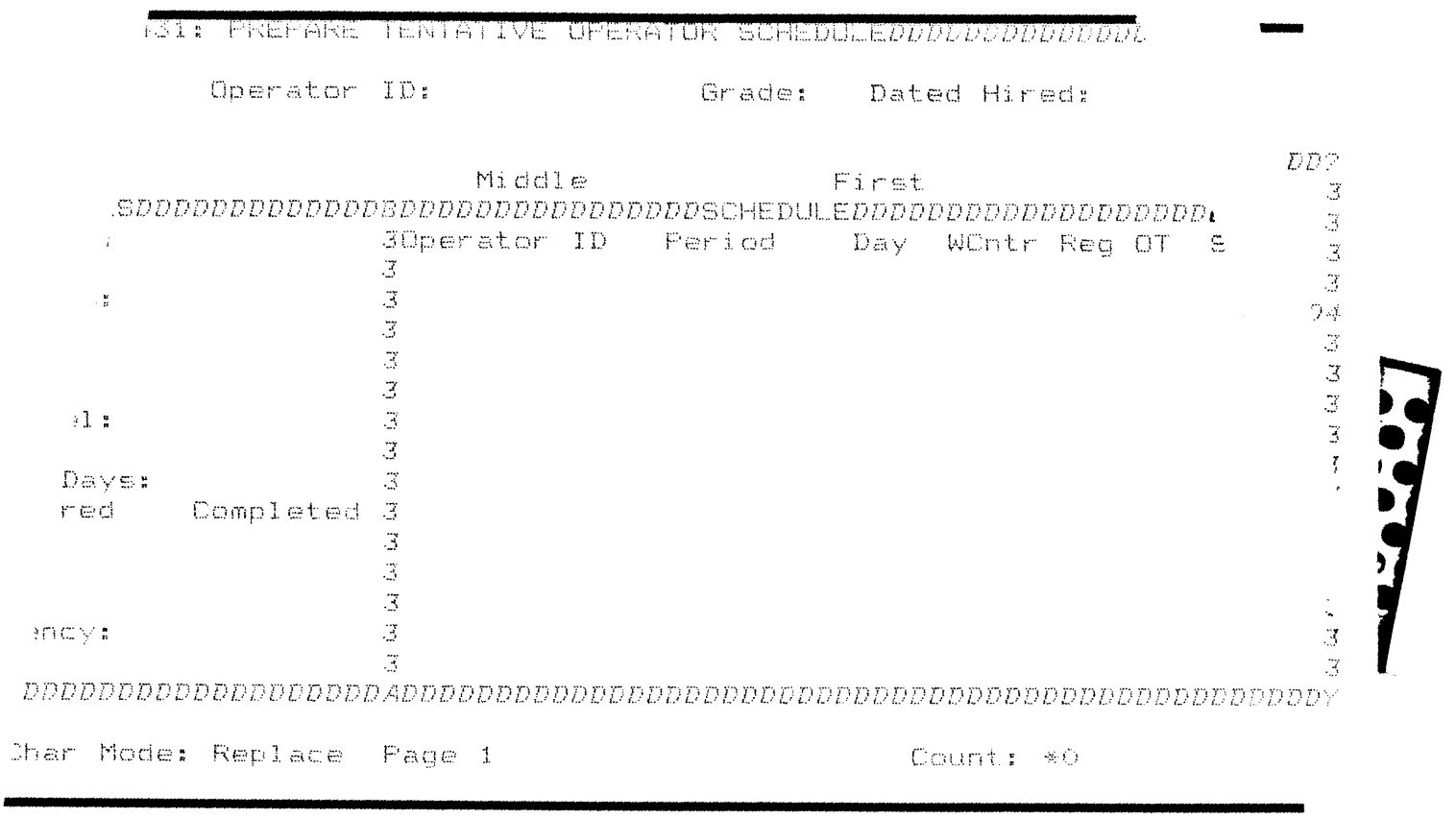
After selecting a suitable workcenter, schedule the order for a processing step in the bottom block.

```
DDDDDDDDDDDDA431: PREPARE TENTATIVE OPERATOR SCHEDULEDDDDDDDDDDDDDDDDDDDDDD?
                                                                          3
ept. Code:       Operator ID:                Grade:    Dated Hired:       3
                                                                          3
ame:                                                                      3
     Last                          Middle                 First           3
DDDDDDSKILLSDDDDDDDDDDDDDBDDDDDDDDDDDDDDDDSCHEDULEDDDDDDDDDDDDDDDDDDDDDD4
perator ID:                  3Operator ID   Period    Day  WCntr Reg OT  Shift 3
                             3                                            3
  Skill No:                  3                                            3
                             3                                            3
peration:                    3                                            3
                             3                                            3
kill Level:                  3                                            3
                             3                                            3
raining Days:                3                                            3
   Required    Completed     3                                            3
                             3                                            3
                             3                                            3
                             3                                            3
roficiency:                  3                                            3
                             3                                            3
DDDDDDDDDDDDDDDDDDDDDDDDDDDADDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDY
     Char Mode: Replace  Page 1                          Count: *0
```

A431: PREPARE TENTATIVE OPERATOR SCHEDULE

Look up operator and skill information in the top and bottom left blocks respectively.

Enter the work schedule for each operator in the bottom right block.



A431: PREPARE TENTATIVE OPERATOR SCHEDULE

Look up operator and skill information in the top and bottom left blocks respectively.

Enter the work schedule for each operator in the bottom right block.

CONFIDENTIAL

FOR DLA USE ONLY

PLEASE DO NOT DISTRIBUTE

UTILIZATION OF APPAREL MANUFACTURING ARCHITECTURE

Volume III: Terry Manufacturing: Case Study in Shared Production

Research Sponsored by:

U.S. Defense Logistics Agency
DLA-AQPOT
Cameron Station
Alexandria, Virginia 22304-6100

DLA Contract #: DLA900-87-D-0018/0015

Reported by:

Dr. Sundaresan Jayaraman
Principal Investigator

Georgia Tech Project #: E-27-618

Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, Georgia 30332

Tel: 404/894-2490
Fax: 404/894-8780

December 1993

SJ-TR-ARCH-9312

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	12/15/93	Final; 2/08/91 - 12/21/93

4. TITLE AND SUBTITLE
Utilization of Apparel Manufacturing Architecture Volume III: Terry Manufacturing: Case Study in Shared Production

5. FUNDING NUMBERS
C

6. AUTHOR(S)
Jayaraman, Sundaresan; Srinivasan, K.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, GA 30332-0295

8. PERFORMING ORGANIZATION REPORT NUMBER
SJ-TR-ARCH-9312

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Defense Logistics Agency
DLA-AQPOT
Cameron Station
Alexandria, VA 22304-6100

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
LIMITED DISTRIBUTION

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Research has been carried out to demonstrate the role and importance of the Apparel Manufacturing Architecture (AMA) to the apparel industry through practical applications of AMA to specific tasks in two apparel plants -- Dowling Textiles and Terry Manufacturing. Working with Dowling personnel, an information system for integrated planning and purchasing was designed, developed and implemented at Dowling. Likewise, an information system for *shared production* was developed at Terry Manufacturing so that it would be capable of increasing its production (in response to DoD's surge requirements) by anywhere between 20 and 60%. Both the developed systems have been tested by plant personnel. The other objective of the effort, viz., transfer the developed technology and modeling know-how to the real-world has also been accomplished.

14. SUBJECT TERMS	15. NUMBER OF PAGES
CIM; Apparel Architecture; Information Systems; Plant Demonstration	71
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

CONFIDENTIAL

FOR DLA USE ONLY

PLEASE DO NOT DISTRIBUTE

UTILIZATION OF APPAREL MANUFACTURING ARCHITECTURE

Volume III: Terry Manufacturing: Case Study in Shared Production

Research Sponsored by:

U.S. Defense Logistics Agency
DLA-AQPOT
Cameron Station
Alexandria, Virginia 22304-6100

DLA Contract #: DLA900-87-D-0018/0015

Reported by:

Dr. Sundaresan Jayaraman
Principal Investigator

Georgia Tech Project #: E-27-618

Georgia Institute of Technology
School of Textile & Fiber Engineering
Atlanta, Georgia 30332

Tel: 404/894-2490
Fax: 404/894-8780

December 1993

SJ-TR-ARCH-9312

Research Project Personnel

Harinarayanan Balakrishnan
K. Srinivasan
Graduate Research Assistants

Dr. Sundaresan Jayaraman
Principal Investigator

ACKNOWLEDGMENTS

This research project was funded by the US Defense Logistics Agency (DLA) under contract number DLA-900-87-0018/0015. The authors would like to thank Mr. Donald F. O'Brien, Ms. Julie Tsao and Ms. Helen Kerlin of DLA for making this research endeavor possible.

Mr. Daniel Wright of Dowling Textiles deserves since appreciation and thanks for championing this project at Dowling. Ms. Ali Barr and Mr. Andrew Boyd from Dowling Textiles deserve thanks for their participation in the project.

Mr. Roy Terry of Terry Manufacturing championed and actively participated in the Terry project and deserves sincere thanks. Ms. Ruth Bedford, Mr. Sidney Johnson, Ms. Cheryl Pate and Mr. Rudolph Terry from Terry Manufacturing also deserve thanks for their time and input during the course of the project.

Finally, Mr. John Adams and Ms. Neysa Brown of AMTC provided the necessary administrative support during the project and their efforts are thankfully acknowledged.

* * *

Do Not Duplicate

This report contains proprietary information obtained from a company during the course of this research. Please do not duplicate or distribute any part of this report without the approval of:

Mr. Donald F. O'Brien
Chief, Technical Enterprise Team
US Defense Logistics Agency DLA-AQPOT
Cameron Station
Alexandria, Virginia 22304-6100

Tel: 703/274-6445
Fax: 703/274-9461

Table of Contents

Volume III

Executive Summary

1. The *As Is* Function Model

2. The *To Be* Function Model

3. The *To Be* Information Model

4. User Manual for Information System

Other Volumes

Volume I

		Page
1.	INTRODUCTION	1
1.1	Apparel Manufacturing Architecture	1
1.2	Research Objectives	2
2.	RESEARCH METHODOLOGY	2
2.1	Research Procedure	3
2.2	Dissemination of Research Results	5
3.	DOWLING TEXTILES: CASE STUDY IN PLANNING AND PURCHASING	6
4.	TERRY MANUFACTURING: CASE STUDY IN SHARED PRODUCTION	7
5.	CONCLUSIONS AND LESSONS LEARNED	8
References		13

Appendix I
Literature for Selection of Industry Partners

Appendix II
Paper Presented at the 20th International Apparel Research Conference

Volume II

Dowling Textiles: Case Study in Integrated Planning and Purchasing
[*Contains Proprietary Information*]

Executive Summary

To stay competitive in the global market, the textile-apparel industrial complex must evaluate and deploy state-of-the-art manufacturing and information technologies. The vitality of this complex is also critical to the US Department of Defense (DoD) which relies on this industrial base to clothe its personnel and maintain a state of readiness. To enable the apparel industry to become competitive by adopting advanced techniques and tools, the US Defense Logistics Agency sponsored the development of an apparel manufacturing architecture (AMA) at Georgia Tech. AMA is a comprehensive set of specifications for implementing computer-integrated manufacturing in an apparel enterprise.

The primary objective of this research is to demonstrate the role and importance of AMA to the apparel industry through practical applications of AMA to specific tasks in apparel plants. Other objectives of the effort are to transfer the developed technology and modeling know-how to the real-world and to serve as a catalyst for similar modeling and process reengineering efforts in the industry.

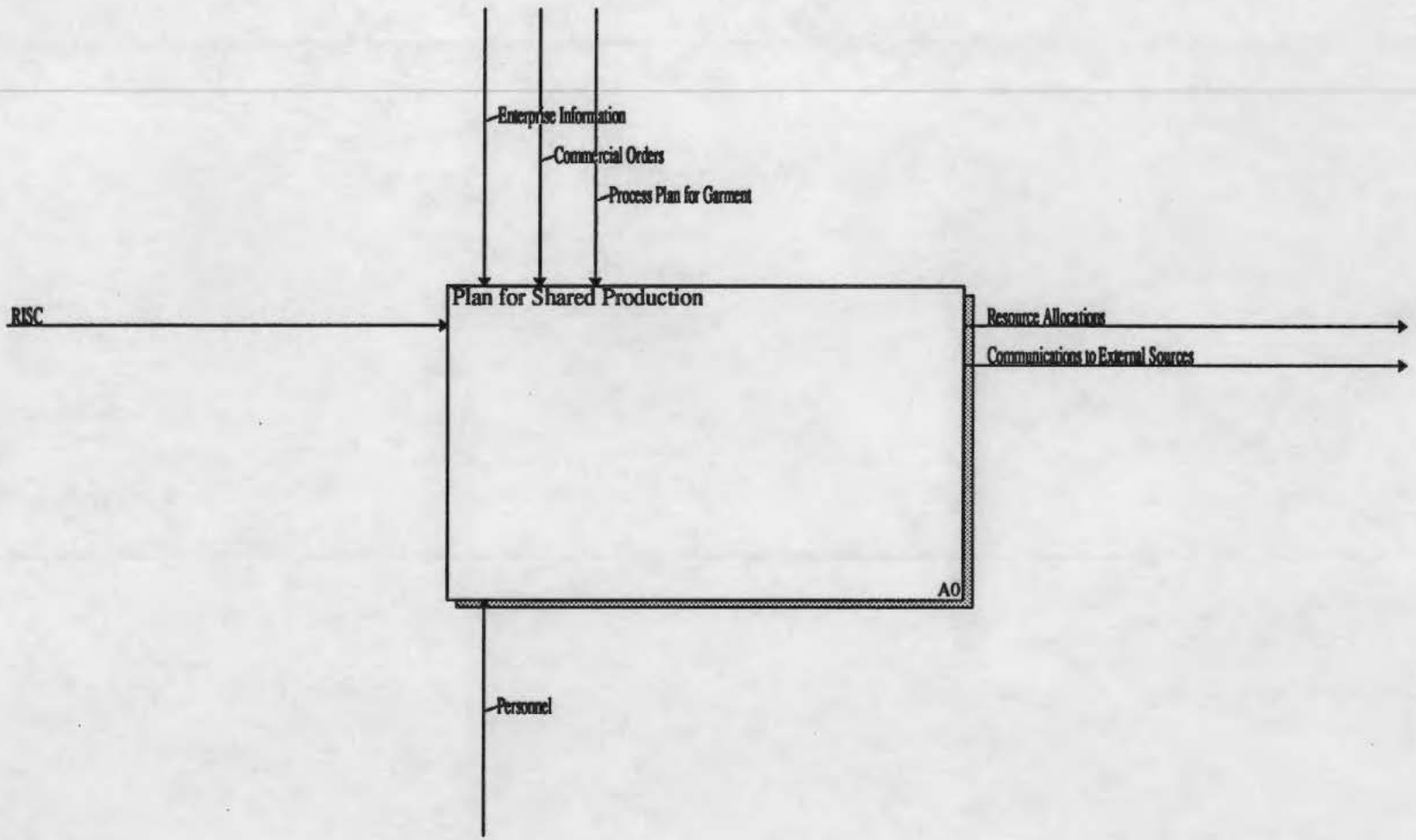
Based on a set of defined evaluation criteria, Dowling Textiles in McDonough, Georgia, and Terry Manufacturing in Roanoke, Alabama, were selected as industry partners on the research effort. A research methodology was developed and used for carrying out the project. Working with Dowling personnel, an information system for integrated planning and purchasing was designed, developed and implemented at Dowling. The underlying objective was to reduce the lead time in delivering garments and to make the purchasing activity less dependent on forecasting. Likewise, an information system for shared production was developed at Terry Manufacturing. The objective here was to enable Terry Manufacturing to be capable of increasing its production (in response to DoD's surge requirements) by anywhere between 20 and 60%. Both the developed systems have been tested by plant personnel.

The following major lessons were learned from these efforts: AMA enabled the rapid development of the architectures for the two systems by serving as a *reference* architecture; moreover, AMA stands to be enriched by incorporation of the detailed specifications of certain functions from the two enterprise-specific models. Thus, there is a symbiotic relationship between the generic architecture for the domain of apparel manufacturing and the architecture for a specific enterprise. Very few *new* information entities had to be introduced in the enterprise-specific information models. Therefore, once a core set of information entities is carefully specified (as in AMA), the entities can be reused to support many new functions with little modification. Hence, a well-designed information system will be a catalyst for rapid changes in an enterprise as opposed to being one more impediment to them. Finally, the industry partners found the architectural approach and the research methodology to be understandable and easy to use. The research results and lessons learned have been presented at conferences.

* * *

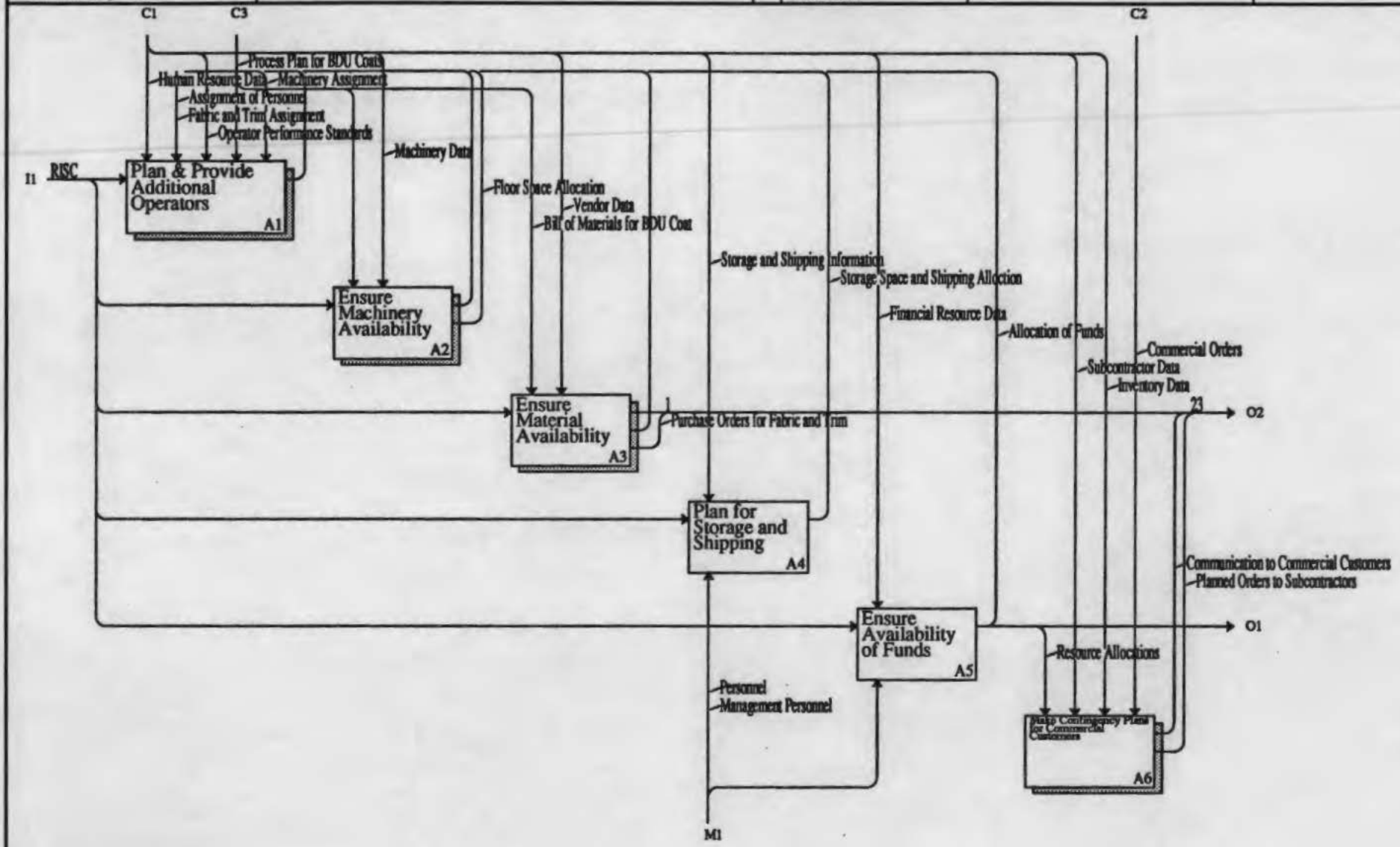
The *As Is* Function Model

Used At:	Author: K. Srinivasan	Date: 12/9/1993		READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_as	Rev:	Working Draft Recommended Publication			
	Notes: 1 2 3 4 5 6 7 8 9 10					



Node:A-0	Title:Plan for Shared Production (Context)	Number:

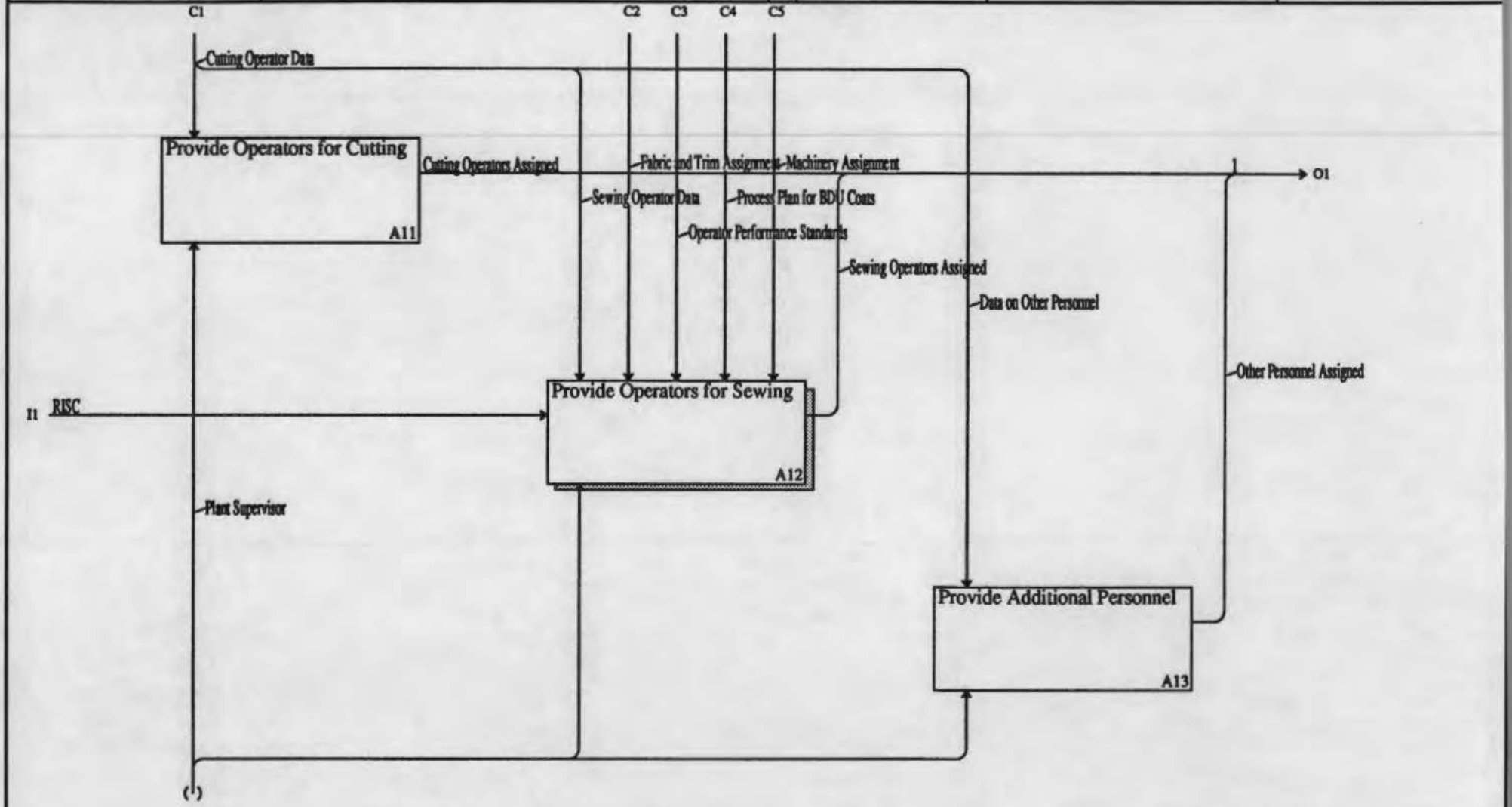
Used At:	Author: K. Srinivasan	Date: 12/9/1993	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_as	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



1. Communications to External Sources
2. Other Communications to Vendors
3. Communications to External Sources

Node:A0	Title:Plan for Shared Production	Number:

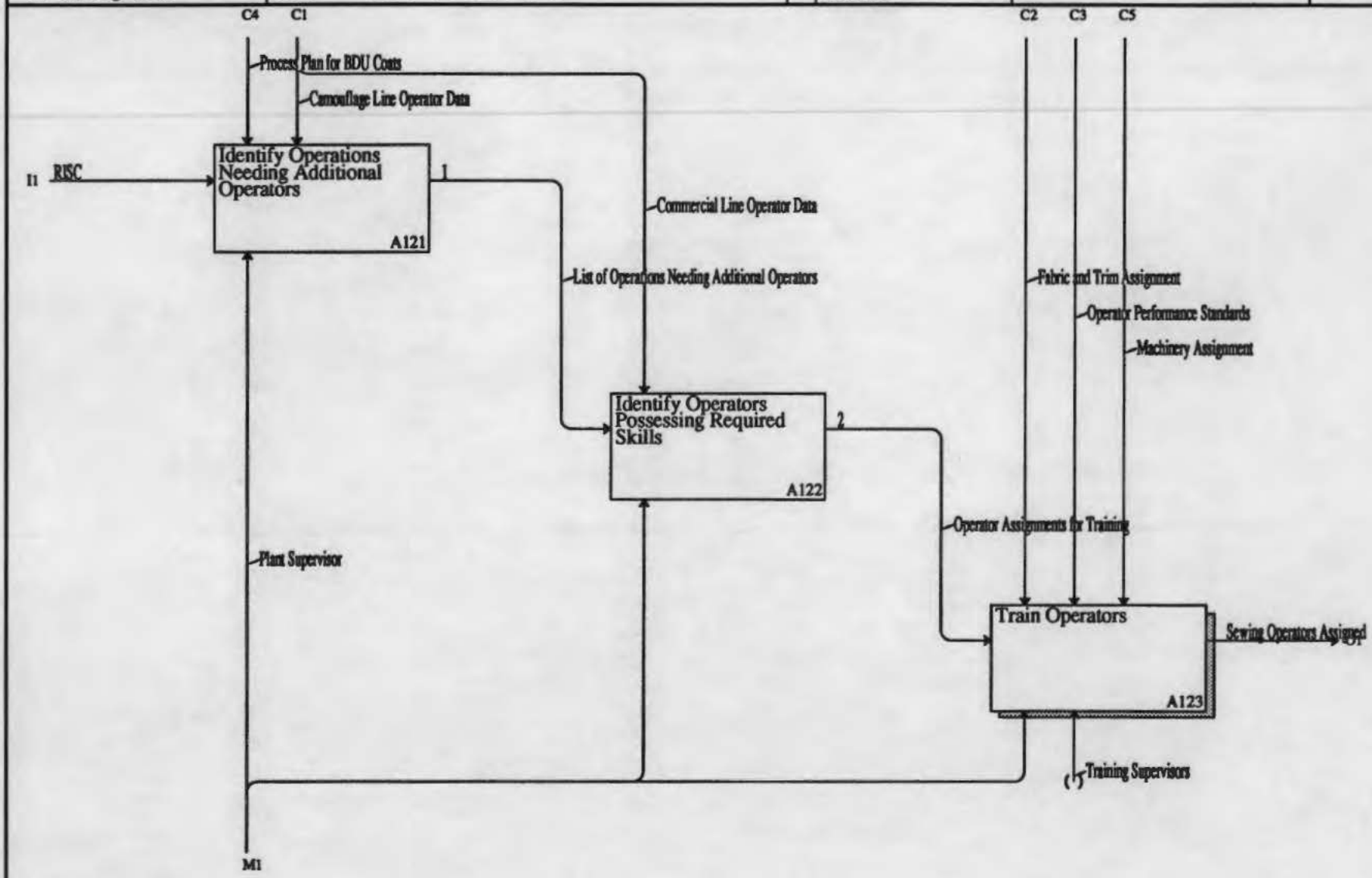
Used At:	Author: K. Srinivasan	Date: 12/9/1993		Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_as	Rev:		Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10			Recommended			
				Publication			



1. Assignment of Personnel

Node:A1	Title:Plan & Provide Additional Operators	Number:

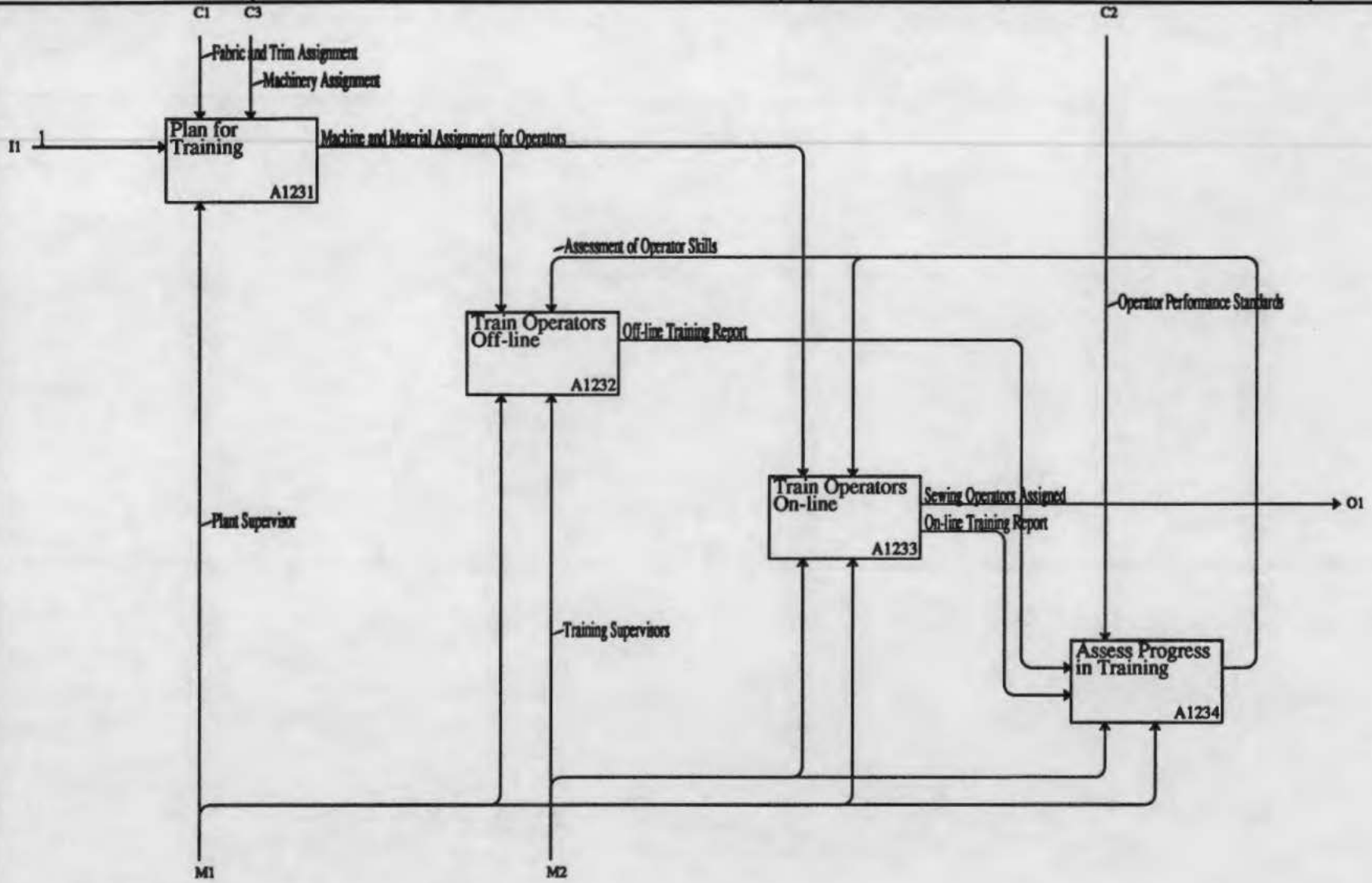
Used At:	Author: K. Srinivasan	Date: 12/9/1993	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_as	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



1. List of Operations Needing Additional Operators
2. Operator Assignments for Training

Node:A12	Title:Provide Operators for Sewing	Number:

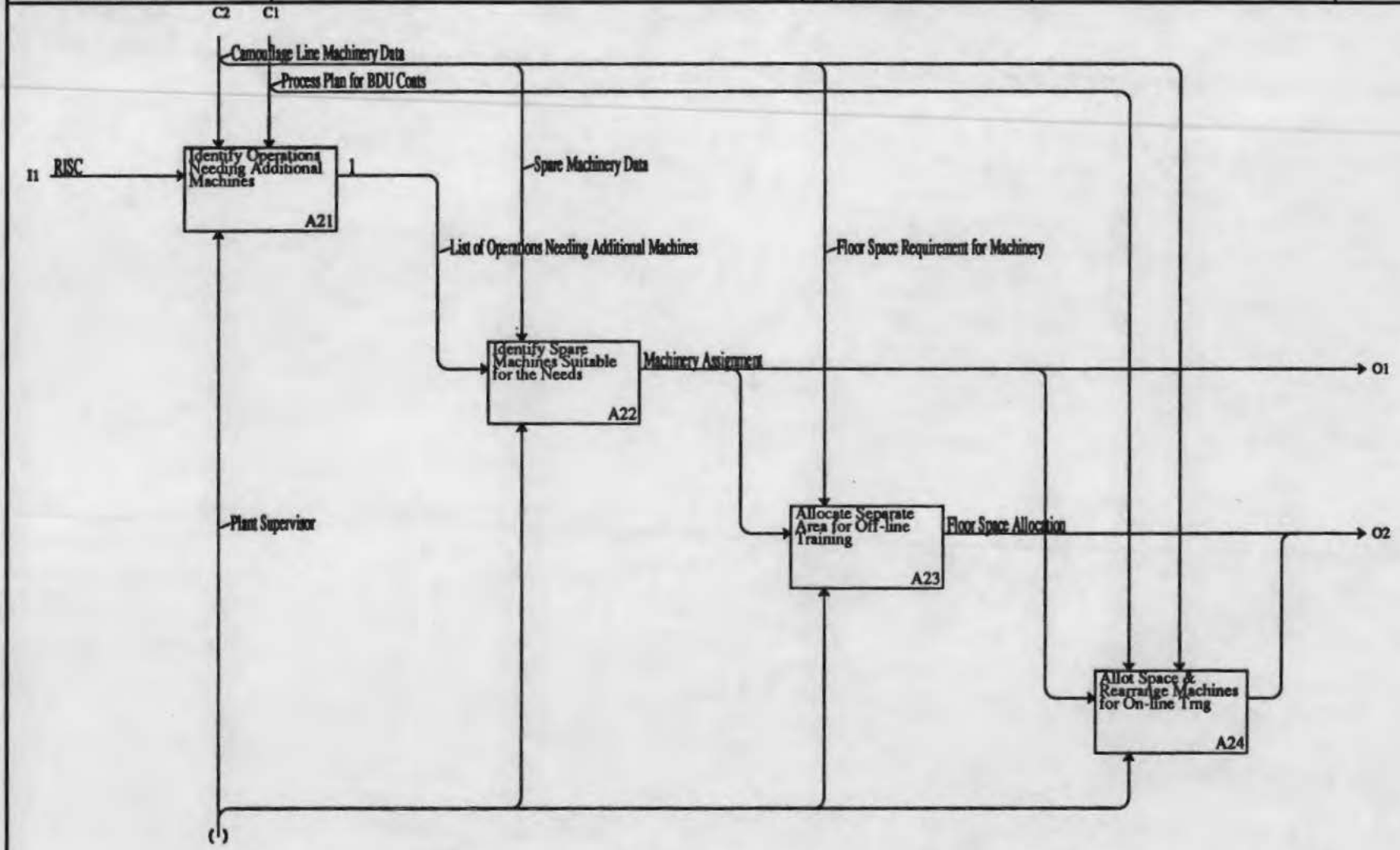
Used At:	Author: K. Srinivasan	Date: 12/9/1993		READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_ss	Rev:	Working Draft Recommended Publication			
	Notes: 1 2 3 4 5 6 7 8 9 10					



1. Operator Assignments for Training

Node:A123	Title:Train Operators	Number:

Used At:	Author: K. Srinivasan	Date: 12/9/1993		Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_as	Rev:		Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10			Recommended			
				Publication			

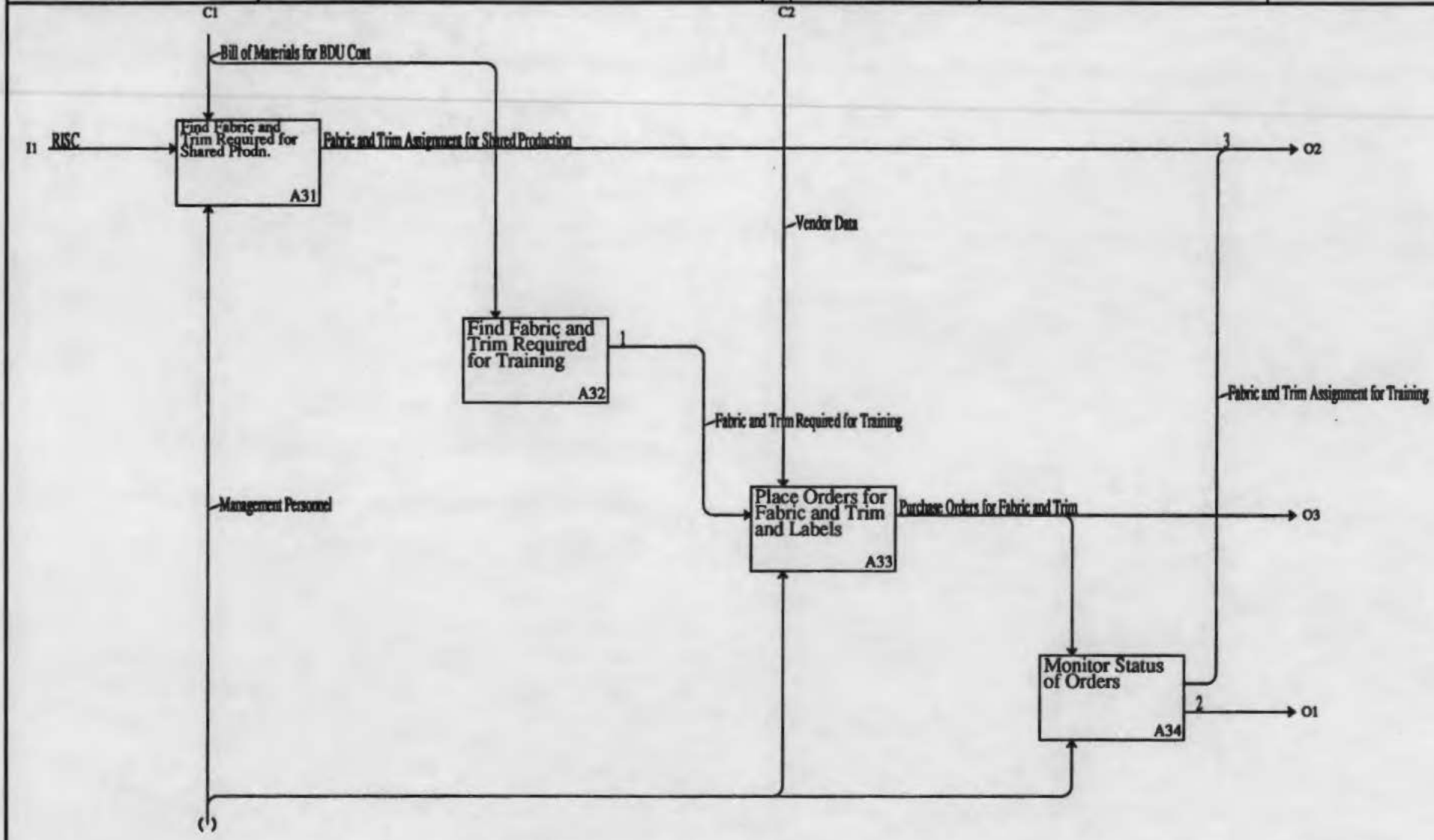


1. List of Operations Needing Additional Machines

Node:A2	Title:Ensure Machinery Availability	Number:

Used At:	Author: K. Srinivasan	Date: 12/9/1993			
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_as	Rev:	Working	READER	DATE
	Notes: 1 2 3 4 5 6 7 8 9 10		Draft		
			Recommended		
			Publication		

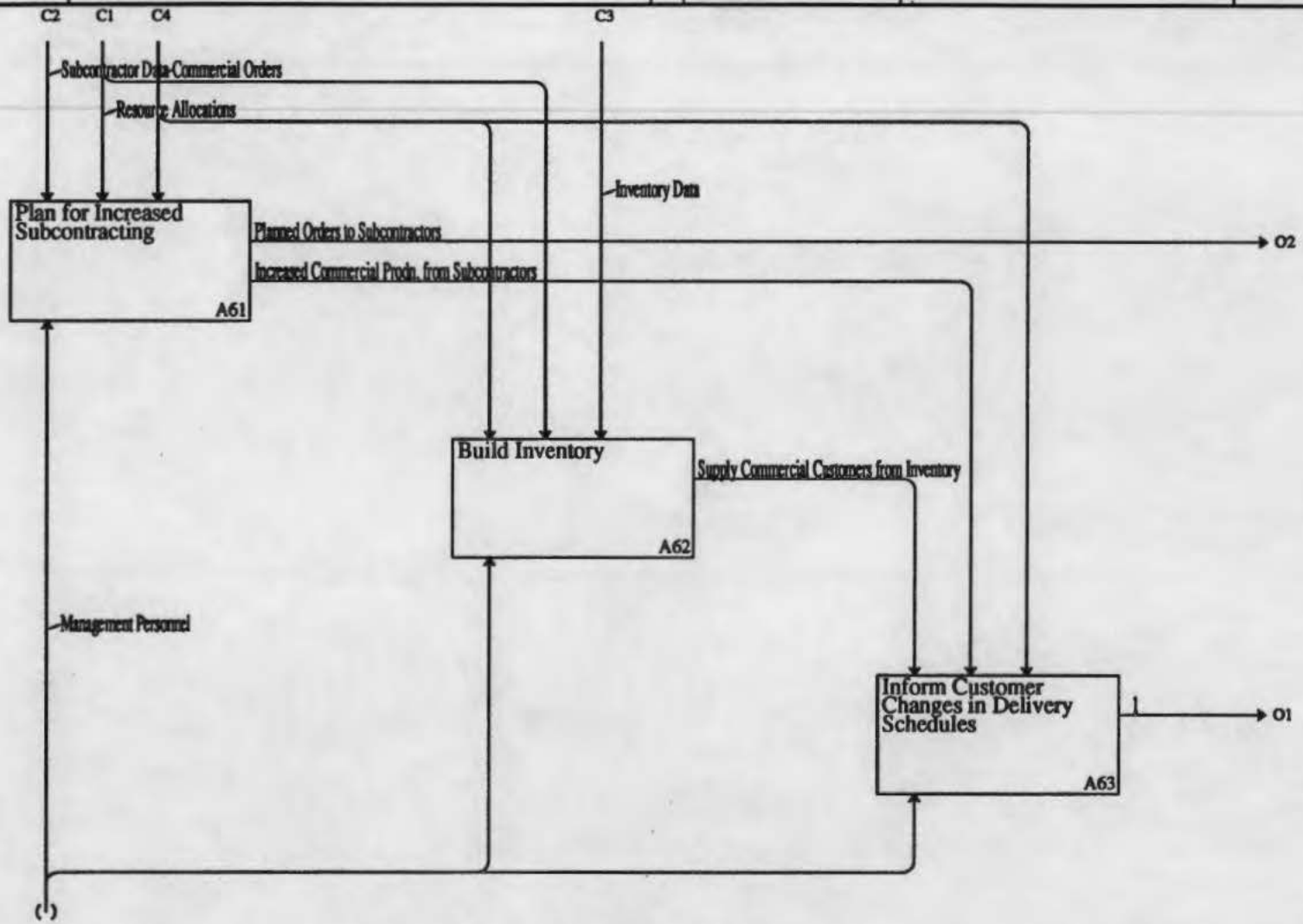
Context



1. Fabric and Trim Required for Training
2. Other Communications to Vendors
3. Fabric and Trim Assignment

Node:A3	Title:Ensure Material Availability	Number:

Used At:	Author: K. Srinivasan	Date: 12/9/1993		Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_as	Rev:		Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10			Recommended			
				Publication			



1. Communication to Commercial Customers

Node:A6	Title:Make Contingency Plans for Commercial Customers	Number:

The *To Be* Function Model

Develop a Plan for Shared Production

Specify the activities to be carried out for increasing shared production capability and the information needed for these functions.

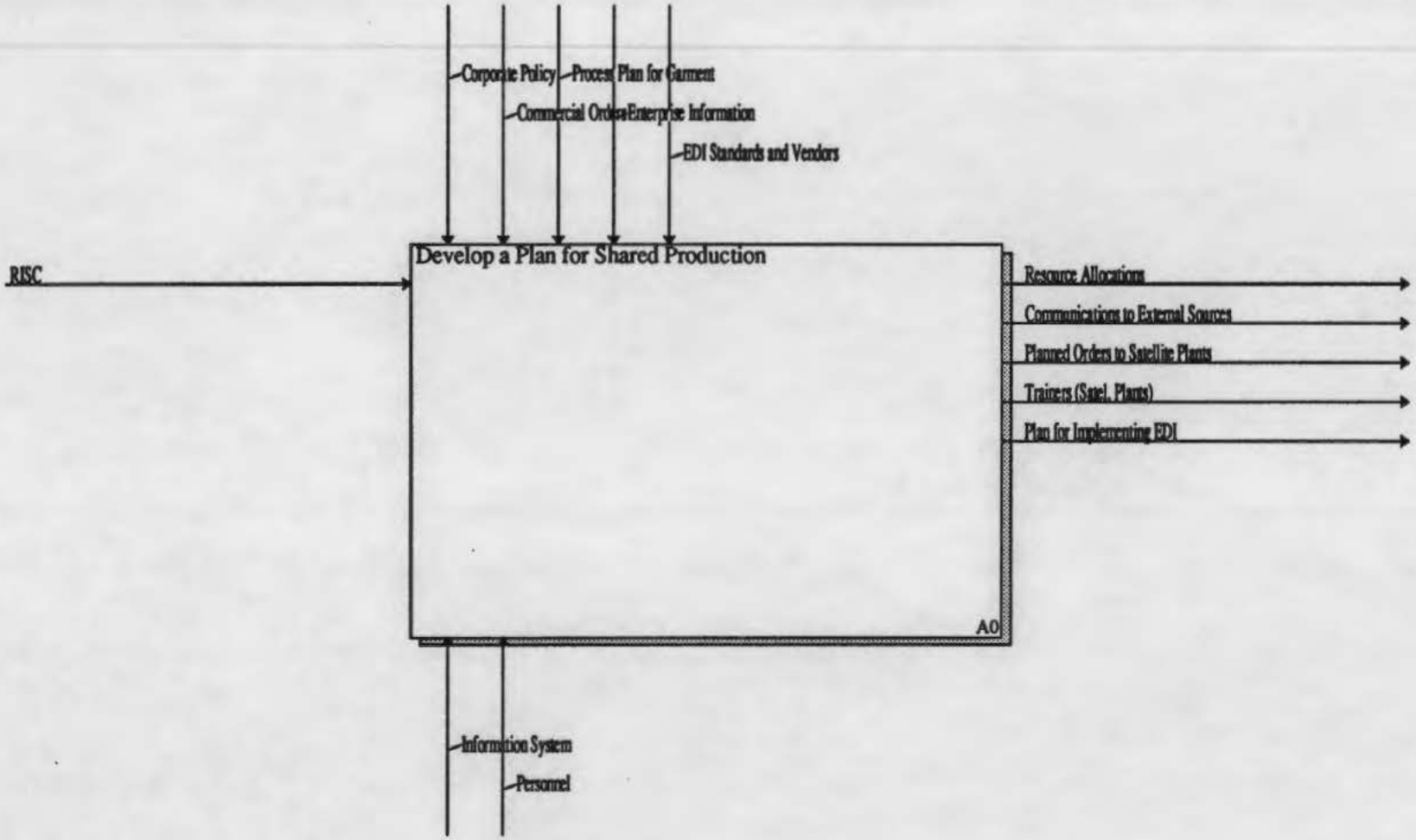
Viewpoint:

Managers and supervisory personnel responsible for shared production planning.

Purpose:

Develop an architecture and associated information system for increasing shared production capability.

Used At:	Author: K. Srinivasan	Date: 12/9/1993			Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Working	READER DATE	
	Notes: 1 2 3 4 5 6 7 8 9 10		Draft		
			Recommended		
			Publication		



Node:A-0	Title:Develop a Plan for Shared Production (Context)	Number:

Identify Potential Satellite Plants

Create a list of garment manufacturers with potential to serve as outside sources for shared production. This is done based on factors such as the plant location, reputation of the manufacturer and any past experience Terry Manufacturing has had with them.

Negotiate with Potential Satellite Plants

Hold discussions with potential satellite plants to inform them about shared production and to determine their willingness and ability to participate in it.

Plan for Shared Production at Satellite Plants

Make detailed plans for getting either entire garments or specific garment sub-assemblies made by individual satellite plants. This includes planning for quality control at satellite plants and training some operators from them to train others in the plant.

Plan for Shared Production at Own Plant

Assess the needs for shared production in terms of resources such as operators, machines and floor space. Make decisions about reallocating them from other product lines or acquiring new resources.

Plan for Integration through EDI

To facilitate rapid redeployment of resources, assess and acquire necessary EDI facilities.

School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Project: Terry_to

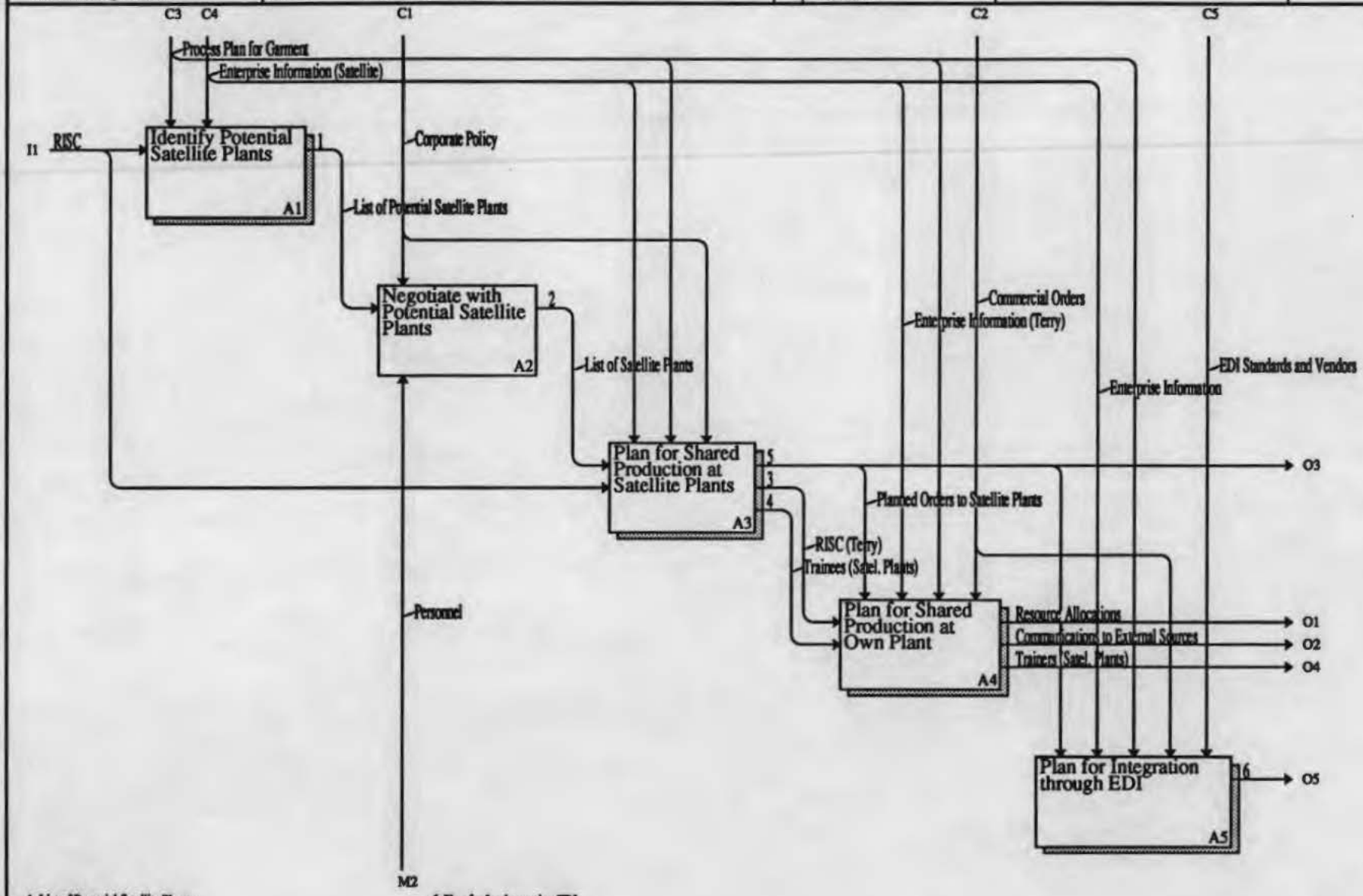
Notes: 1 2 3 4 5 6 7 8 9 10

Date: 12/9/1993

Rev:

	READER	DATE
Working		
Draft		
Recommended		
Publication		

Context



Node:A0	Title:Develop a Plan for Shared Production	Number:

Consider Location

Rank potential satellite plants according to their distance from Terry Manufacturing and accessibility (in terms of factors such as distance from the nearest highway) and select only the plants that are within an acceptable distance and are easily accessible.

Consider Product Range

Examine the product range of the potential satellite plants and rank them according to the extent of similarity with BDU coats.

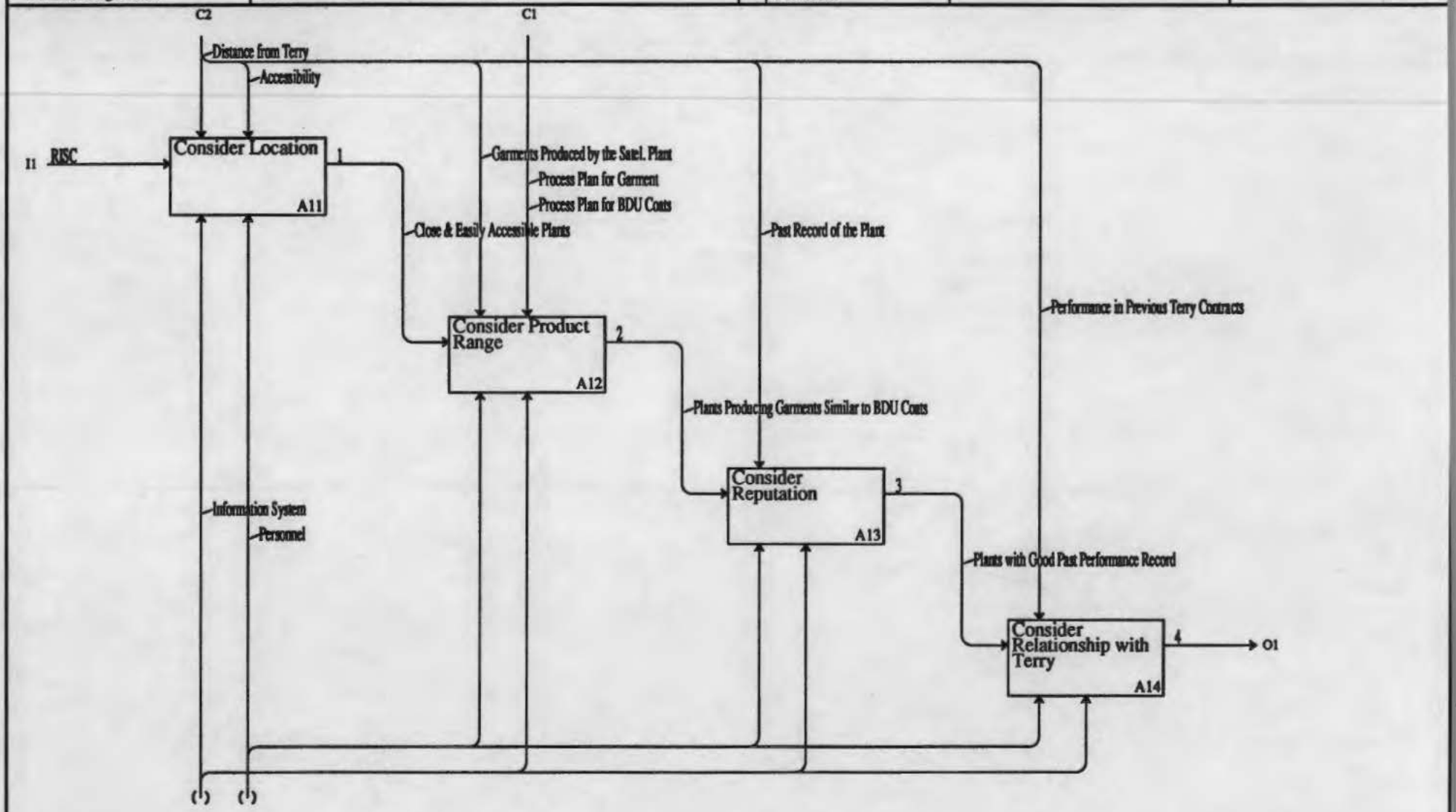
Consider Reputation

Examine available information on the past record of the plant in terms of quality and on-time delivery.

Consider Relationship with Terry

If the plant has been a subcontractor to Terry Manufacturing in the past, consider its performance on those contracts.

Used At:	Author: K. Srinivasan	Date: 12/9/1993			Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Working	READER DATE	
	Notes: 1 2 3 4 5 6 7 8 9 10		Draft		
			Recommended		
			Publication		



1. Close & Easily Accessible Plants
2. Plants Producing Garments Similar to BDU Costs
3. Plants with Good Past Performance Record
4. List of Potential Satellite Plants

Node:A1	Title:Identify Potential Satellite Plants	Number:

Identify Operations for Satellite Plants

Classify operations based on (1) their complexity in both performing them and in training for them; and (2) logical grouping of operations which are easy when performed at a single location. Based on these classifications and data about the resources available with the satellite plants, select operations which can be performed by the satellite plants.

Assign Operations & Order Levels to Satellite Plants

Determine the garment sub-assemblies and quantities to be produced at each satellite plant. This includes generating a detailed delivery schedule.

Plan for Inspection & Retraining at Satellite Plants

Develop a plan to ensure that the garment sub-assemblies are made to military specifications and also that the personnel get adequate retraining to maintain the required skill level.

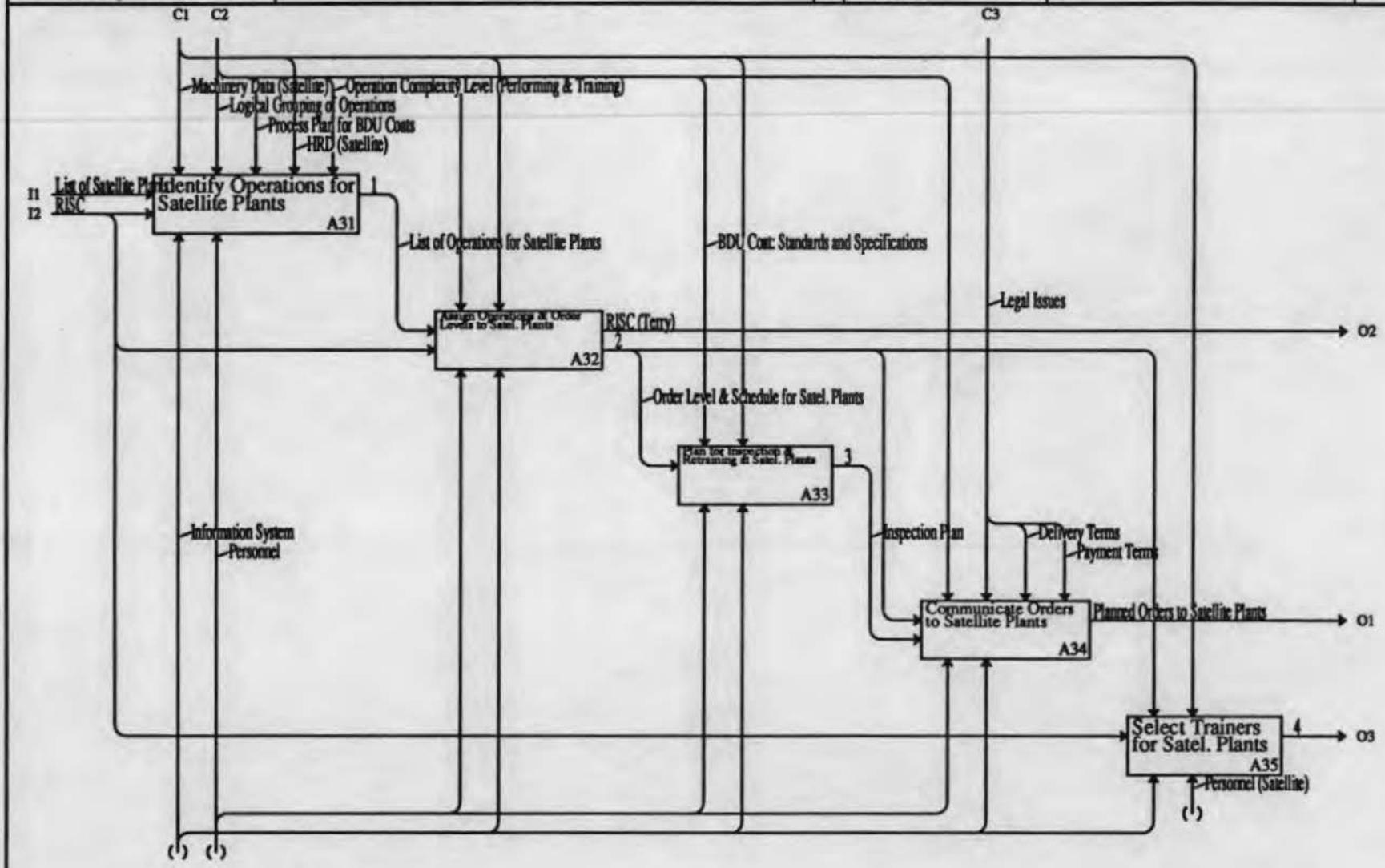
Communicate Orders to Satellite Plants

Inform the satellite plants of the order levels they will have to fulfill when shared production commences.

Select Trainers for Satellite Plants

Request the satellite plants to choose personnel to be trained at Terry Manufacturing. These will in turn train other operators in the satellite plants.

Used At:	Author: K. Srinivasan	Date: 12/9/1993		Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:		Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10			Recommended			
				Publication			



1. List of Operations for Satellite Plants
2. Order Level & Schedule for Satel. Plants
3. Inspection Plan
4. Trainees (Satel. Plants)

Node:A3	Title:Plan for Shared Production at Satellite Plants	Number:

Plan & Provide Additional Operators

Ensure availability of sufficient operators by reassigning operator responsibilities or by hiring new operators. In both the cases, it will be necessary to train the operators.

Ensure Machinery Availability

Use surplus machines, reassign machines from other product lines, work additional shifts or purchase new machines to provide sufficient capacity for shared production.

Ensure Material Availability

Determine raw material requirements for shared production and identify sources. Order raw materials for training and ensure their availability on time.

Plan for Storage and Shipping

Shared production increases the quantity of raw materials, finished garments and in process goods to be handled and necessitates shipping out to and receiving of sub-assemblies from satellite plants. Plan for providing sufficient storage space and shipping.

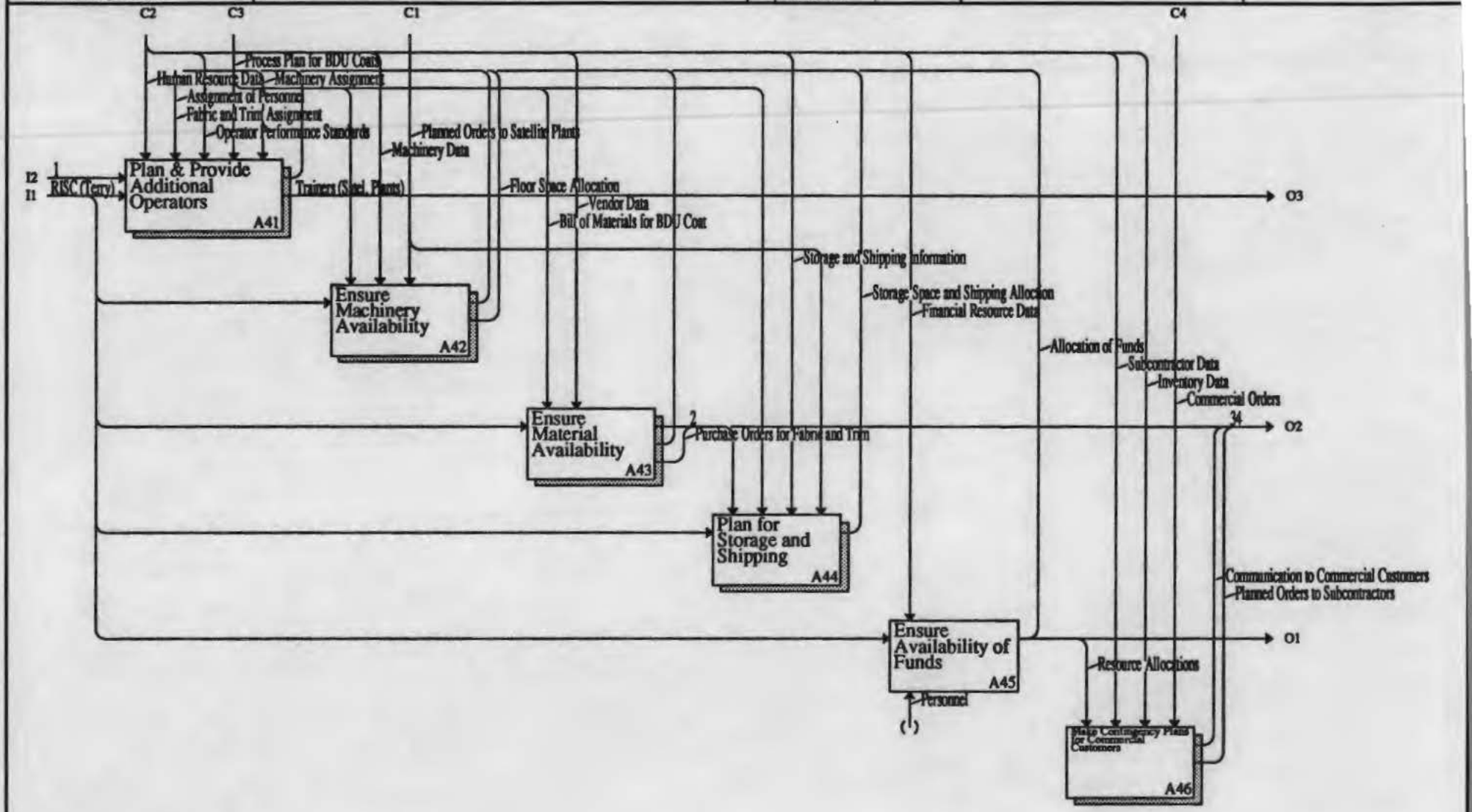
Ensure Availability of Funds

Provide for the investment required for additional machinery, human resources, material requirement, etc.

Make Contingency Plans for Commercial Customers

Minimize the impact on commercial customers by trying to maintain the supply level to them through means such as outside sourcing, and carrying inventory. If some commercial orders cannot be met, inform the customer in advance.

Used At:	Author: K. Srinivasan	Date: 12/9/1993	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



1. Trainees (Satel. Plants)
2. Other Communications to Vendors
3. Other Communications to Vendors
4. Communications to External Sources

Node:A4	Title:Plan for Shared Production at Own Plant	Number:

Provide Operators for Cutting

To cut sufficient fabrics for shared production, operate additional shifts in cutting. To meet the manpower requirement, reassign other personnel to cutting or hire new cutting operators. In either case, the new operators have to be trained.

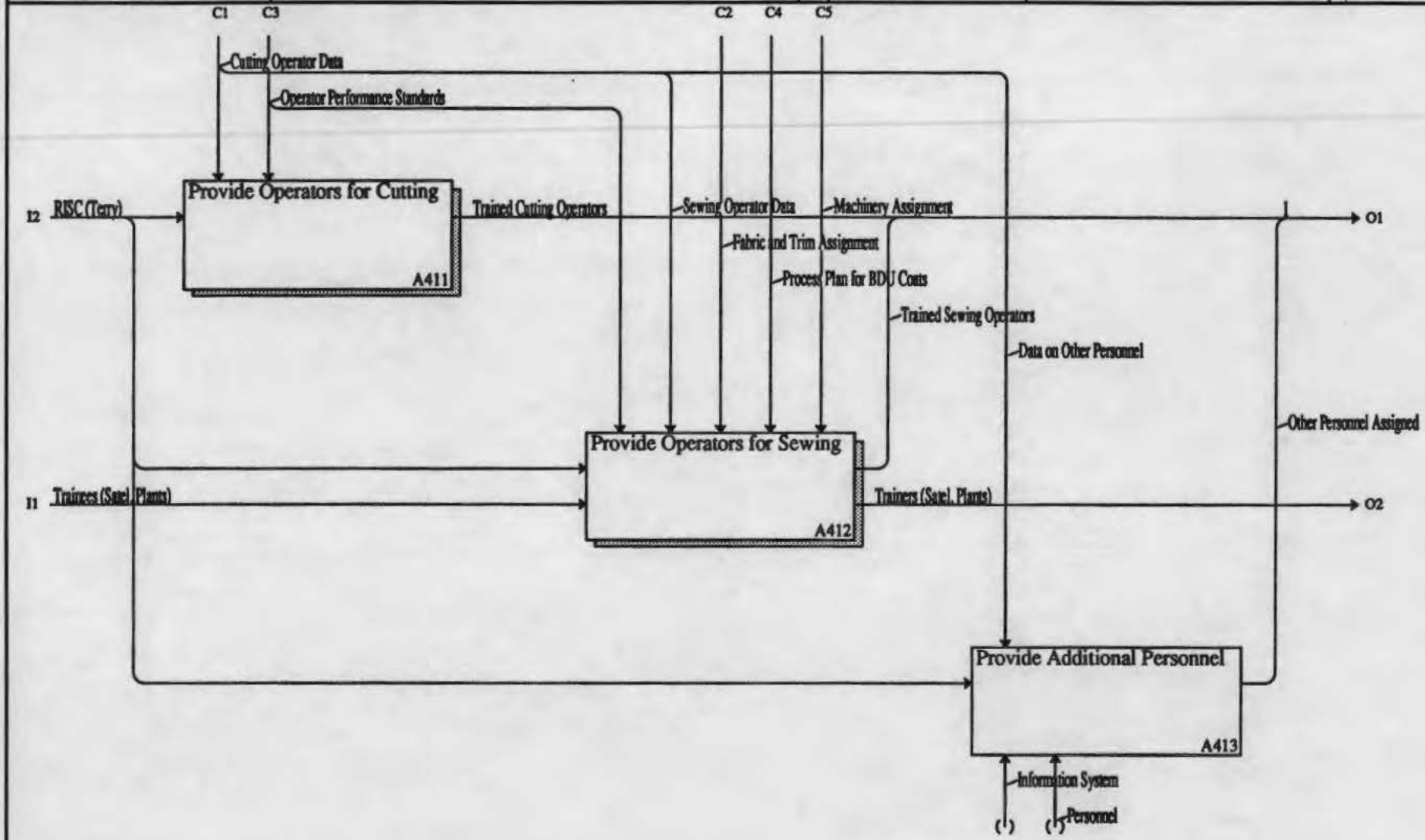
Provide Operators for Sewing

Identify operators currently performing operations similar in skill requirements to the BDU coat manufacturing operations and/or hire new operators, and train them.

Provide Additional Personnel

Ensure sufficient personnel in departments other than cutting and sewing, such as packing and warehouse.

Used At:	Author: K. Srinivasan	Date: 12/9/1993	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



1. Assignment of Personnel

Node:A41	Title:Plan & Provide Additional Operators	Number:

Operate Additional Shifts

To cut sufficient fabrics for shared production, operate the cutting machine for more than one shift per day.

Identify Personnel for Training in Cutting

Identify personnel currently performing other jobs who can be trained to be cutting operators.

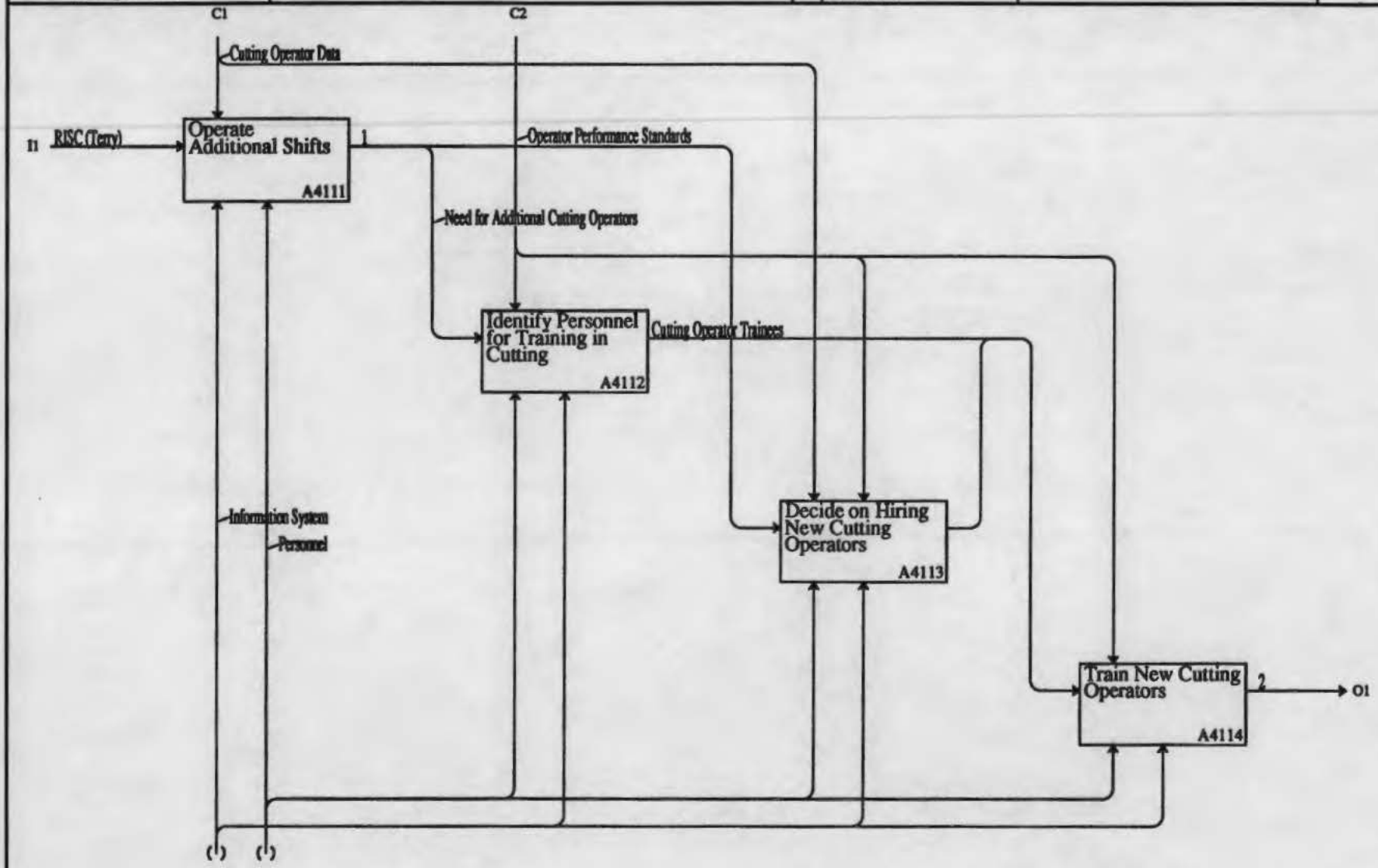
Decide on Hiring New Cutting Operators

Hire new cutting operators to meet the shared production requirements.

Train New Cutting Operators

Train both the reassigned and newly hired cutting operators. If a decision is made to acquire NC cutters, all operators will need to be trained.

Used At:	Author: K. Srinivasan	Date: 12/9/1993		Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:		Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10			Recommended			
				Publication			



1. Need for Additional Cutting Operators
2. Trained Cutting Operators

Node:A411	Title:Provide Operators for Cutting	Number:

Identify Operations Needing Additional Operators

Based on the order for shared production and the currently available human resources, identify operations that need more operators.

Identify Operators Possessing Required Skills

Select operators currently working on other product lines, but performing jobs requiring skills similar to those required by BDU coat manufacturing operations.

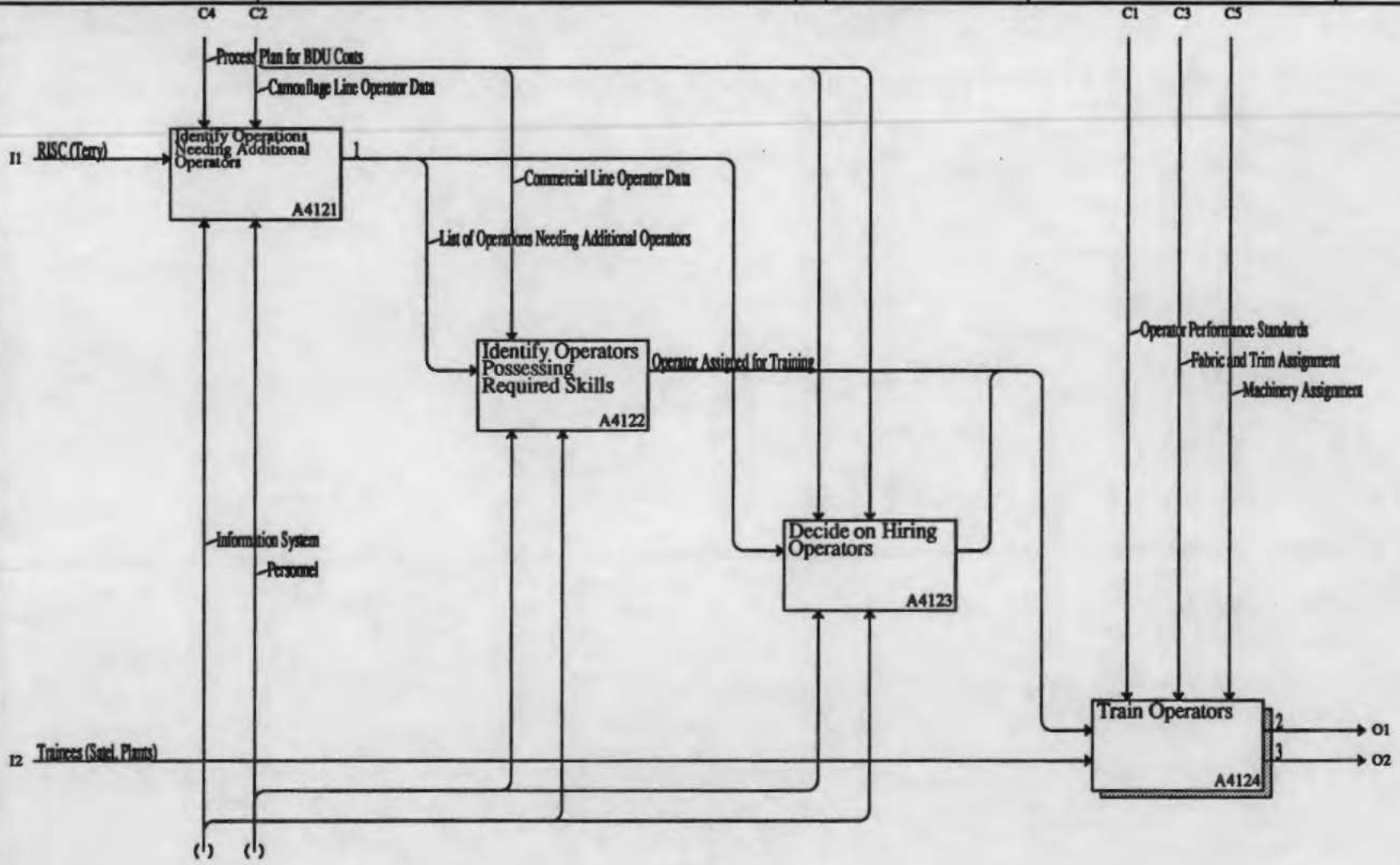
Decide on Hiring Operators

If reassigning operators does not fulfill the operator requirement for an operation, determine how many new operators will have to be hired.

Train Operators

Provide required training for both reassigned and newly hired operators.

Used At:	Author: K. Srinivasan	Date: 12/9/1993	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



1. List of Operations Needing Additional Operators
2. Trained Sewing Operators
3. Trainers (Satel. Plants)

Node:A412	Title:Provide Operators for Sewing	Number:

Plan for Training

Ensure availability of machines and fabric required for training. Assign resources to each trainee.

Train Operators Off-line

Train operators until they attain the minimum skill level for the operation.

Train Operators On-line

Integrate trainees into the production line to work along with regular operators. Continue this till the trainees acquire defined skill levels.

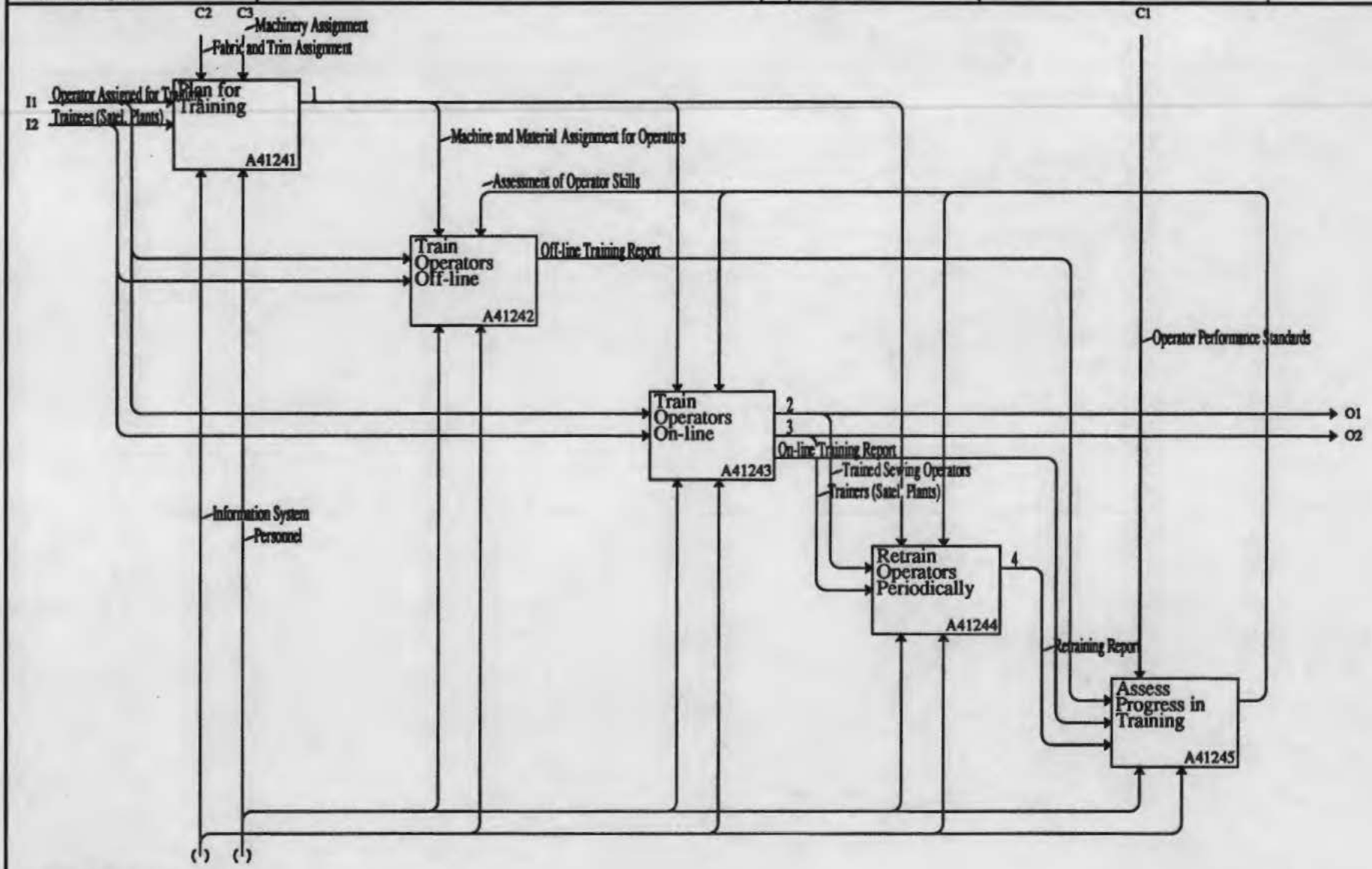
Retrain Operators Periodically

To ensure that the trained operators retain their skill levels, take them off their regular job and retrain them periodically.

Assess Progress in Training

Monitor both on-line and off-line trainees to make sure they make sufficient progress.

Used At:	Author: K. Srinivasan	Date: 12/9/1993		READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Working Draft Recommended Publication			
	Notes: 1 2 3 4 5 6 7 8 9 10					



1. Machine and Material Assignment for Operators
2. Trained Sewing Operators
3. Trainers (Satel. Plants)
4. Retraining Report

Node:A4124	Title:Train Operators	Number:

Identify Operations Needing Additional Machines

Based on the order for shared production and the currently available machinery, identify operations that need more machines.

Identify Spare Machines Suitable for the Needs

Identify machines that are capable of performing operations similar to BDU coat manufacturing operations; currently these machines may either be assigned to other product lines or may be spare.

Decide on Machines to be Purchased

Find out machines that need to be purchased to fulfill shared production requirements. One important decision to be made is if an NC cutter is to be purchased.

Allow Separate Area for Off-line Training

Design the layout for off-line training. Ease of supervision is the main consideration in doing this.

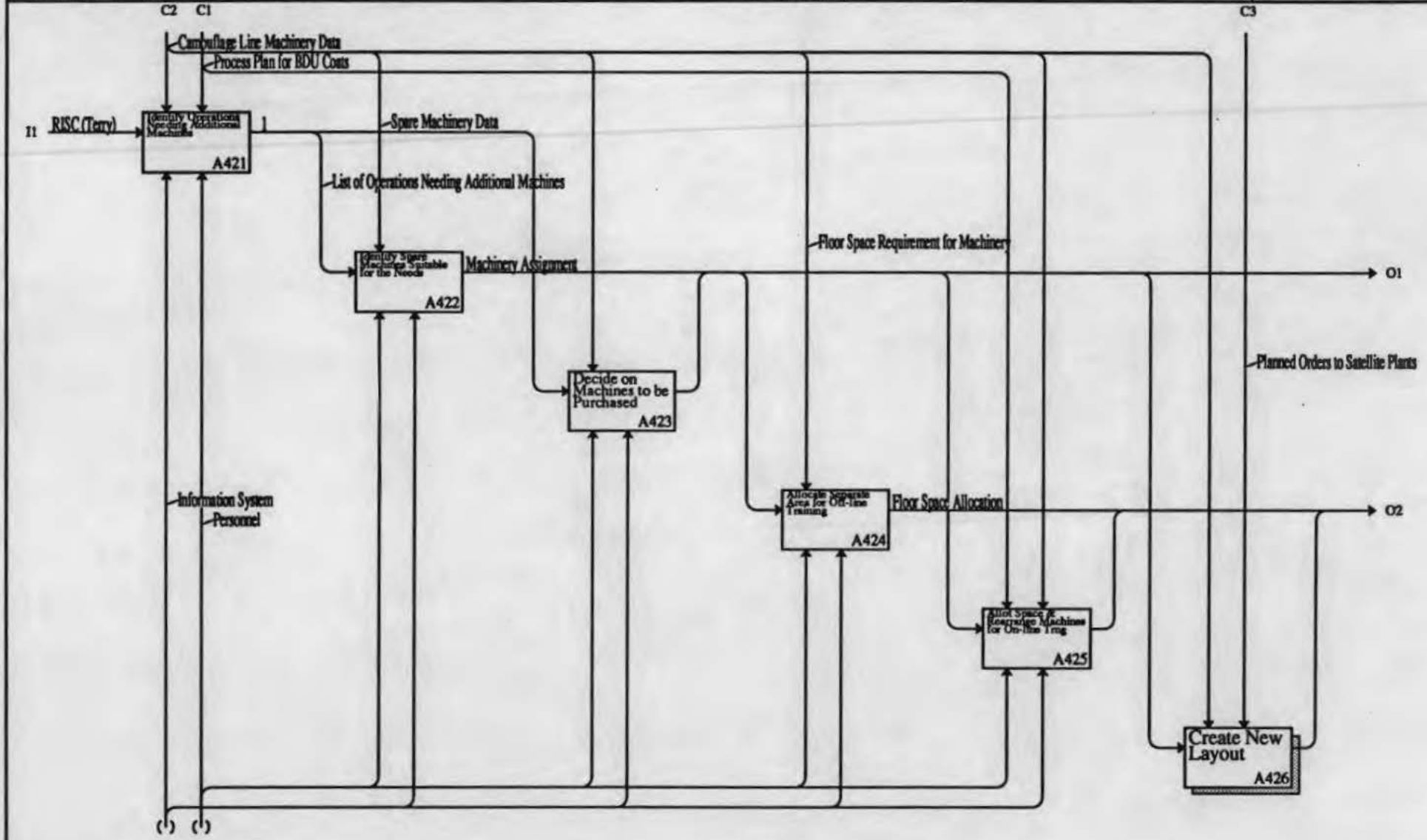
Allot Space & Rearrange Machines for On-line Training

Design the layout for on-line training. Balanced material flow and minimum handling of in-process material are the main considerations here.

Create New Layout

Design a layout for sewing floor for actual shared production.

Used At:	Author: K. Srinivasan	Date: 12/9/1993	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



1. List of Operations Needing Additional Machines

Node:A42	Title:Ensure Machinery Availability	Number:

Add Floor Space

Add sufficient floor space for the new machines to be added.

Reassign Machines to Operations

Taking the availability of additional machines into consideration, work out an optimum assignment of machines to operations.

Provide for Handling Sub-assemblies

Shared production necessitates shipping out to and receiving of sub-assemblies from satellite plants. Plan for routing parts accordingly.

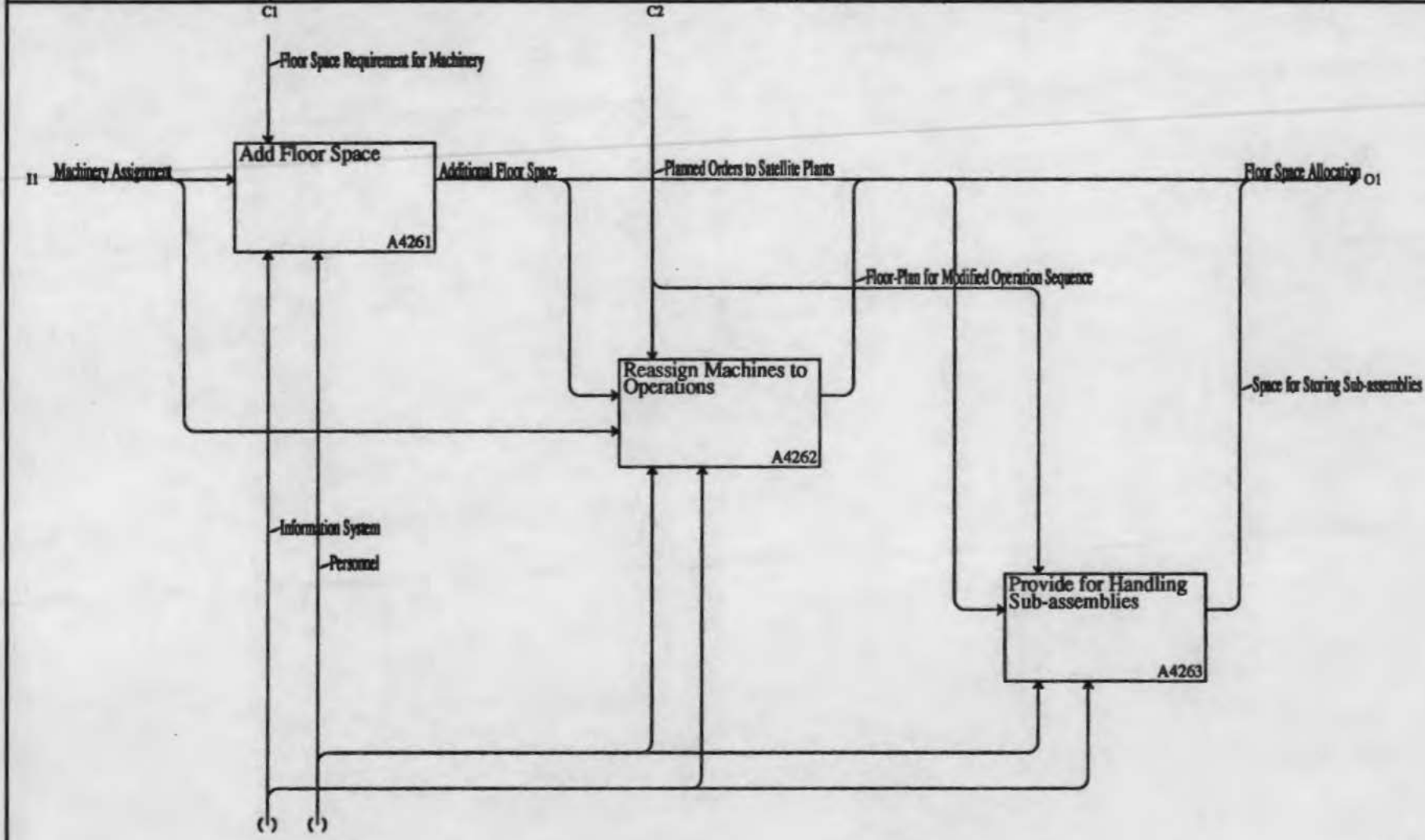
School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Author: K. Srinivasan
Project: Terry_to
Notes: 1 2 3 4 5 6 7 8 9 10

Date: 12/9/1995
Rev:

	Working	READER	DATE
	Draft		
	Recommended		
	Publication		

Context



Node:A426 | Title:Create New Layout | Number:

Estimate Fabric & Trim Requirement for Shared Production

Based on the level of production required for shared production and the bill of materials for BDU coat, estimate the quantity of fabric and trim that will be required.

Estimate Fabric & Trim Requirement for Training

Estimate the fabric and trim requirement for both off-line and on-line training.

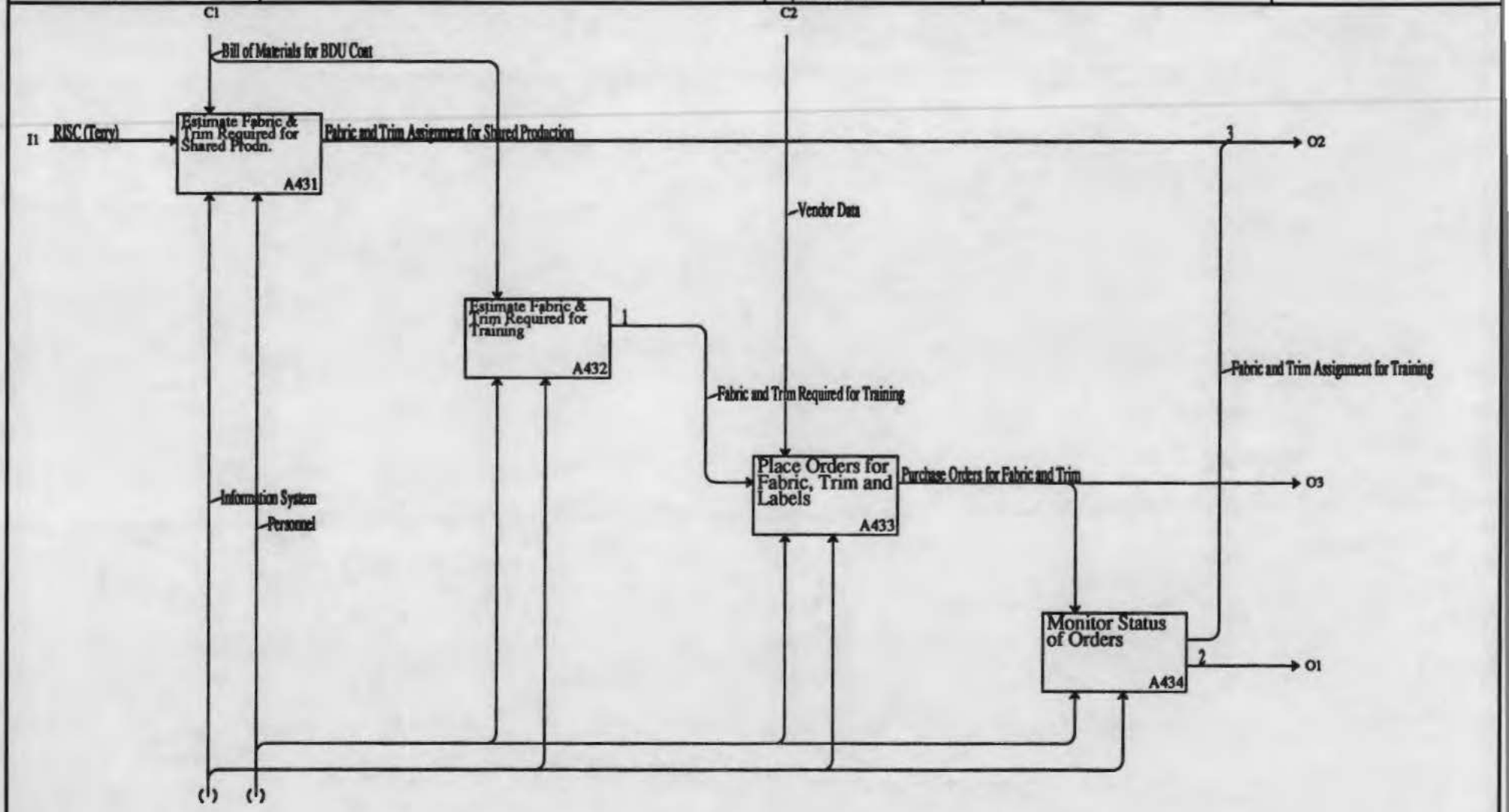
Place Orders for Fabric, Trim and Labels

Select vendors for materials required for training and send purchase orders to them.

Monitor Status of Orders

Ensure that materials required for training are obtained on time.

Used At:	Author: K. Srinivasan	Date: 12/9/1993		READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Working Draft Recommended Publication			
	Notes: 1 2 3 4 5 6 7 8 9 10					



1. Fabric and Trim Required for Training
2. Other Communications to Vendors
3. Fabric and Trim Assignment

Node:A43	Title:Ensure Material Availability	Number:

Receive Raw Materials

Make plans for receiving, inspection and storage of additional quantity of raw materials required for shared production.

Ship Cut Parts

Plan for collecting and shipping cut packages to satellite plants.

Receive Sub-assemblies

Plan for verifying the quantity and quality of sub-assemblies received from satellite plants and routing them to further operations.

Ship Finished Garments

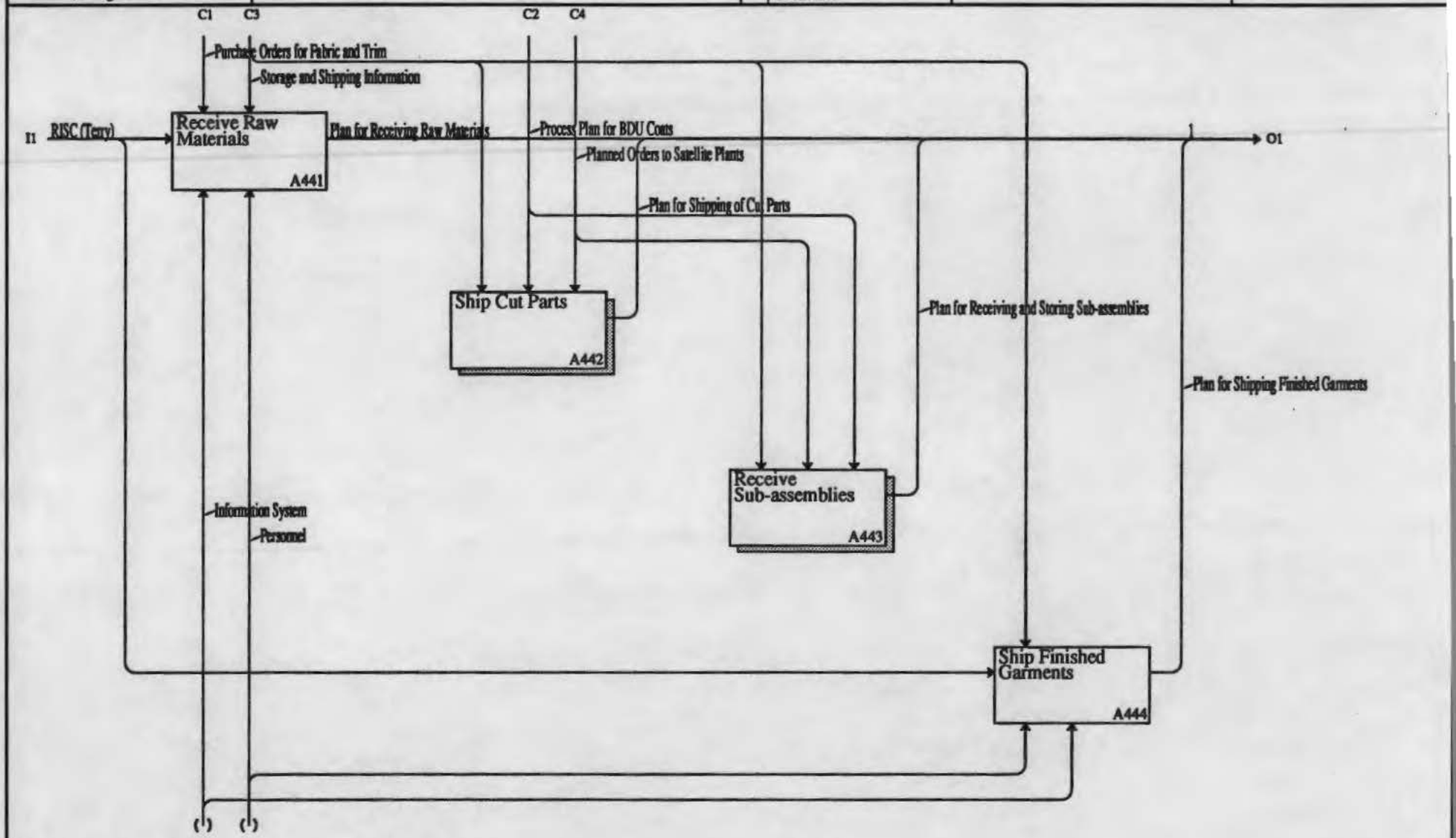
Plan for shipping additional quantity of finished garments.

School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Author: K. Srinivasan
Project: Terry_to
Notes: 1 2 3 4 5 6 7 8 9 10
Date: 12/9/1993
Rev:

	READER	DATE
Working		
Draft		
Recommended		
Publication		

Content



Node:A44	Title:Plan for Storage and Shipping	Number:

Collect and Inspect Cut Parts

Collect all parts required for the operation(s) assigned to a satellite plant and make sure they are free of defects.

Collect Required Trim

Collect any trim required for the assigned operation(s).

Print Bundle Ticket and Process Plan for Assigned Operations

Print detailed instructions specifications for the assigned operation(s).

Record and Ship Cut Package

Ship the cut parts, trim and process plan after recording the details of the shipment.

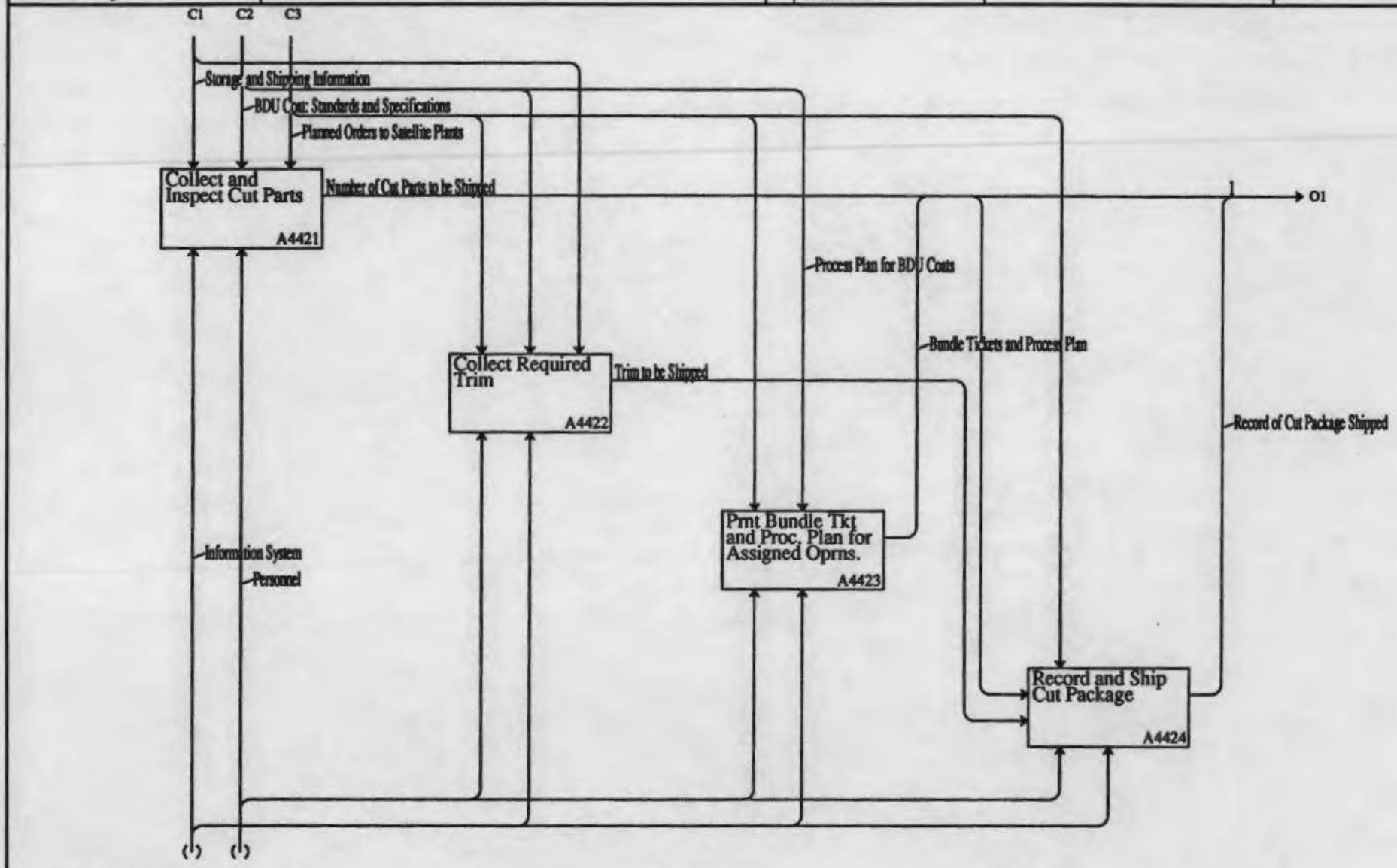
School of Textile & Fiber Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Author: R. Srinivasan
Project: Terry_to
Notes: 1 2 3 4 5 6 7 8 9 10

Date: 12/9/1993
Rev:

	Working	READER	DATE
	Draft		
	Recommended		
	Publication		

Context



1. Plan for Shipping of Cut Parts

Node:A442	Title:Ship Cut Parts	Number:

Check Quantity of Sub-assemblies

When sub-assemblies are received from the satellite plants, ensure that the bundle contains the required number of sub-assemblies.

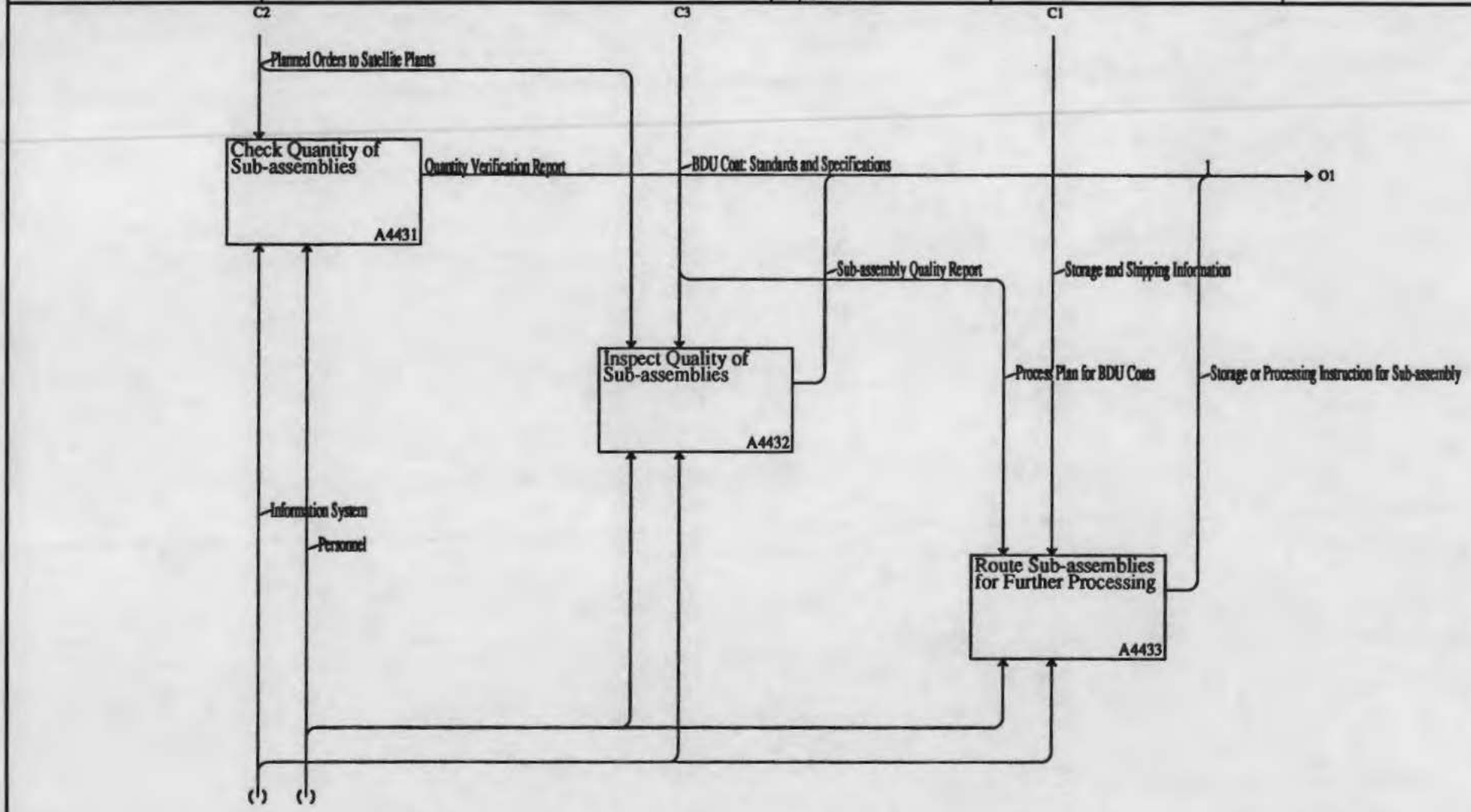
Inspect Quality of Sub-assemblies

Ensure that the operations performed at the satellite plant conform to the BDU coat specifications.

Route Sub-assemblies for Further Processing

Collect sub-assemblies (possibly from different sources) and route them to the machines assigned for further processes.

Used At:	Author: K. Srinivasan	Date: 12/9/1993		READER	DATE	Context:
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Working Draft Recommended Publication			
	Notes: 1 2 3 4 5 6 7 8 9 10					



1. Plan for Receiving and Storing Sub-assemblies

Node:A443	Title:Receive Sub-assemblies	Number:

Plan for Increased Outside Sourcing

Identify garment manufacturers who can supply garments required by commercial customers. Discuss the terms and finalize arrangements with the identified manufacturers.

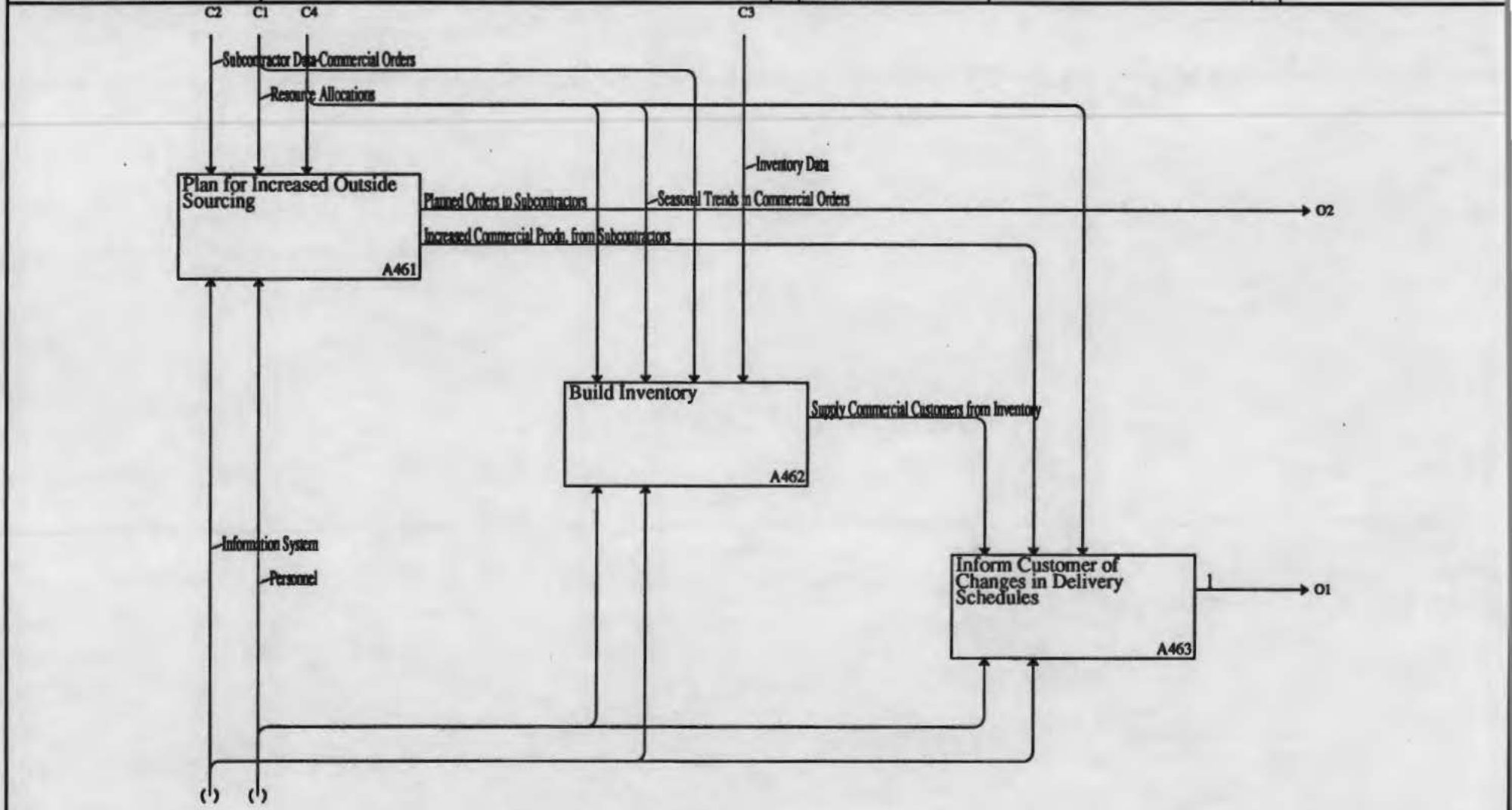
Build Inventory

Forecast the requirements of the commercial customers based on the seasonal variations in their orders. Build inventory to fulfill these requirements. Working overtime is one of the means for building the inventory.

Inform Customer of Changes in Delivery Schedules

Inform commercial customers about possible changes in delivery schedule and source of shipping.

Used At:	Author: K. Srinivasan	Date: 12/9/1993	Working	READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Draft			
	Notes: 1 2 3 4 5 6 7 8 9 10		Recommended			
			Publication			



1. Communication to Commercial Customers

Node:A46	Title:Make Contingency Plans for Commercial Customers	Number:

Establish Enterprisewide Database

Information about operations, their resource requirements, current availability of these resources and potential sources of these resources are essential for implementing shared production. Develop a specification of all information required and develop a database to ensure the availability of the information.

Link Marker Making with NC Cutting

Direct link between marker making and cutting facilitates rapid changes in garment style and sizes. If necessary, acquire this capability.

Monitor Work in Process on Sewing Floor

Real-time data from the shop-floor is essential for implementing EDI in the enterprise.Consider acquiring a data collection system.

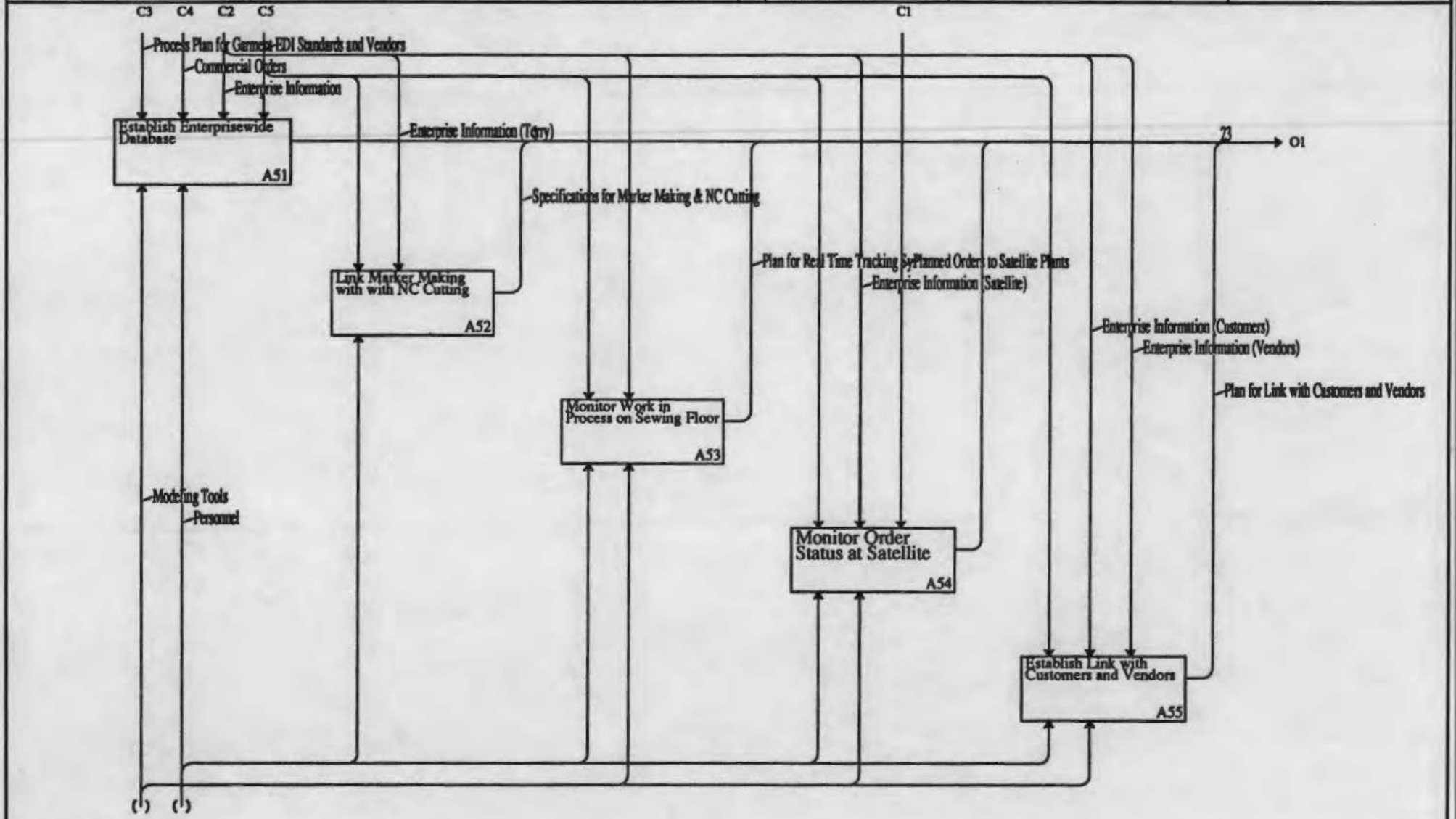
Monitor Order Status at Satellite Plants

Create a database to record the quantity and quality of garment sub-assemblies shipped to and received from satellite plants.

Establish Link with Customers and Vendors

Consider acquiring the ability to receive customer orders and place purchase orders electronically to shorten the product cycle time.

Used At:	Author: K. Srinivasan	Date: 12/9/1993		READER	DATE	Context
School of Textile & Fiber Engineering Georgia Institute of Technology Atlanta, Georgia 30332	Project: Terry_to	Rev:	Working Draft Recommended Publication			
	Notes: 1 2 3 4 5 6 7 8 9 10					

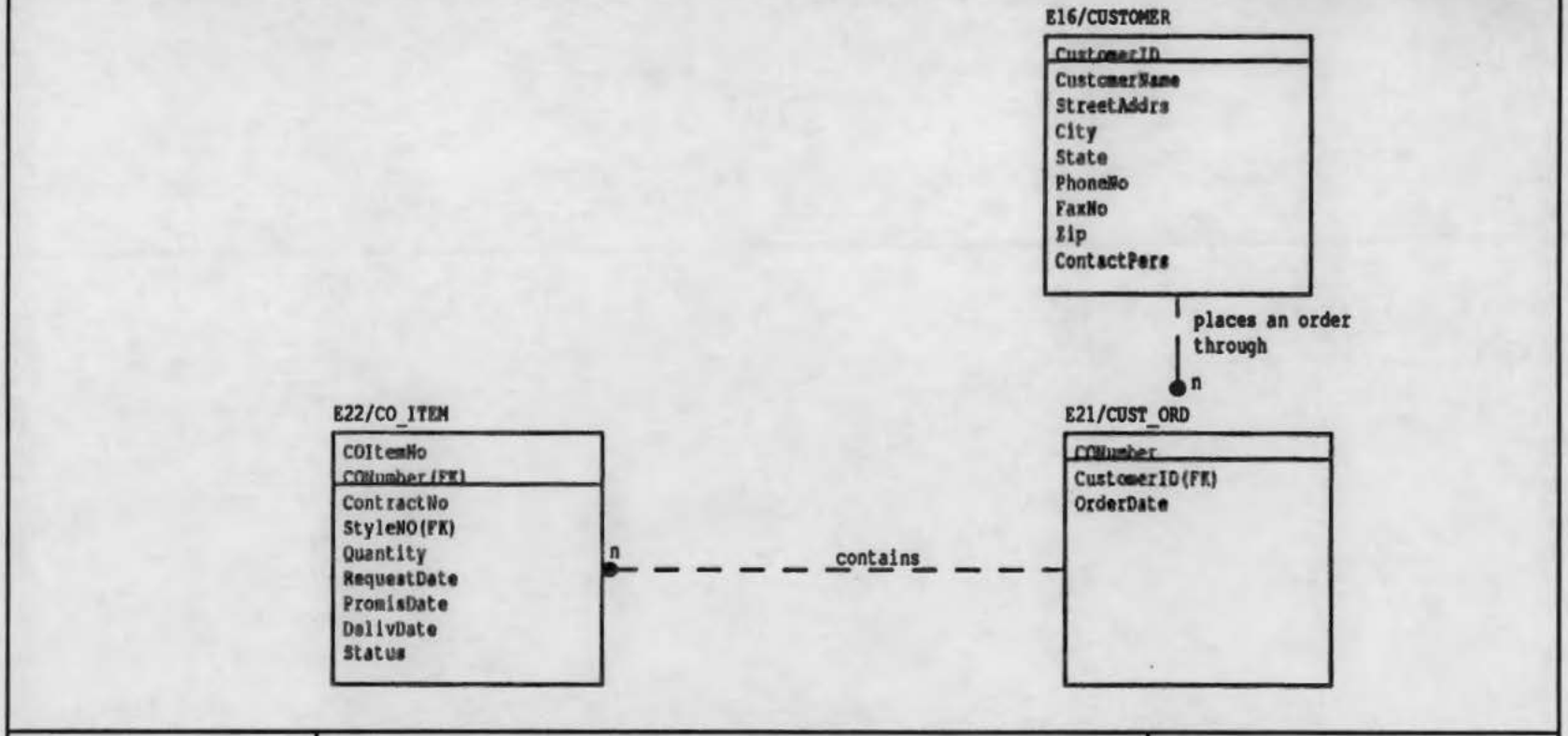


1. TMA (Terry Manufacturing Architecture)
2. TMA (Terry Manufacturing Architecture)
3. Plan for Implementing EDI

Node:A5	Title:Plan for Integration through EDI	Number:

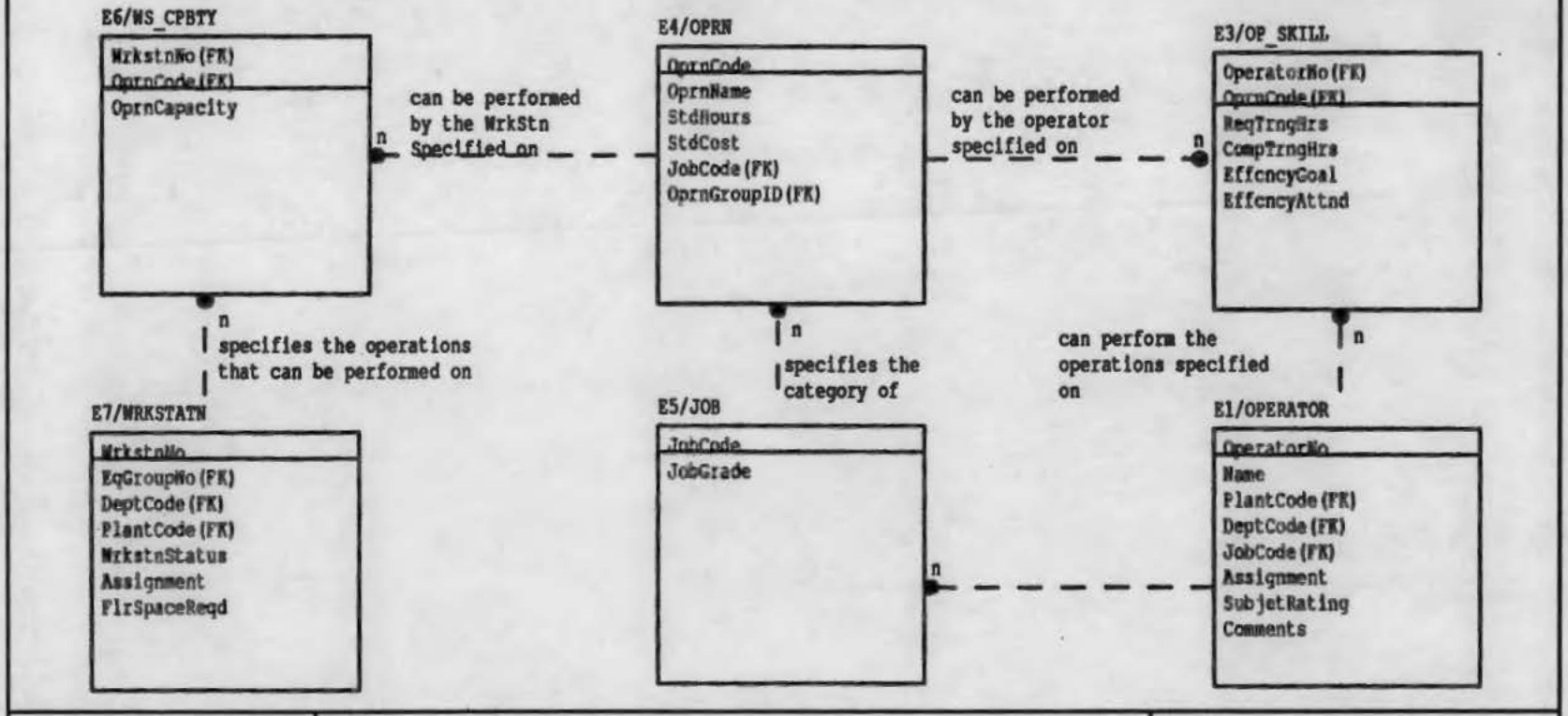
The *To Be* Information Model

USED AT:	AUTHOR : K. Srinivasan	DATE: 5/11/92	X	WORKING	READER DATE	CONTEXT:
	PROJECT: terry	REV.: 22/2/93		DRAFT		
	COMPANY: GEORGIA TECH.			RECOMMENDED		
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION		



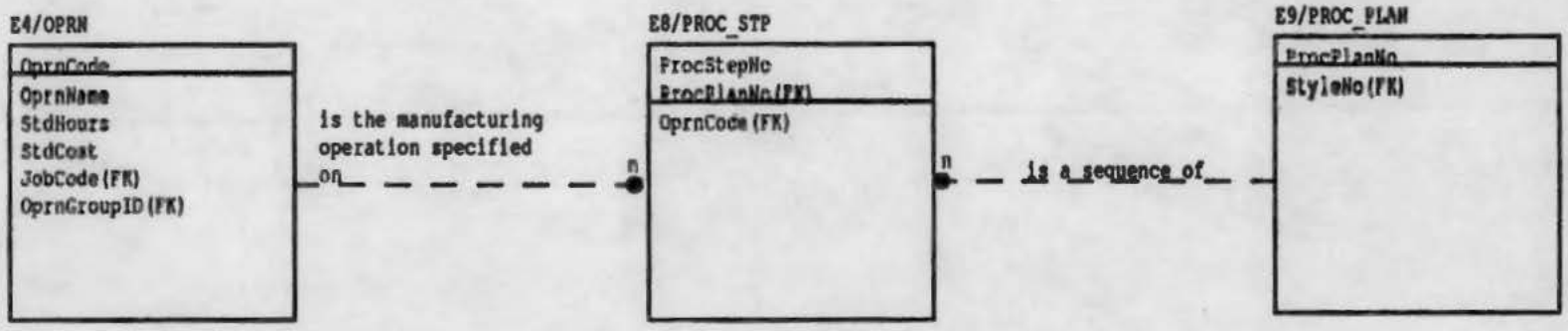
NODE:	TITLE:	NUMBER:
terry/F1-0	Customer Orders (including RISC)	KS1

USED AT:	AUTHOR : K. Srinivasan	DATE: 6/11/92	X	WORKING	READER	DATE	CONTEXT:
	PROJECT: terry	REV.: 24/2/93		DRAFT			
	COMPANY: GEORGIA TECH.			RECOMMENDED			
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION			



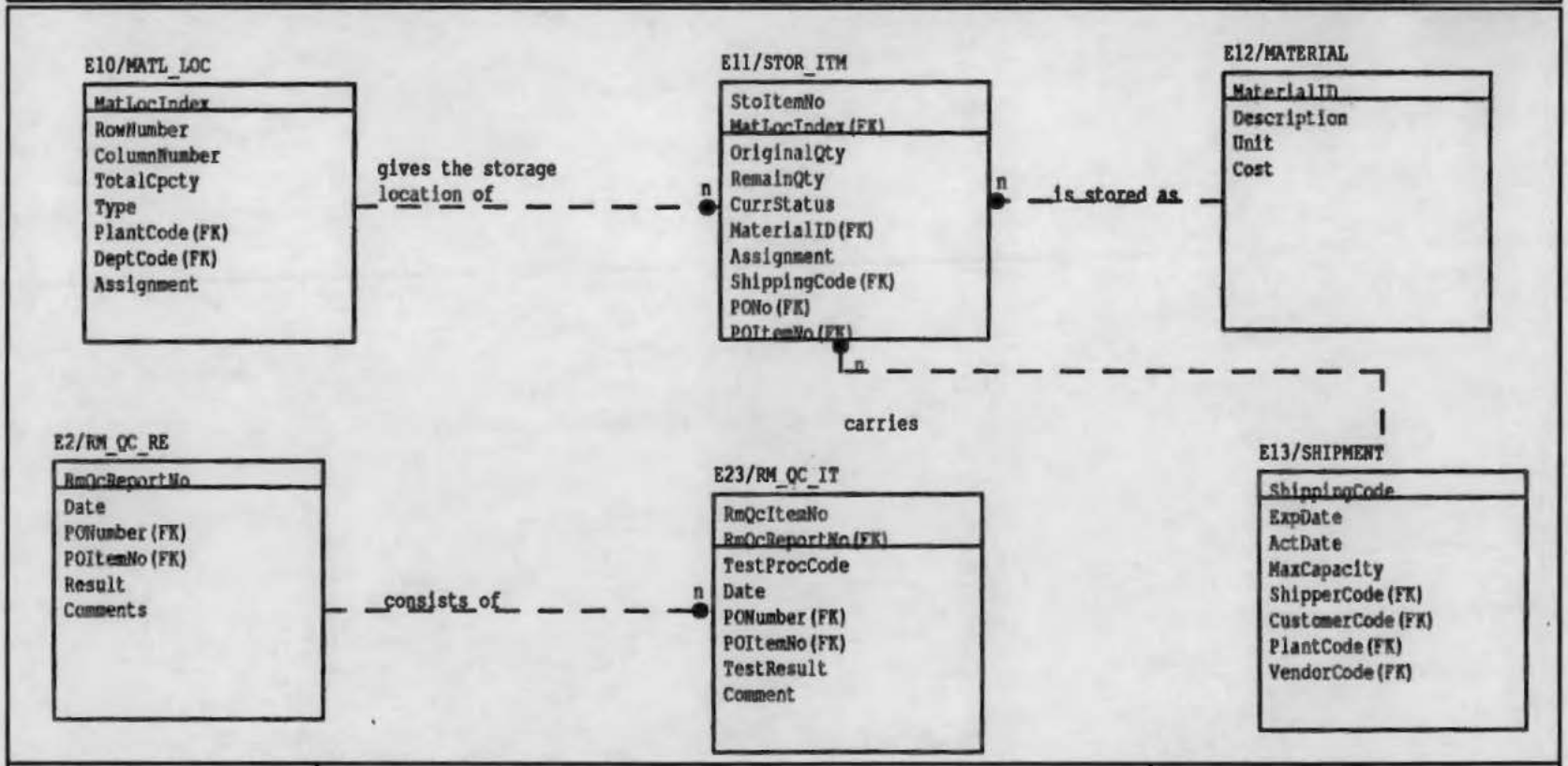
NODE:	TITLE:	NUMBER:
terry/F2-0	Manufacturing Resources	KS2

USED AT:	AUTHOR : K. Srinivasan	DATE: 6/11/92	X	WORKING	READER	DATE	CONTEXT:
	PROJECT: terry	REV.: 24/2/93		DRAFT			
	COMPANY: GEORGIA TECH.			RECOMMENDED			
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION			



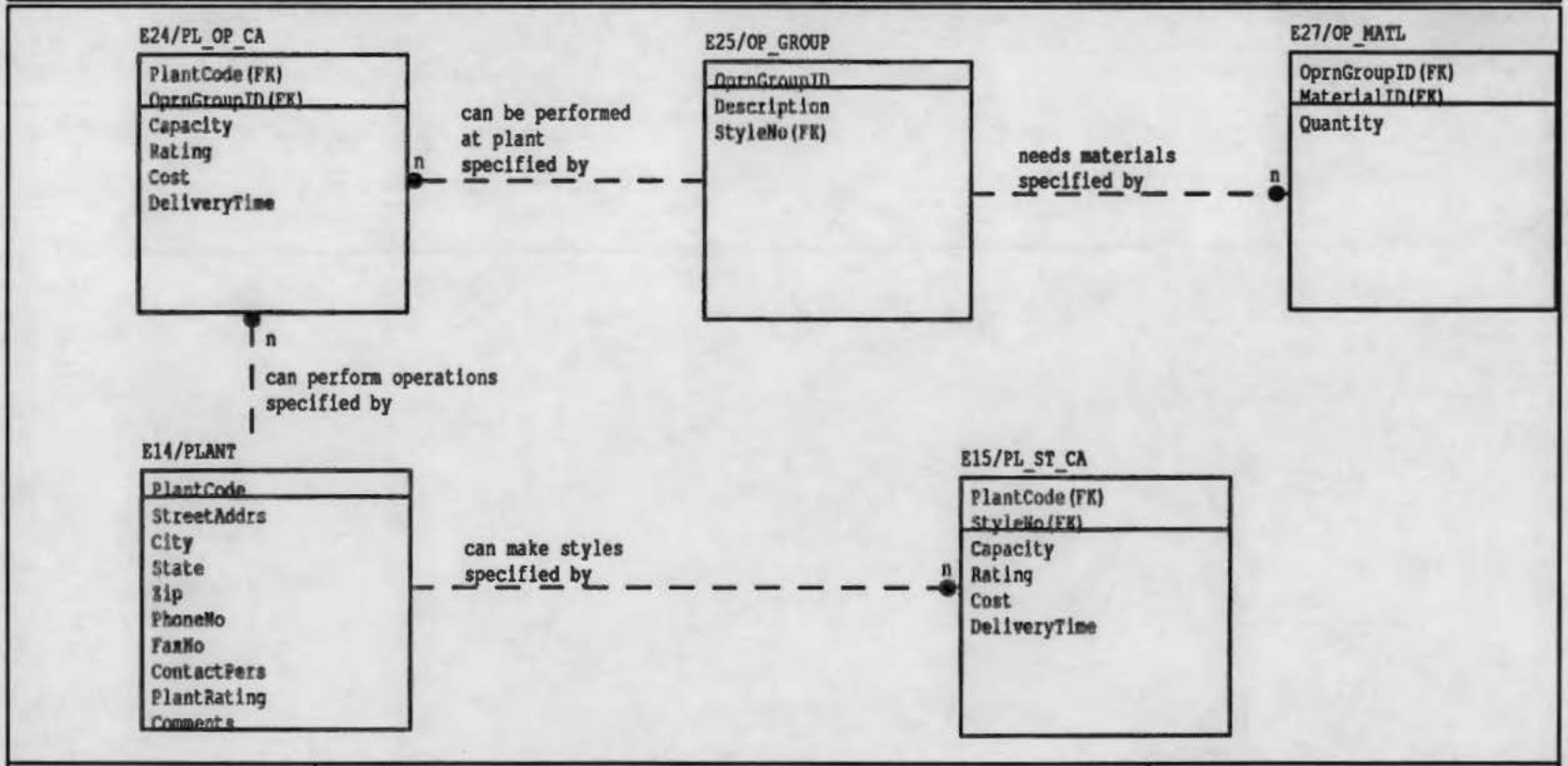
NODE:	TITLE:	NUMBER:
terry/F3-0	Process Plan	KS3

USED AT:	AUTHOR : K. Srinivasan	DATE: 8/11/92	X	WORKING	READER DATE	CONTEXT:
	PROJECT: terry	REV.: 24/2/93		DRAFT		
	COMPANY: GEORGIA TECH.			RECOMMENDED		
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION		



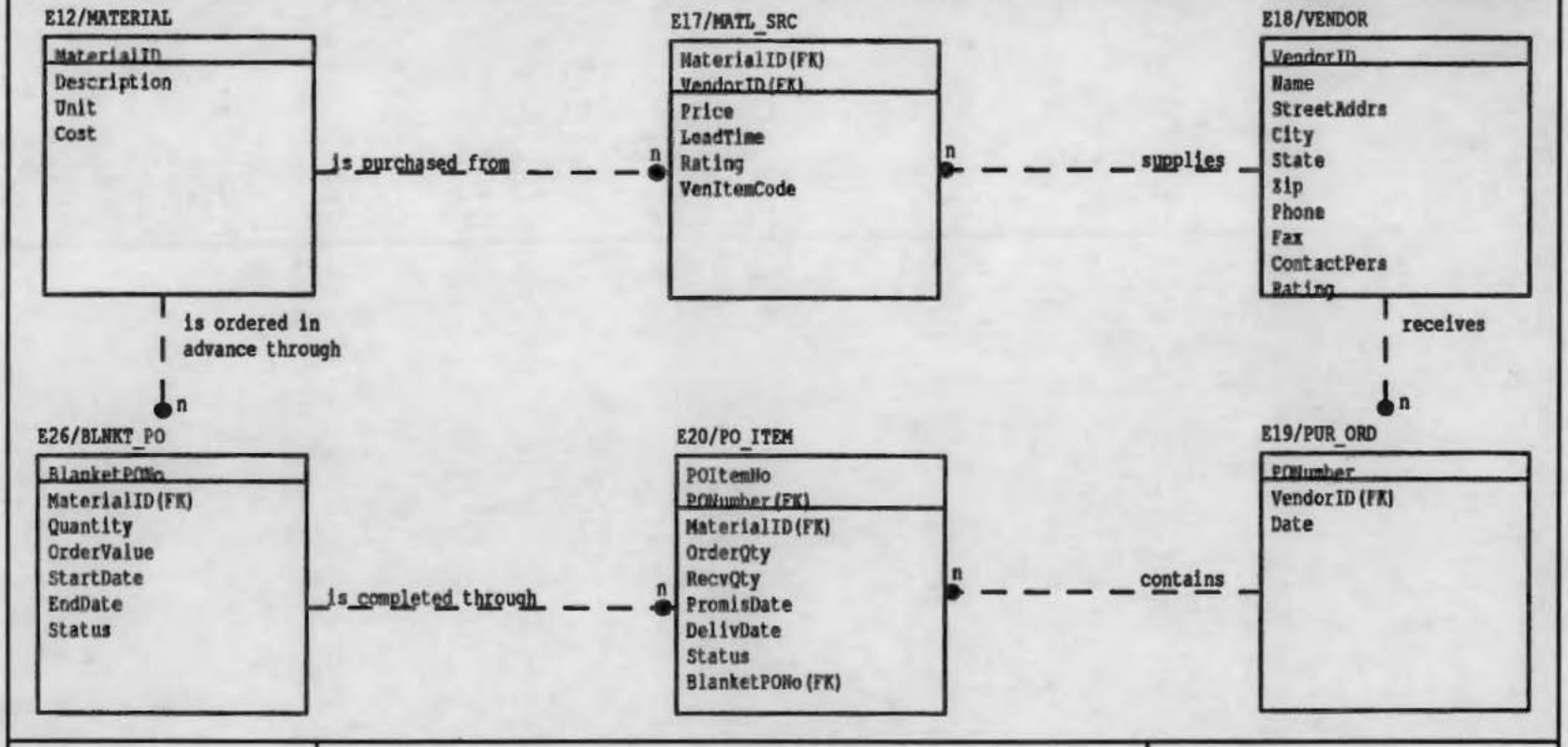
NODE:	TITLE:	NUMBER:
terry/F2-1	Manufacturing Resources	KS4

USED AT:	AUTHOR : K. Srinivasan	DATE: 9/11/92	X	WORKING	READER	DATE	CONTEXT: [redacted]
	PROJECT: terry	REV.: 24/2/93		DRAFT			
	COMPANY: GEORGIA TECH.			RECOMMENDED			
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION			



NODE:	TITLE:	NUMBER:
terry/F4-0	Plant (own, satellite and sub-contract)	KS5

USED AT:	AUTHOR : K. Srinivasan	DATE: 9/11/92	X	WORKING	READER DATE	CONTEXT:
	PROJECT: terry	REV.: 24/2/93		DRAFT		
	COMPANY: GEORGIA TECH.			RECOMMENDED		
	NOTES : 1 2 3 4 5 6 7 8 9			PUBLICATION		



NODE:	TITLE:	NUMBER:
terry/F6-0	Purchase raw materials	KS6

TABLE OF ENTITIES AND THEIR ATTRIBUTES

ATTRIBUTE NAME	PK	FK	ATTR TYPE	COMMENT

ENTITY NO: 1 ENTITY NAME: OPERATOR

The human responsible for operating the workstation to perform an operation (64)[1].

OperatorNo	Y	N	n	Unique ID for the operator
Name	N	N	a(25)	Last name, first name
PlantCode	N	Y	*	The Plant at which employed
DeptCode	N	Y	*	Department in which employed
JobCode	N	Y	*	Highest job category
Assignment	N	N	a(1)	Whether assigned to shared prodn.
SubjectRating	N	N	n	Overall subjective rating
Comments	N	N	m	Memo field for detailed comments

ENTITY NO: 2 ENTITY NAME: RM_QC_RE

Summary report for all tests performed on purchased material..

RmQcReportNo	Y	N	n	Unique ID for the QC Report
Date	N	N	d	Date of report
PONumber	N	Y	*	PO Number for the item tested
POItemNo	N	Y	*	Item number within the PO
Result	N	N	a(25)	Accepted, rejected, ...
Comments	N	N	m	Detailed comments

ENTITY NO: 3 ENTITY NAME: OP_SKILL

The skill level and training level of an operator to perform a particular job (65).

OperatorNo	Y	Y	*	Unique ID for the operator
OprnCode	Y	Y	*	Unique code for the operation
ReqTrngHrs	N	N	n	Standard no. of training hours
CompTrngHrs	N	N	n	No. of training hours completed
EffcncyGoal	N	N	n	Efficiency target
EffcncyAttnd	N	N	n	Current operator efficiency

1. The number in the parenthesis indicates the corresponding entity in the AMA information model.

n: Number; a(x): Alphanumeric string of length x; d: date; m: memo; $: Currency

ATTRIBUTE NAME	PK	FK	ATTR TYPE	COMMENT

ENTITY NO: 4 **ENTITY NAME: OPRN**

Basic unit operation performed in the various function areas of the enterprise (108).

OprnCode	Y	N	n	Unique code for the operation
OprnName	N	N	a(35)	Descriptive name
StdHours	N	N	n	Standard Hours for 100 units
StdCost	N	N	$	Cost assigned to the operation
JobCode	N	Y	*	Job category of the operation
OprnGroupID	N	Y	*	Logical operation group

ENTITY NO: 5 **ENTITY NAME: JOB**

A generic entity for a class of construction operations that have same level of complexity and require similar skills to perform (66).

JobCode	Y	N	a(18)	Unique ID for the job
JobGrade	N	N	n	Skill level of the job

ENTITY NO: 6 **ENTITY NAME: WS_CPBTY**

A construction operation that a particular workstation is capable of performing. This entity also gives the capacity of the workstation for this particular operation (63).

WrkstnNo	Y	Y	*	Unique ID for a work station
OprnCode	Y	Y	*	Unique ID for the operation
OprnCapacity	N	N	n	Units produceable in 1 hr

ENTITY NO: 7 **ENTITY NAME: WRKSTATN**

A single machine or a group of related machines used to perform unit manufacturing operation (62).

WrkstnNo	Y	N	n	Unique ID
EqGroupNo	N	Y	*	Group to which the WS belongs
DeptCode	N	Y	*	Dept to which the WS belongs
PlantCode	N	Y	*	Plant to which the WS belongs
WrkstnStatus	N	N	a(20)	Current Status (busy, idle,...)
Assignment	N	N	a(1)	Whether assigned for shared prodn.
FlrSpaceReqd	N	N	n	Floor space required in sq. ft

n: Number; a(x): Alphanumeric string of length x; d: date; m: memo; $: Currency

ATTRIBUTE NAME	PK	FK	ATTR TYPE	COMMENT

ENTITY NO: 8 **ENTITY NAME: PROC_STEP**

A step in the process plan that transforms the state of a garment sub-assembly (24).

ProcStepNo	Y	N	n	Sequence no. in the process plan
ProcPlanNo	Y	Y	*	Unique ID for the process plan
OprnCode	N	Y	*	Mfg. oprn. corresponding to step

ENTITY NO: 9 **ENTITY NAME: PROC_PLAN**

A sequence of operations involved in the manufacture of a garment style (23).

ProcPlanNo	Y	N	n	Unique ID for the process plan
StyleNo	N	Y	*	Process plan for garment style

ENTITY NO: 10 **ENTITY NAME: MATL_LOC**

Storage location for material including garments, garment sub-assemblies and raw materials. These are usually bins or racks arranged in aisles (36).

MatLocIndex	Y	N	a(15)	Unique ID of a storage location
RowNumber	N	N	n	Row identifier for storage location
ColumnNumber	N	N	n	Column number (or shelf number)
TotalCpcty	N	N	n	Maximum capacity at the location
Type	N	N	a(15)	Shelf, bin, ...
PlantCode	N	Y	*	Unique ID for the plant
DeptCode	N	Y	*	Unique ID for the dept
Assignment	N	N	a(1)	Whether assigned to shared prodn.

n: Number; a(x): Alphanumeric string of length x; d: date; m: memo; $: Currency

ATTRIBUTE NAME	PK	FK	ATTR TYPE	COMMENT

ENTITY NO: 11 ENTITY NAME: STOR_ITEM

A unit of material that is stored. This may be a garment, garment sub-assembly, a bolt of fabric or a carton containing a specific quantity of a trim item (35).

StoItemNo	Y	N	a(15)	Unique ID for the stored item
MatLocIndex	Y	Y	*	Location of storage
OriginalQty	N	N	n	Initial qty stored
RemainQty	N	N	n	Currently available qty
CurrStatus	N	N	a(20)	Item may be temporarily absent
MaterialID	N	Y	*	Material Stored
Assignment	N	N	a(1)	Whether assigned to shared p.
ShippingCode	N	Y	*	Shipping assigned for the item
PONo	N	Y	*	Purchase Order number
POItemNo	N	Y	*	Purchase order item number
ProdOrdNo	N	Y	*	Production order assigned to

ENTITY NO: 12 ENTITY NAME: MATERIAL

Includes garments and materials that go into garment construction, such as trim, closures and labels (22).

MaterialID	Y	N	a(30)	Unique ID for fabric, trim,..
Description	N	N	a(30)	Brief description
Unit	N	N	a(10)	Rolls, yards, and so on
Cost	N	N	n	Standard cost of the material

ENTITY NO: 13 ENTITY NAME: SHIPMENT

Garments for customers, garment sub-assemblies for satellite plants and raw materials from vendors.

ShippingCode	Y	N	a(24)	Unique ID for the shipment
ExpDate	N	N	d	Date of expected shipping
ActDate	N	N	d	Actual shipping date
MaxCapacity	N	N	n	Maximum capacity
ShipperCode	N	Y	*	Shipping company identifier
CustomerCode	N	Y	*	Customer to whom shipped
SatelCode	N	Y	*	Satellite plant to receive
VendorCode	N	Y	*	Vendor shipping the goods

n: Number; a(x): Alphanumeric string of length x; d: date; m: memo; $: Currency

ATTRIBUTE NAME	PK	FK	ATTR TYPE	COMMENT

ENTITY NO: 14 **ENTITY NAME: PLANT**

A manufacturing facility for cutting, sewing or finishing activities. This includes own, satellite and sub-contractor's facilities (42).

PlantCode	Y	N	a(15)	Unique ID for the plant
StreetAddrs	N	N	a(50)	Street address of the plant
City	N	N	a(20)	City of location
State	N	N	a(2)	Two lettered state code
Zip	N	N	a(9)	Zip code with 4 digit exten
PhoneNo	N	N	n	Ten digit telephone number
FaxNo	N	N	n	Ten digit telephone number
ContactPers	N	N	a(25)	Contact person in the plant
PlantRating	N	N	n	Overall performance rating
Comments	N	N	m	Detailed comments

ENTITY NO: 15 **ENTITY NAME: PL_ST_CA**

Installed capacity of a plant to produce a complete garment specified by the style number (43).

PlantCode	Y	Y	*	ID for the plant
StyleNo	Y	Y	*	ID for a garment type
Capacity	N	N	n	Units of garments/week
Rating	N	N	n	Rating for a garment
Cost	N	N	$	Cost/unit of garment
DeliveryTime	N	N	n	Time in days to deliver

ENTITY NO: 16 **ENTITY NAME: CUSTOMER**

The party for whom the garments are manufactured (4)

CustomerID	Y	N	a(15)	Unique Id for the customer
CustomerName	N	N	a(25)	Name of the customer
StreetAddrs	N	N	a(50)	Street address of the customer
City	N	N	a(20)	Customer's city
State	N	N	a(2)	Two lettered state code
Zip	N	N	n	Zip code with 4 digit extn
PhoneNo	N	N	n	Ten digit telephone number
FaxNo	N	N	n	Ten digit telephone number
ContactPers	N	N	c(25)	Contact person

n: Number; a(x): Alphanumeric string of length x; d: date; m: memo; $: Currency

ATTRIBUTE NAME	PK	FK	ATTR TYPE	COMMENT

ENTITY NO: 17 ENTITY NAME: MATL_SRC

A supplier from whom a particular material can be obtained (94).

MaterialID	Y	Y	*	Source given for this material
VendorID	Y	Y	*	Source of the material
Price	N	N	$	Purchase price/unit
LeadTime	N	N	n	Lead time for delivery in days
Rating	N	N	n	Performance rating
VenItemCode	N	N	a(15)	Vendor's code for material

ENTITY NO: 18 ENTITY NAME: VENDOR

Supplier of materials such as fabrics, threads and labels (31).

VendorID	Y	N	a(15)	Unique ID for the vendor
Name	N	N	a(30)	Company name
StreetAddrs	N	N	a(50)	Street address
City	N	N	a(20)	City name
State	N	N	a(2)	Two lettered state code
Zip	N	N	n	Zip code with 4 digit extn
PhoneNo	N	N	n	Ten digit telephone number
FaxNo	N	N	n	Ten digit telephone number
ContactPers	N	N	a(25)	Contact person
Rating	N	N	n	Overall rating of the vendor
Comments	N	N	m	Detailed comments

ENTITY NO: 19 ENTITY NAME: PUR_ORD

Order sent out to a vendor to procure one or more types of materials (32).

PONumber	Y	N	n	Unique number assigned to PO
VendorID	N	Y	*	PO is placed with
Date	N	N	d	Date of order

ENTITY NO: 20 ENTITY NAME: POITEM

An item on the purchase order providing details of material ordered,the desired quantity and delivery status (33).

POItemNo	Y	N	a(7)	sequence number in the PO
PONumber	Y	Y	*	PO containing the item
MaterialID	N	Y	*	Material ordered
OrderQty	N	N	n	Ordered quantity
RecvQty	N	N	n	Actual received quantity
PromisDate	N	N	d	Vendor promises to deliver on
DelivDate	N	N	d	Actual delivery date
Status	N	N	c(12)	Current status -- pending, ...
BlanketPONo	N	Y	*	PO item against this BPO

n: Number; a(x): Alphanumeric string of length x; d: date; m: memo; $: Currency

ATTRIBUTE NAME	PK	FK	ATTR TYPE	COMMENT

ENTITY NO: 21 **ENTITY NAME: CUST_ORD**

Order from a customer for one or more types of garments.

CONumber	Y	N	n	Unique number for CO
CustomerID	n	Y	*	Customer placing the order
OrderDate	N	N	d	Date of receiving the order

ENTITY NO: 22 **ENTITY NAME: CO_ITEM**

An item in customer order, specifying the garment ordered, quantity and delivery status.

COItemNo	Y	N	n	Sequence number with in CO
CONumber	Y	Y	*	CO to which item belongs
ContractNo	N	N	a(17)	DLA contract number
StyleNo	N	Y	*	Style ordered by customer
Quantity	N	N	n	Units of materials ordered
RequestDate	N	N	d	Customer requests delivery on
PromisDate	N	N	d	Date mentioned on order confirm
DelivDate	N	N	d	Date of actual delivery
Status	N	N	a(15)	delivered, cancelled, ...

ENTITY NO: 23 **ENTITY NAME: RM_QC_IT**

Data on individual tests performed on an item..

RmQcReportNo	Y	Y	n	Report to which this item belongs
RmQcItemNo	Y	N	n	Unique item number within a report
TestProcCode	N	N	a(21)	ASTM, MIL or other test procedures
Date	N	N	d	Date of testing
TestResult	N	N	a(25)	Accept, Reject,...
Comment	N	N	m	Detailed comments on test result

ENTITY NO: 24 **ENTITY NAME: PL_OP_CA**

Installed capacity to perform a specific logical group of operations.

PlantCode	Y	Y	*	Plant whose capacity is given
OprnGroupID	Y	Y	*	Logical group of operations
Capacity	N	N	n	Units/week
Rating	N	N	n	Rating for this operation group.
Cost	N	N	$	Cost charged by plant /unit
DeliveryTime	N	N	n	Lead time for delivery (days)

n: Number; a(x): Alphanumeric string of length x; d: date; m: memo; $: Currency

ATTRIBUTE NAME	PK	FK	ATTR TYPE	COMMENT

ENTITY NO: 25 ENTITY NAME: OP_GROUP

Logical group of operations: usually a set of operations to complete a sub-assembly of a garment such as fly and sleeve.

OprnGroupID	Y	N	a(15)	Unique ID for the oprn group
Description	N	N	a(50)	Detailed description of op group
StyleNo	N	Y	*	Garment whose part is made

ENTITY NO: 26 ENTITY NAME: BLNKT_PO

A contract entered into with a supplier to purchase a specific quantity of a material over a time period.

BlanketPONo	Y	N	n	Serial number for BPO
MaterialID	N	Y	*	Material Ordered through BPO
Quantity	N	N	n	Total ordered quantity
OrderValue	N	N	$	Dollar value of the BPO
StartDate	N	N	d	Beginning of BPO period
EndDate	N	N	d	End of BPO period
Status	N	N	a(15)	Completed, cancelled, ...

ENTITY NO: 27 ENTITY NAME: OP_MATL

Construction material required to produce a particular garment sub-assembly (21).

OprnGroupID	Y	Y	*	Matl req. specified for OpGp
MaterialID	Y	Y	*	Material item reqd for OpGp
Quantity	N	N	n	Number of units needed/garment

ENTITY NO: 28 ENTITY NAME: SUB_CONT

Order for outside sourcing of one or more entire garments or garment subassemblies.

SubContNo	Y	N	n(6)	Unique ID of the sub-contract
PlantCode	N	Y	*	Plant to which subcontracted
Date	N	N	d(6)	Date of award of contract

n: Number; a(x): Alphanumeric string of length x; d: date; m: memo; $: Currency

ATTRIBUTE NAME	PK	FK	ATTR TYPE	COMMENT

ENTITY NO: 30 **ENTITY NAME: SU_CON_I**

An item in an order to an outside source. It can be an entire garment or a sub-assembly of it. It specifies the quantity ordered and delivery status.

SubContItNo	Y	N	n(2)	Sequence no. within subcont.
SubContNo	Y	Y	*	Contract to which item belongs
StyleNo	N	Y	*	Garment being contracted
OprnGroupID	N	Y	*	Operation being contracted
Quantity	N	N	n(7)	Number of units ordered
RequestDate	N	N	d(6)	Delivery requested on
PromisDate	N	N	d(6)	Delivery promised on
DeliveryDate	N	N	d(6)	Actual delivery on
Status	N	N	c(15)	completed, pending, ...

n: Number; a(x): Alphanumeric string of length x; d: date; m: memo; $: Currency

User Manual for Information System

Terry Manufacturing

Information System for Shared Production: User's Guide

Installation

Create a directory by name *terry* (or any other name) under the Paradox directory and copy all the files provided on the diskette labelled "Terry - Shared Production" under the directory *terry*.

C:\> cd pdox40
C:\pdox40>mkdir terry
C:\pdox40>cd terry
C:\pdox40\terry>copy a:\terry*.*

The following file types are currently used in the Terry system. A complete list of file types can be found on Page 7 of Paradox User's Guide.

Extension	File Content
.DB	Table
.MB	Memos for one table (memo data type is used for storing long texts. The comment field of Operator table is an example)
.SC	Script (For example, Bpo_sumq.sc is a query script)
.PX	Primary index (used for searching records)

Starting Up

Start Paradox. You can start it from any directory if "C:\pdox40" has been added to the *path* variable in autoexec.bat.

C:\>\pdox40\terry\>**paradox**

This puts the Paradox main menu on the screen.

The directory *C:\pdox40\terry* is the default directory for using the Terry system. If Paradox is started from any other directory, use **[Tools, More, Directory]** from the Paradox main menu to set the default directory to *C:\pdox40\terry*.

Viewing Tables

- To look at any table, select **[View]** from the Paradox main menu (Note: items from a menu can be selected either using a mouse or by moving the cursor using arrow keys and pressing <enter>). Paradox prompts the user for a table name.

- If you know the table name, enter the table name and then press <enter>.

- If you do not know the table name, press <enter> to display the list of tables.

- Once a table is selected, all the records in the table are shown. You can browse through the table using arrow keys or the vertical and horizontal scroll bars. When only a part of a field is displayed on the screen, move the cursor to that field by using arrow keys or the mouse and press **Alt-F5** to display the entire contents (or you can double click on that field).

Editing Tables

You can edit a table in one of two ways:

1. If you are viewing a table, you can press F9.
2. Otherwise, select **[Modify, Edit]** from the main menu and then enter or select the name of the table to be edited.

- Select **[DoIt]** or press **F2** to save changes.
- Select **[Cancel]** to discard all changes.
- If you press **Ctrl-D** while in a field, the value from the corresponding field in the previous record is copied to the field.
- When the message line at the bottom of the screen shows **F1 LookUp**, you can select a value from a predefined lookup table. For example, while entering a record in the *Oprn* table (Table 4), you can lookup the possible values for *JobCode* and *OprnGroupID* from the tables *Job* (Table 5) and *Op_group* (Table 25), respectively. While in the lookup table, go to the record you want to copy the value from and press **F2**. This puts the value in the corresponding field in the *Oprn* table.
- The formats of certain fields have been predefined. The system will guide you in entering the value in the right format and accept a value only if it is in the right format. The following predefined formats are associated with the fields:

Table	Field	Format	Example
Operation (4)	OprnCode	!!!-!!!!!!-!!!!-!!!!!	BDU-4448-02-32
Wrkstatn (7)	WrkstnNo	!!-!!-!!!!!-!!!!-####	SN-LS-UTRIM-NPOS-0001
Material (12)	MaterialID	!!!-!!!!!!-!!!!-!!!!!	FAB-TWILLX-BLUE-00001
Pur_ord (19)	PONumber	!!-###	TC-489
Miscellaneous	PhoneNo, FaxNo	###-###-####	717-790-2601
Miscellaneous	Assignment	One of <y, Y, n, N>	Y
Miscellaneous	Rating	1 to 10	10

! represents any alphanumeric character in uppercase and # represents a number.

You are free to type in lower or upper case and you need not type the "-" character; the system converts whatever is typed into upper case and automatically enters the "-" character at the appropriate places.

- To modify format, select **[ValCheck, Define]** from the Edit menu. Indicate the field by selecting it (either by clicking or by pressing <enter> while in the field).
- Select **[Picture]** for modifying the first six formats shown in the table; select **[LowValue]** and **[HighValue]** for the last format.

• For more information refer to Pages 343 and 353 in Paradox User's Guide.

Note: If you wish to only add new records (as opposed to modifying existing records), use **[Modify, DataEntry]** from the main menu. This will prevent the old records from being accidentally edited.

Using Queries

Paradox provides the user with an easy to use "query by example" feature. Setting up queries is explained in Chapters 5 and 6 of the Paradox User's Guide. Once a query is set up, it can be used for future use.

• To save a query, Select **[Scripts, QuerySave]** from the main menu and assign an appropriate name.

Currently three such queries are available:

(i) *Bpo_detq* is a query to find out all the purchase orders that have been issued against at Blanket Purchase Order (BPO);

(ii) *Bpo_sumq* summarizes the same information by showing the BPO quantity, the quantity remaining to be ordered and the date on which the BPO period ends; and

(iii) *Pend_coq* gives a list of pending customer orders with the number of days from the current date to the date on which delivery has been promised.

• To run any query script, select **[Scripts, Play]** from the main menu. Enter or select the query to be run.
• A query can be modified before it is run.

Modifying Table Structure

To add fields to a table, change field names or data types select **[Modify, Restructure]** from the main menu and then enter or select the table to be modified. You can navigate through a table definition using the mouse or the arrow keys. **Alt-F5** allows you to move within a field using the arrow keys. Select **[DoIt]** to save changes or **[Cancel]** to discard changes.

Adding Tables

To add a new table, select **[Create]** from the main menu. Enter the name of the new table. Enter the field names and types on the screen.

Deleting Tables

To delete a table, select **[Tools, Delete, Table]** from the main menu and then enter or select the name of the table to be deleted.