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THESIS

A BUSINESS PROCESS MODEL AND REENGINEERING PLAN FOR THE STUDENT SERVICES DEPARTMENT OF THE MARINE CORPS INSTITUTE

by

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September 1997

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This research is part of a year long project commissioned by the Marine Corps Institute to develop the architecture and supporting migration plan to transition from an existing legacy system to an open, client/server based relational database management system (DBMS) for the Student Services Department (SSD). The objective of this thesis is to develop the As-Is process model, redesign the processes to increase efficiency and reduce costs, and develop a To-Be process model to improve the current business processes. Additionally, data flow diagrams of the To-Be processes are developed to assist in prototype design and implementation. The DoD standard IDEF0 modeling technique is used for developing the process models. Implementation recommendations include: (1) adopting an ongoing reengineering strategy at MCI supported by the information systems architectures, methodologies and CASE tools, and (2) utilizing a single database to facilitate data sharing among MCI departments, streamline processes, facilitate automation, eliminate data redundancy, and improve customer service.

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A BUSINESS PROCESS MODEL AND REENGINEERING PLAN FOR THE STUDENT SERVICES DEPARTMENT OF THE MARINE CORPS INSTITUTE

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ABSTRACT

This research is part of a year long project commissioned by the Marine Corps Institute to develop the architecture and supporting migration plan to transition from an existing legacy system to an open, client/server based relational database management system (DBMS) for the Student Services Department (SSD). The objective of this thesis is to develop the As-Is process model, redesign the processes to increase efficiency and reduce costs, and develop a To-Be process model to improve the current business processes. Additionally, data flow diagrams of the To-Be processes are developed to assist in prototype design and implementation. The DoD standard IDEF0 modeling technique is used for developing the process models. Implementation recommendations include: (1) adopting an ongoing reengineering strategy at MCI supported by the information systems architectures, methodologies and CASE tools, and (2) utilizing a single database to facilitate data sharing among MCI departments, streamline processes, facilitate automation, eliminate data redundancy, and improve customer service.

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I. INTRODUCTION

This chapter provides introductory information on the purpose and content of the thesis. It discusses the background and objectives of the research, the research questions and methodology used. It defines the scope of the thesis, and provides a list of acronyms used throughout. Finally, it outlines the content of each of the chapters.

A. BACKGROUND

The Marine Corps Institute (MCI) was established to "develop, publish, distribute, and administer distance training and education materials to enhance, support, or develop required skills and knowledge of Marines and to satisfy other training and education requirements as identified by the Commanding General, MCCDC" (MCI Mission, 1997). To accomplish its mission, MCI is organized into seven functional departments: education and operations, student services, information management systems, occupation specialty, professional military education, production, and logistics.

The mission of the student services department is to support the enrollment, grading and management of the Marine Corps distance education and training programs. In support of its mission, the student services department employs an automated information system (AIS) to automate the actions required to support a student in the MCI correspondence program, maintain student records, and produce necessary management reports. The automated system, known as the Marine Corps Institute Automated Information System (MCIAIS), is a legacy system developed in the late 1970's. It runs on a Hewlett-Packard 3000 mini computer running the MPE/iX operating system. MCIAIS is written in HP proprietary language "Transact" and accesses a Turbo-

IMAGE hierarchical database. As is typical of many legacy systems, MCIAIS suffers from many shortcomings:

- It has over 110 "spaghetti coded" programs that are difficult to maintain, modify, and upgrade.
- It does not have underlying data or process models.
- The programs have poor functionality, no statistical analysis capability, and limited "ad hoc" query capability.
- It utilizes a "closed" non-relational database.
- It does not support Graphical User Interfaces (GUI).

In response to these shortcomings, MCI initiated a modernization project to redesign MCIAIS using "open" system architecture (both hardware and software). In addition, MCI is also reviewing and redesigning the business processes to better support its mission and current advances in training and education. MCI contracted with the Naval Postgraduate School to perform an analysis and develop a business process reengineering evaluation and migration plan proposal. A team of students was selected by Dr. Magdi N. Kamel, Ph.D. to conduct the evaluation and prepare the proposal.

This thesis documents the process redesign portion of the Student Services Department (SSD) information system. The research was conducted from August 1996 through August 1997 The complete project report is available as the following two technical reports.

- NPS-SM-97-001: *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Preliminary Report* (Kamel et al., 1997)

- NPS-SM-97-006: *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Final Report* (Kamel et al., 1997)

Other Naval Postgraduate School theses that cover related aspects of the modernization project include:

- Data model design: *A Relational Database Model and Data Migration Plan for the Student Services Department at the Marine Corps Institute* (Slaughter, 1997).

- Architecture model design: *A System Architecture and Migration Plan for the Student Services Department of the Marine Corps Institute* (Evers Jr., 1997).

- Prototype design: *Development of Graphical User Interface Standards and Prototype for the Student Services Department of the Marine Corps Institute* (Hehe, 1997).

B. OBJECTIVE

The objective of this thesis is to perform a detailed analysis of process requirements, review existing processes, develop the AS IS process model, redesign the processes to increase efficiency and reduce costs, and develop a TO BE process model to improve the current business processes using IDEF0 models. Additionally, data flow diagrams of the To-Be AIS were developed to assist in prototype design and coding.

C. RESEARCH QUESTIONS

This research was focused on the following questions:

- Can a process model be developed to reflect the current business process of the Student Services Department of the Marine Corps Institute (MCI)?

- Can the business process of the Student Services Department of MCI be reengineered?

- Can a process model be developed to reflect the reengineered business process of the Student Services Department of MCI?

- What BPR methodology is most suitable for reengineering the Student Services Department of MCI?
- What CASE tool is most suitable for reengineering the Student Services Department of MCI?
- Can a CRUD diagram be developed to support the BPR of the Student Services Department of MCI?

D. SCOPE, LIMITATIONS, ASSUMPTIONS

Prior to reengineering a large and complex organization, a business process reengineering methodology, a modeling technique, and supporting CASE tools must be identified. Once these are chosen, reengineering begins at the enterprise level and progresses down through the organization examining every process for ways to improve it. This thesis focuses on the process modeling, analysis, and redesign of the Student Services Department of the Marine Corps Institute. Other business areas at MCI identified in the enterprise analysis could be analyzed in a similar fashion in future efforts.

E. RESEARCH METHODOLOGY

Following a literature survey of business process reengineering methodologies, the methodology adopted for this research combines classic business process reengineering philosophy with information engineering techniques developed by James Martin. Before the data gathering stage of the project, considerable time was spent by the authors evaluating potential CASE tools. Once a CASE tool was chosen, more time was spent developing expertise with the tool's features and capabilities. With the technical ground work laid, the authors each made three trips to MCI to interview personnel, observe daily operations, and gather documents. Personal visits were augmented by telephone conversations and the electronic exchange of model diagrams and associated information.

The information gathered was analyzed and structured by conducting the following activities: MCI enterprise analysis, business area analysis of the Student Services Department resulting in As-Is model development, logical redesign of the Student Services Department processes, To-Be model development, and SSD information system model redesign. The final result was a proof-of-concept prototype fully described in another team member's thesis (Hehe, 1997). Complete model diagrams and documentation are contained in Naval Postgraduate School Technical Reports cited earlier.

F. DEFINITIONS AND ABBREVIATIONS

The following definitions and abbreviations are used throughout the thesis.

ABC	Activity Based Costing
AIS	Automated Information System
ALMAR	All Marine Message
AVRS	Automated Voice Response System
BAA	Business Area Analysis
BPI	Business Process Improvement
BPR	Business Process Reengineering
CASE	Computer Aided System Engineering
CIM	Corporate Information Management
DoD	Department of Defense
FEA	Functional Economic Analysis
FPI	Functional Process Improvement
GUI	Graphical User Interface

HQMC	Headquarters, United States Marine Corps
ICOM	Input, Control, Output, Mechanism (acronym for all arrows on an IDEF0 activity model)
IDEF0	Integrated Definition for Information Modeling Language for Process Modeling
IT	Information Technology
LOGAIS	Logistics Automated Information System
MCC	Major Command Code
MCCDC	Marine Corps Combat Development Command
MCI	Marine Corps Institute
MCIAIS	Marine Corps Institute Automated Information System
MCTFS	Marine Corps Total Force System
MCU	Marine Corps University
MIS	Management of Information Systems
MISD	Management of Information Systems Department
MOS	Military Occupational Specialty
NCO	Noncommissioned Officer
OSD	Occupational Specialty Department
PME	Professional Military Education
PMED	Professional Military Education Department
RUC	Reporting Unit Code
SNCO	Staff Noncommissioned Officer
SSD	Student Services Department

SSN	Social Security Number
UAR	Unit Activity Report
USMC	United States Marine Corps

G. ORGANIZATION OF STUDY

Chapter II of this thesis is a description of the Marine Corps Institute, the problems with its current information system, and the overarching MCI modernization project. Chapter III discusses the information engineering methodology developed by James Martin and how it was applied to the MCI modernization project. Chapter IV discusses business process reengineering methodology and its application to reengineering the Student Services Department of MCI. Chapter V is a discussion of the IDEF0 modeling technique, functional decomposition techniques, data flow diagramming, and CASE tool alternatives that were considered for use on this project. Chapter VI presents the enterprise analysis of MCI. Chapter VII details the business area analysis and the information system design portions of the methodology to the Student Services Department of MCI. Finally, Chapter VIII details recommendations for implementation and further research, and conclusions.

II. THE MCI MODERNIZATION PROJECT

This chapter provides the details of the Marine Corps Institute (MCI) Modernization Project performed by the Naval Postgraduate School MCI Thesis Team. The chapter begins with a background of MCI, which includes a discussion of its history, mission, organization and description. The chapter introduces the MCI Automated Information System (MCIAIS) identifying the system interfaces, non-system interfaces, and known problems. The chapter presents the strategic plan for the enterprise-wide modernization effort of MCI. It then discusses the Naval Postgraduate School (NPS) role, the NPS MCI team members and their focused area of research. The chapter concludes with the benefits that MCI will reap from the project presented in a "process perspective".

A. MCI BACKGROUND

MCI started as a school house in Quantico with part-time Marine instructors, but quickly developed into an accredited correspondence school. It was established to provide vocational training and personal development through part-time education during a period of the 1920s fraught with military indifference. A brief review of its history, mission, organization and description of services may shed some light on where its future should lead. (MCI Dream, 1997)

1. History

Lieutenant General John A. Lejeune is often referred to as "the greatest of all Leathernecks." Among his noteworthy achievements during more than 40 years of service include the thirteenth Commandant of the Marine Corps, the first Marine to command an Army Division, a recognized strategist and effective leader (Lejeune, 1949). Lejeune also established the Fleet Marine Force, formalized Amphibious Doctrine (Hough et al., 1997), and founded the Marine Corps Institute (MCI Dream, 1997). Lejeune left an indelible mark on the Marine Corps challenging leaders to develop their subordinates much like "fathers to sons or teachers to scholars"(Larson, 1996).

Exhibiting that leadership against substantial resistance, then Major General Lejeune issued a Post Order on November 12, 1919, one month after assuming command of Marine Barracks Quantico, Virginia, establishing the first three vocational schools in the Marine Corps. The schools operated under the premise that normal military duties would be performed in the morning and vocational training would be available in the afternoon on a voluntary basis. The Vocational Training Schools Detachment at Quantico opened on January 5, 1920. Courses like Automobile Mechanics, Band Music and Playing, Blacksmithing, Carpentry, Cooking and Baking, Drafting, Electrical Mechanics, Forestry, Gas Engine Design and Operations, Livestock, Painting, Plumbing, and Stenography and Clerical Work clearly demonstrated their utility during that era. (MCI Dream, 1997)

MCI's affiliation with correspondence courses began almost as soon as the Vocational Training Schools Detachment was established. The first Director, Lieutenant Colonel William C. "Bo" Harllee, traveled to Scranton, Pennsylvania and made an agreement with International Correspondence School (ICS) to use their courses for the instruction of Marine students. ICS reviewed ten percent of the completed examinations and Marine officer instructors reviewed the rest. This arrangement provided Marines, that satisfactorily completed a course, a completion certificate from ICS and co-signed by the Commandant of the Marine Corps. (MCI Dream, 1997) This accreditation and certification philosophy remains with MCI today, as an incentive and reward for Marines pursuing self-improvement.

The correspondence course aspect was first implemented in May 1920 when enrolled students at Quantico were transferred to the USS HENDERSON and ordered to counter a potential uprising in Mexico. Lieutenant Colonel Harllee sent a school representative with course materials to the ship. The action demonstrated the need, and intent, to support Marine education using methods that do not infringe upon the Marine warfighting mission "in every clime and place." The popularity of self-improvement was reflected in increased enrollments and a recruiting campaign that offered enlistees an assignment to Quantico where they could enroll in one of the schools. (MCI Dream, 1997)

MCI has been moved and redesignated many times over the last 77 years. The Vocational Training Schools Detachment was forced to close the first month it opened because of an influenza epidemic. However, it reopened on the recognized founding date, February 2, 1920. The Vocational Training Schools Detachment at Quantico was officially designated as the Marine Corps Institute in July of 1920 and moved to Marine Barracks Washington, DC on November 10, 1920. In January 1926, military subjects were added to the available correspondence courses. In December of 1946, it was organized under the Extension Division, Marine Corps Schools. In November of 1953, MCI was directed to discontinue its vocational courses, which were provided by the U.S. Armed Forces Institute, and focus only on military subjects. At this time, the arrangements with ICS ended. In June of 1977, the National Home Study Council gave accreditation to MCI. In October of 1980, the Extension School and MCI was consolidated and all Marine Corps training and education correspondence courses became and the responsibility of the Director, Marine Corps Institute. MCI moved to its current location at the Washington Navy Yard in November 1993. Today, most MCI courses receive college credit through American Council on Education (ACE) accreditation. (MCI History, 1997)

2. Mission

MCI has two missions that govern their operations: education of Marines and ceremonial support to the Commandant of the Marine Corps. Early in its history, MCI administered and distributed correspondence courses developed by ICS. Today, in addition to administration and distribution, MCI must also identify and develop the courses that improve Marine proficiency. This shift in focus accounts for the evolution to MCI's current mission (MCI In-Brief, 1996):

> To develop, publish, distribute, and administer distance training and education materials to enhance, support, or develop required skills and knowledge of Marines and to satisfy other training and education requirements as identified by the Commanding General, Marine Corps Combat Development Command.

In the earliest days of MCI, the staff performed their primary military duties first and volunteered to assist in the vocational schools as a collateral duty. Today, MCI has a full-time staff, Marines and civilians, dedicated to course development and administration. Not to stray too far from their roots, the Marines have retained collateral military duties. This second mission of MCI results from its administrative assignment to Marine Barracks, Washington, DC (MCI In-Brief, 1996):

> To support the ceremonial mission of Marine Barracks, Washington, DC

There are seven tasks that detail the execution of the two missions (MCI Mission, 1997):

1. Plan, develop, and administer a distance training program to increase the specialized skill proficiency of enlisted Marines.

2. Plan, develop, and administer nonresident professional military education courses that parallel and supplement those resident courses provided by the Marine Corps Combat Development Command.

3. Develop, print, stock and distribute the Marine Battle Skills Training Handbook and a performance test for use by commanders to measure proficiency in the Marine battle skills.

4. Design, develop, revise, stock, and distribute training materials for those tasks contained in the Individual Training Standards system that are the responsibility of the unit commander to teach.

5. Develop, print, stock, and distribute additional training materials as may be directed by the Commanding General, Marine Corps Combat Development Command.

6. Provide personnel and administrative support as required for ceremonial purposes as directed by the Commanding Officer, Marine Barracks, Washington, DC.

7. Provide automated information support to Marine Barracks, Washington, DC.

These tasks specify Marines as the target student population. They also assign responsibility for the complete training package, from development through delivery, to MCI. These tasks also give an indication of the organizational requirements necessary to successfully carry out the seven mission tasks.

3. Organization

MCI is operationally controlled by the Commanding General, Marine Corps Combat Development Command (CG, MCCDC). Specifically, the Director, Training and Education Division, MCCDC, provides operational guidance to MCI. MCI receives technical direction on Professional Military Education course content from the President, Marine Corps University. MCI is administratively controlled by the Commanding Officer, Marine Barracks, Washington, DC who is also the Director of MCI. (MCI In-Brief, 1996)

Marine Barracks, Washington, DC is composed of a headquarters company, two ceremonial companies and the MCI company. The Barracks performs two evening parades every week during the summer and supports other ceremonial activities at the White House. The MCI Company of Marine Barracks provides escort and support services for the parades. The MCI company consists of six departments: Headquarters, Professional Military Education, Occupational Specialty, Logistics, Student Services, and Management Information Systems. (MCI In-Brief, 1996)

The Headquarters Department has four sections that provide staff cognizance over MCI's departments involved in the production and support of distance education and training materials. The Professional Military Education Department(PMED) provides courses based on Marine Corps resident PME school curricula or resident school prerequisites. The Occupational Specialty Department (OSD) develops and maintains military occupational specialty (MOS) related courses and MOS specific job aids. The Logistics Department (LOG) is responsible for the procurement, stock management, packaging, and distribution of MCI courses and training products. The Student Services Department (SSD) is responsible for the enrollment, grading, and student record administration of the distance education and training programs. The Management Information Systems Department (MISD) provides automated student administration and course material handling through MCI's automated information system (MCIAIS) and information systems support to MCI and the Marine Barracks. (MCI Mission, 1997)

4. Description of Services

Since the days of General Lejeune, the Marine Corps has advocated personal development, and MCI has been focused on this objective. MCI has shifted from providing vocational and personal development courses for uneducated Marines in the early days to courses designed to improve the performance of today's more educated Marines. MCI currently maintains six PME courses, 166 Military Operational Specialty (MOS) related courses, 16 MOS job aids, the Marine Battle Skills Training Handbooks and the Battle Drill Guide books. These materials are designed to enhance the student's proficiency in their skill specialty, increase their awareness of Marine warfighting concepts and tactics, and prepare them for advancement to the next higher grade. (MCI Mission, 1997)

The Marine Corps has emphasized the importance of completing MCI courses by granting enlisted Marines extra points toward promotion cutting scores. This incentive provides a more immediate benefit to an individual than college credit and education. (MCO1400.32, 1989)

Professional Military Education (PME) is intended to ensure that leaders have the knowledge required for their grade, and prepare them for the next higher grade (ALMAR26, 1996). Marine Corps University (MCU) was established to develop and implement PME programs (Mundy, 1994). The Commandant of the Marine Corps announced, with the All Marine message (ALMAR) 256-93, that promotion and retention would be linked to satisfactory completion of PME requirements (ALMAR256, 1993). MCU has established centralized resident PME schools and provides technical guidance to MCI on the development of non resident PME programs.

MCI programs were established as the baseline for PME programs, serving as either a substitute for resident programs or fulfilling prerequisites prior to acceptance in a resident program (ALMAR339-96). PME is so important that unless a Marine has completed the prescribed grade-specific PME program, resident or non-resident, he/she will not be considered "fully qualified" for promotion or retention (reenlistment). (ALMAR256, 1993)

Whether the guidance was seen as a scare tactic or the result of a successful awareness campaign, Marines responded to the non-resident educational opportunities provided by MCI. On a monthly basis, MCI processes 50,000 enrollments, grades 80,000 lessons and examinations, prints and mails 200,000 individual status documents, 56,000 completion certificates and diplomas, 1,500 Unit Activity Reports, and produces 45 internal management reports. The management of this student record activity is the responsibility of the Student Services Department. (MCI In-Brief, 1996)

B. MCI AUTOMATED INFORMATION SYSTEM

The mission of SSD is to support the enrollment, grading and student record management of the Marine Corps distance education and training programs. In support of its mission, SSD employs an automated information system (AIS) to automate the actions required to support a student in the MCI correspondence program, maintain student records, and produce necessary management reports. (MCI Mission, 1997)

1. MCIAIS System Overview

The automated system, known as the Marine Corps Institute Automated Information System (MCIAIS), is a legacy system developed in the late 1970's. It uses a

Hewlett-Packard 3000 mini computer running the MPE/iX operating system. MCIAIS is written in the Hewlett-Packard proprietary language, "Transact", and accesses a Turbo-IMAGE hierarchical database. MCIAIS maintains eight non-relational databases (MCI In-Brief, 1996):

- ANSREF - contains all answers and references for every exam and lesson.
- ARCHIV - contains student records that have been inactive for 13 months or more.
- DBLOGS - contains the inventory records of courses and components.
- MCIDB - contains all student course and information records.
- MMSDB - an extract of the Marine Corps' Manpower database that contains information on all active duty Marines.
- MSEXAM - contains information on exam stock on-hand status.
- REMPDB - an extract of the Marine Corps Reserve's Manpower database that contains information on all class III reserve Marines.
- SALEDB - contains the raw data for the Statistical Analysis of Lessons and Exams Report (S.A.L.E. Report).

These databases are only accessible from terminals within the Student Services or MIS Departments.

2. System Interfaces

System interface refers to the ability of two automated information systems to exchange data directly. While MCIAIS is a "closed" system, not originally designed to interface with external systems, the volume of transactions and the customer base has forced MCIAIS to be modified so that it can interact with certain external systems to reduce manual data entry. There are four systems with which MCIAIS interfaces: Marine

Corps Total Force System, the Marine Corps Unit Diary System, Conversant and the Logistic Automated Information System.

The Marine Corps Total Force System (MCTFS) is the database maintained by Defense Finance and Accounting Center (DFAS) in Kansas City and contains all of the manpower information on Marines, both active duty and reservists. Specified MCTFS data elements are periodically downloaded to populate MCIAIS. Specifically, MCIDB and REMPDB are replaced by the download. This information is used by MCI for enrollment validation and material distribution. The interface is a labor intensive process that requires NATURAL computer language scripting and a lengthy daily download process through a host server at MCCTA in Quantico, Virginia.

The MCTFS database is updated by individual Marine Corps units using an on-line system called the Unit Diary. Marine Corps units submit Unit Diary transactions to MCTFS. MCTFS screens the transactions and posts the valid transactions to the database.

In the case of Unit Diary transactions that request MCI enrollment, disenrollment and completion, the validated transactions post to an advisory database. Transactions that fail screening post to the unit's Unit Diary Error/Advisory Report. MCI downloads the validated transactions from the advisory database. This is also a labor intensive effort that requires scripting in the computer language ROSCOE.

Once the Unit Diary transactions are downloaded, they must be formatted as input to MCIAIS. The transactions can error out when they run the program to post the transactions to MCIAIS. Each Unit Diary transaction rejected by MCIAIS must receive a response to notify the Marine Corps unit of the failed transaction. The unit then must notify the student of the failed transaction, research the discrepancy, and resubmit the corrected transaction.

MCI also maintains an Automated Voice Response System (AVRS) called Conversant. This system responds to a caller's telephone keypad entry of social security number and course number and provides the caller with course status. This is an Oracle® database that contains copies of records for every student currently enrolled in an MCI course or program. The database is updated by during a weekly cycle that downloads, by overwriting, key data element to the Conversant database.

The Logistics Department maintains a separate information system called LOGAIS. It provides automated management of the fiscal plan, organizational supply, logistic support and procurement of MCI materials. It also provides certain inventory management functions. MCIAIS does not interface directly with LOGAIS for inventory management. MCIAIS creates mailing labels with material information and the student's address for material distribution. Periodically, the inventory data is manually input into MCIAIS.

3. Non-System Interfaces

Non-System interface refers to interactions between an automated information system and another source that is not an automated information systems. This section will address six non-system interfaces that exist outside the MCIAIS: course and program development, course and program advertisement, Unit Activity Reports, telephone inquiries, U.S. mail, and electronic mail.

MCI courses and programs are designed in OSD and PMED respectively. All courseware is developed on PC's in the respective departments. Each course is routed in paper form for editing and course content review. Once approved, the "proof" is prepared and sent to the printer for reproduction. The new or revised course is added to the course catalog and appropriate data elements manually entered into MCIAIS pending receipt of materials. Students can be enrolled in the new course once the materials arrive and are stocked.

Availability of new courses and revised courses must be advertised. Advertisement is done using three methods: MCI Course Catalog, MCI newsletters, and MCI mobile briefing teams. The MCI Course Catalog is revised and published, in paper form, annually making it an outdated tool for advertisement. MCI newsletters are published quarterly to update Marine Corps units on the availability of new or revised courses and other initiatives at MCI. MCI also forms a team that travels to major commands. The briefing teams meet with the Marine Corps unit commanders, training officers and training non-commissioned officers (NCO) to provide an update of current initiatives, training on administrative procedures and changes to old procedures, and to solicit input on MCI performance. The newsletters and the briefing teams, however, only reach a small fraction of the customer base.

The Unit Activity Report (UAR) is designed to give the Marine Corps unit Commander visibility over the unit's participation in MCI courses and programs. It contains a summary section with data compiled from enrolled students in each unit and a detailed transaction history section for each student. MCI prepares a UAR for every

Marine Corps unit twice a month. One report is produced in paper form and mailed to the unit at the end of the month. Another report is produced in digital format and stored on a file server for units to download.

The UAR also serves as a tool for reconciliation between the unit and MCI. The Marine Corps unit training NCO verifies that the unit's enrollment record matches MCI's record reflected in the UAR. The training NCO annotates any discrepancies or expected changes on the UAR and returns it to MCI. Annotations would reflect that a Marine has enrolled in a course that has not posted, been transferred, completed a course, disenrolled, or is awaiting completion certification. MCI manually processes the returned UARs by inputting the corrections into the student's record on MCIAIS.

Telephone inquiries are handled by the Student Services Department. The Immediate Assistance section of SSD has a number of telephones staffed with clerks to answer inquiries. Non-Marine students, potential students and Training NCOs can contact MCI with their inquiries. MCI administrative procedures advise Marine students to address their questions to their unit Training NCO first. If unable to answer the question, the training NCO will contact MCI for resolution. This procedure is intended to minimize telephone calls to MCI.

MCI receives a large volume of U.S. mail on daily basis. This mail consists of enrollment requests, material requests, inquiries, disenrollment notification, returned UARs, and completed lesson or course examinations for grading. The mail must be opened, sorted and distributed. This is a manual and time consuming process.

Electronic mail is another method of interacting with MCI. The volume of electronic mail processed by MCI has grown significantly over the last two years due to expanded access to the Internet and increased unit access to the Marine Corps' Banyan-vines network. Electronic mail traffic consists of enrollment requests, material requests, status inquiries, disenrollment notification, and returned UARs.

4. Problems with MCIAIS

As is typical of many legacy systems, MCIAIS suffers from many shortcomings. It utilizes a "closed" non-relational database. It lacks well-defined procedures without underlying data or process models and the code has been poorly documented. It has over 110 "spaghetti coded" programs that are difficult to maintain, modify, and upgrade. The programs have poor functionality, no statistical analysis capability, and limited "ad hoc" query capability. It does not support Graphical User Interfaces (GUI). These problems lead to further questions about data integrity and the credibility of the stored data.

Internal problems within MCIAIS contribute to the loss of functionality within some of the databases. Many of the problems can not be repaired because of poor documentation and untraceable code within the legacy system.

One example of lost functionality is the SALEDB, which provides the statistical analysis capability to determine the quality and effectiveness of test questions and answers. This capability provided critical information to the distance training instructors (DTI) which develop and revise the courses and examinations.

The functionality of DBLOGS, the inventory management system, is also lost. As a result, the Logistics Department performs frequent cyclic inventories and manually adjusts the on-hand quantity within MCIAIS to reflect changes. In the meantime, the Logistics Department switched to another logistics management system, ATLASS, that provides inventory functions in addition to functions not directly related to the inventory management of course materials.

The interface with MCTFS poses an additional problem. The procedure for downloading Marine student information includes backing up the MCIAIS MCIDB and REMPDB databases and replacing them with the downloaded data. Any changes that were entered into the two databases are not reflected in the new data. This negates any Marine student address changes that have been updated via telephone, electronic mail or UAR since the last cycle.

The UAR does not receive the attention it was designed to attract. Due to MCIAIS obsolescence, inaccurate reports have been historically produced. With over 1500 UARs produced monthly, a lot of manual data entry is required to input the necessary changes.

MCIAIS data accuracy was exacerbated by the UAR cycle time. As noted, student history data was not always accurate. A function of the UAR is to reconcile MCIAIS data with actual data from Marine Corps Units. The volume of corrections requiring manual entry into MCIAIS from UARs invariably did not get accomplished before the next UARs were distributed. Training NCOs became frustrated by MCI's apparent lack of response and stopped returning UARs. Without corrected UARs, additional inaccuracies developed. Innovative training NCOs discovered that calling MCI and submitting corrections directly to MCI through an immediate assistance clerk was an effective method to correct their unit's records. This solution heightened telephone congestion problems.

At a time when MCI was experiencing its greatest challenges with MCIAIS's ability to respond to the increased volume pressures as MCI courses and programs became requisite for promotion, the Marine Corps introduced Marine Mail. Marine Mail is an electronic mailbox set up for the Commandant to receive feedback about any subject directly from Marines. MCI problems were a common subject of Marine Mail. This type of visibility gave MCI an awareness of problems that they could not otherwise document and added impetus to find solutions. Many of the MCI problems can be attributed to the problems characteristic of legacy systems.

One common problem identified was poor responsiveness and reliability when enrolling in MCI programs. In 1995, MCI initiated an enrollment process for active duty and reserve Marines using the Marine Corps unit's Unit Diary system. This required detailed coordination with the programmers of MCTFS to establish prerequisite screening criteria and coded modules. Despite the MCTFS enrollment edits, Unit Diary transactions that passed MCTFS screening do not pass the MCIAIS screening. By shifting the data entry tasks to the unit, nearly 90 percent of enrollments are now automated. Research showed that it takes a unit an average of one week to process and run a Marine's enrollment request on the unit diary and another week for that request to be processed and posted on MCIAIS. There was not an effective or timely way for MCI to inform a student that an enrollment attempt failed. Other methods of enrollment, such as R-1 card by mail or the monthly Unit Activity Report, are more reliable. Those methods are also slow because of MCI manual data-entry processing time. This demonstrates the difficulty of programming between systems with a "closed" system. (ALMAR51, 1996)

Another problem frequently identified was that delivery of MCI course materials was unreliable and not timely. A survey conducted by Columbia Services Group identified that faster service was what MCI students wanted most from MCI (MCIAIS Brief, 1996). Research attributed three causes to delivery problems. (ALMAR51, 1996)

First, the vast majority of delays for material was because MCI did not have a valid address or location for individual Marines. MCIAIS was using an outdated Reporting Unit Code (RUC) structure for Marine unit addresses instead of the current Major Command Code/ Reporting Unit Code (MCC/RUC) structure used by the Marine Corps Total Force System (MCTFS). The MCTFS MCC/RUC is updated every time the unit's address changes, as well as when a Marine is transferred. Since MCIAIS was using the RUC structure for mailing labels, which had not been updated for 18 years, materials were shipped to the wrong address. Consequently, MCI depended on the Commander's monthly Unit Activity Report (UAR) to identify a Marine's valid address. But only 60 percent of the units returned their UAR to MCI every month. (ALMAR51, 1996)

The second cause was associated with Marine Corps unit mail handling procedures. MCI addressed course materials to the unit and the unit distributed the materials to the individuals. MCI research discovered that U.S. mail takes between three to twelve days to deliver course materials to units around the world. Delays beyond that were attributed to unit mail handling procedures. (ALMAR51, 1996)

The third cause of delayed course material delivery was attributed to replacement of out of stock materials. MCI found that it took up to two months to have course materials printed. This is compounded by the lost inventory management functionality of DBLOGS. There was not a reliable method to anticipate how soon the stock of a course would expire. Resolution of this problem within MCIAIS will require extensive analysis and coding to return the functionality of DBLOGS or establishing a direct system interface with LOGAIS. (ALMAR51, 1996)

Yet another problem identified by Marine Mail was the delay in the delivery of final examinations. Administrative procedures required the student to complete the course lessons and/or a review exam and submit them to MCI for evaluation prior to issuing the proctored final exam. Once submitted, MCI would return the results and the final exam to the unit Training NCO to administer. The same mailing address problems associated with course materials also hampered final examination delivery. (ALMAR51, 1996)

The last problem raised by Marine Mail was inconsistent posting of a course completion to the Marine's official military record at Headquarters, Marine Corps. MCI research identified approximately 20 percent of course completions recorded in MCIAIS failed to post to the MCTFS record. When MCIAIS transferred data to MCTFS, data was lost. This was attributed to logic flaws within MCIAIS. This is another example of how undocumented "fixes" in a legacy system are difficult to trace or troubleshoot. It also demonstrates the risk of a "closed" system interface with another system. (ALMAR51, 1996)

MCI was established on a foundation of "vision" by far-sighted and resourceful innovators. Over the past ten years, the information system could barely support MCI's primary mission of student record management, let alone accommodate changes necessary to keep pace with advances in distance learning. Innovation was spent on creating courses that the limited information system could support. The hallmark of vision was blurred and MCI's reputation was tarnished. MCI was reacting, revising and distributing courseware that headquarters contrived, instead of designing innovative ways to educate Marines.

C. MCI MODERNIZATION PLAN

In response to the shortcomings, MCI initiated a modernization project to redesign and rewrite MCIAIS using "open" system architecture, both hardware and software. In addition, MCI began reviewing and redesigning their business processes to better support its mission and advances in training and education.

1. Overview

MCI's modernization plan began with a requirements analysis that identified system design alternatives. A three-phase strategy was developed from the alternatives that planned for three phases of transition.

The first phase focuses on transforming the information system from the current MCIAIS to a new MCIAIS-II. This plans for the replacement of the "closed" legacy system with an open system, relational database using Fourth Generation Programming Language (4GL). The plan requires documentation of the data and process models. MCIAIS-II should maintain the same functionality of MCIAIS-I, but adds capability to send an electronic copy of diplomas to the Manpower Management Records Branch

(MMRB) of Headquarters, Marine Corps (HQMC), print mailing labels for individual course components, use "selected grade" of a Marine to determine enrollment eligibility, and has the ability to distinguish between different types of course media (i.e., paper, diskette, CD-ROM, etc.). MCIAIS-II should also perform statistical analysis of exams and ad hoc reporting for management and users. This phase includes plans to stand up a non-interactive Internet Home Page for MCI and to upgrade the Automated Voice Response System (AVRS) for enrollment without operator assistance. (MCI Redesign, 1997)

The second phase plans for enhancements to MCIAIS-II. The customer should have the ability to enroll or inquire over the telephone AVRS or Internet accessing MCIAIS-II directly without a MCI operator. MCI should have an Automated Help Desk installed. This phase also includes the automation of warehouse operations and complete integration with MCIAIS-II. (MCI Redesign, 1997)

The third phase is focused on development of Distance Learning Centers (MCI Redesign, 1997). MCI's Distance Learning Center is connected to Training and Education Division's distributed learning plan. Distributed learning is the use of instructional technology to increase an instructor's effectiveness and provide a student-centered learning environment. The distributed learning plan is based on course modernization, end user computers, and a network infrastructure. (Eisiminger, 1996)

2. NPS Role

MCI contracted with the Naval Postgraduate School to lay the foundation with the modernization plan's first phase. A team of NPS students was selected by Dr. Magdi Kamel to conduct a Business Process Reengineering evaluation and prepare a migration plan proposal. Two reports, *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Preliminary Report*, (Kamel et al., 1997) and *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Final Report*, (Kamel et al., 1997), were prepared by the NPS MCI Team and delivered to MCI.

a. Deliverables

The objective of the NPS effort is to demonstrate a methodology that can assist MCI in transforming their current legacy information system into a modern environment that can take advantage of contemporary architectures and open technologies. Specifically, the NPS effort is to accomplish the following:

1. Perform a detailed data and process requirements analysis at both the enterprise and the Student Services Department business area levels
2. Review existing SSD processes and develop a new model that includes redesigned processes to increase their efficiency and reduce costs
3. Develop a target hardware, software, and network architecture based on open systems
4. Develop a proof-of-concept prototype to validate the proposed methodology
5. Develop a data migration and change management plan for the new system.

The first report, *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Preliminary Report*, (Kamel et al., 1997), develops an enterprise-wide architecture for the use of information systems in support of the MCI activities. The overall architecture is specified by defining three types of architectures:

1. *Data Architecture*: Defines the major kinds of data needed to support MCI's business. IDEF1X modeling is used to represent data.

2. *Functional Architecture*: Defines the major functions of the enterprise needed to manage the data. IDEF0 modeling is used to represent this architecture.

3. *Technology Architecture*: Defines the technology platforms needed to provide an environment for the applications that manage the data and support business functions.

In addition to defining the above architectures, a set of matrices is developed showing the relationship between entities, functions, organization units and locations. The information provided by these matrices is intended to challenge management to think about its structure, mission, goals, and the information needed to run the MCI business.

The second report, *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Final Report*, (Kamel et al., 1997), conducts a detailed business area analysis of the Student Services Department (SSD) and Management Information Systems (MIS) functions. It presents a business area analysis by defining three types of models:

1. *SSD Data Model:* Defines the major data entities, attributes and relationships used by SSD. IDEF1X technique is used to represent the data model.

2. *SSD Process Model:* Defines the major processes needed to manage that data and support the operations of SSD. IDEF0 modeling is used to represent the process model.

3. *SSD Technology Model.* Defines the technology platform options required to provide an environment for the applications that manage the data and support the SSD business processes.

Specifically, the final report develops detailed data, process, and technology models for the SSD and MIS functions. The report also includes the associated design specifications for development of information systems applications to support Student Services, and a generated Oracle® relational database schema with associated triggers.

In addition to defining the above models, a proof-of-concept prototype of selected applications was developed to validate the methodology, refine resulting models and to establish graphical user interface standards for use across all MCI applications.

b. Team Members and Research Topics

The effort by NPS faculty and five students formed an integrated team to support the redesign of the Marine Corps Institute's Automated Information System (MCIAIS) using contemporary architectures, methodologies and tools. In addition to the two reports submitted to MCI, four theses are also presented.

Dr. Magdi N. Kamel is an Associate Professor of Information Systems in the Department of Systems Management. He has been at the Naval Postgraduate School since August 1988. His research interests are in the areas of application development, database management systems and information system architecture. Since joining the faculty at NPS, he has been the principal investigator on several research projects in application development, database management and expert systems. He is the author of numerous published papers on these subjects and a driving force in the NPS MCI Team activities.

Major Aaron T. Slaughter is a U.S. Marine Corps tank officer. He has a Bachelor of Arts in Political Science, presently in a Master of Science Degree program for Information Technology Management at the Naval Postgraduate School. He has been involved in several research projects in database management, application development and distributed support systems. He performed the data analysis and, working with the process model, produced the data model and data migration plan for the MCI Modernization Project.

Major Clayton O. Evers Jr. is a U.S. Marine Corps communications officer. He has a Bachelor of Arts in Political Science, presently in a Master of Science Degree program for Information Technology Management at the Naval Postgraduate School. He has been involved in several research projects in network management, database management, application development and distributed support systems. He performed the system architecture analysis and, using the process model, produced the recommendations for the target architecture and the change management plan for the MCI Modernization Project.

Commander (Select) Gerald L. Hehe is a U.S. Navy E-2C Naval Flight Officer. He has a Bachelor of Arts in Business Management, presently in a Master of Science Degree program for Information Technology Management at the Naval Postgraduate School. He has been involved in several research projects in database management, application development and distributed support systems. He performed the user interface analysis and, using the data, process and information models, produced a prototype to demonstrate the functionality of selected applications for the MCI Modernization Project.

Lieutenant Colonel (Select) Kurt A. Baden is a U.S. Marine Corps CH-46E pilot. He has a Bachelor of Science in Aerospace Engineering, presently in a Master of Science Degree program for Information Technology Management at the Naval Postgraduate School. He has been involved in several research projects in database management, application development and distributed support systems. He performed the process analysis and produced the information system modeling effort for the MCI Modernization Project.

Major Gerald A. Peters is a U.S. Marine Corps aviation supply officer. He has a Bachelor of Science in Political Science, presently in a Master of Science Degree program for Information Technology Management at the Naval Postgraduate School. He has been involved in several research projects in database management, application development and distributed support systems. He performed the process analysis and produced the process modeling effort for the MCI Modernization Project.

3. Business Process Model Benefits

The focus of this thesis is directed at the reengineering of MCI and the resulting process models. MCI has no prior model documentation on their information system or business processes. The documentation provided by the two reports and this thesis can facilitate communication between departments within MCI. The communication can develop a common understanding of department processes and their inter-relationship to each other.

Such documentation is useful for understanding the magnitude of change and identifies the tasks required to migrate to the new process. The documentation is dynamic. It will, and should, change to reflect continuous process improvements. It aids in recognizing previous problems and ensures those problems are not repeated in new processes. Documentation can provide a measure of the value of a proposed innovation. Data collection provides situational awareness. Given a process objective of reducing cost, for example, data collection would need to include the measurement of cost with which to compare. (Davenport, 1993)

Since MCI has no documentation on their current system, the process model can serve as baseline documentation to support their current phase of modernization. It also provides a methodology that can be used with the subsequent phases of their redesign effort. The methodology employed was developed after a broad spectrum of techniques were evaluated and selected one as appropriate to fit MCI.

III. INFORMATION ENGINEERING APPLICATION TO MCI

This chapter describes the Information Engineering (IE) methodology and its relevance to the MCI modernization project. The first section briefly describes the entire methodology. Portions of the methodology that pertain to this thesis, enterprise analysis, business area analysis, and business system design are discussed in greater detail. Details of business process reengineering methodology, process modeling, CASE tools, and data flow diagrams are covered in later chapters.

A. INFORMATION ENGINEERING METHODOLOGY

James Martin originally conceived the information engineering methodology as a development tool for new information systems. Since IE provides a comprehensive framework for satisfying an organization's information needs, the analytical techniques can also be applied to the reengineering of existing systems. IE encompasses all phases of life cycle development and implementation. IE methodology models the business process with three distinct but equally important models: a business data model, documenting the information and its source used by the business; a business process model, that decomposes the process into more detailed activities; and the interaction between the two, that defines the relationship between the data and the process models. Model development begins with analysis of business objectives and describes techniques to be applied that yield executable applications in the target environment.

1. Information Engineering Overview

Collectively, information engineering is an integrated set of tasks and techniques designed to support the systems development process. Integration is the crucial aspect that accounts for successful outcome. Integration is fostered by a series of abstract layers devised to provide different views of the same business model. Within this information engineering framework, each layer serves as a platform from which to view the application systems in a different level of detail. If the system under evaluation is a new system, the path through the layers follows traditional system design methodology. However, if the methodology is applied to reengineer an existing system, entry may be made at the appropriate level and reengineering improvements are pushed through to the execution level. Figure 1 illustrates the IE layers and some typical paths through them.

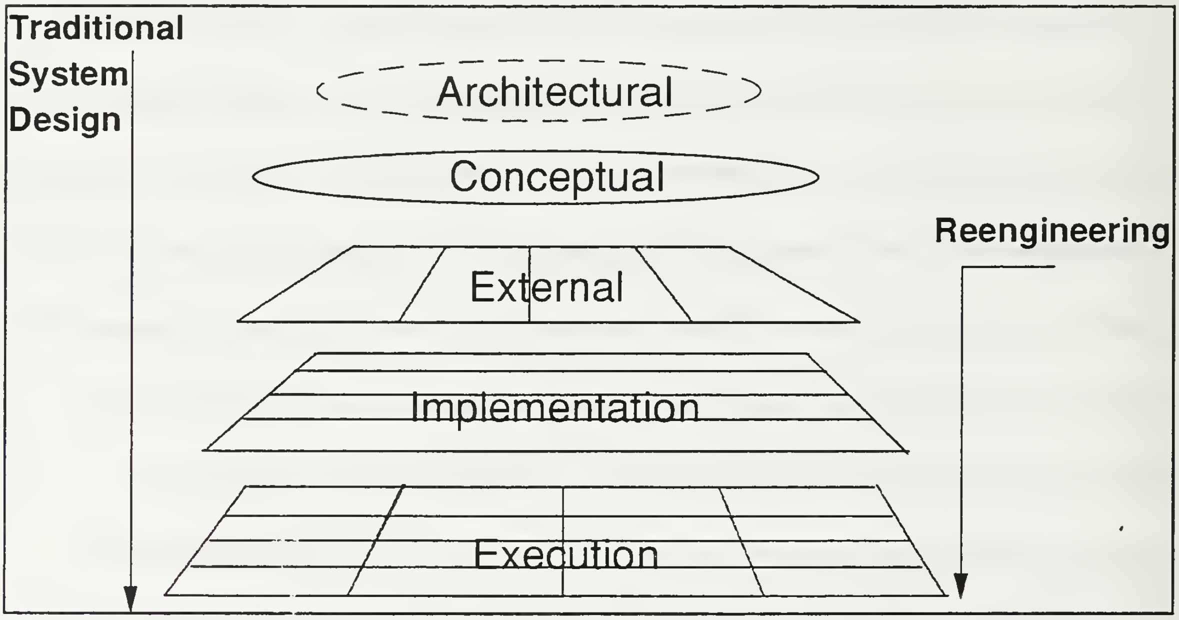

Figure 1. The Layers of Information Engineering and Two Methods of Negotiating Them. After IEF™ Technical Description, 1992.

The *architectural* layer models the organization at the highest level by examining the business strategy and business plan. It consists of three interlocking architectures: a data architecture, a process architecture, and a technology architecture. These three architectures can be represented as models and describe a high-level blue print for meeting the organization's goals and objectives. (IEF Technological Description, 1992)

The *conceptual* layer models the business process and data. Process decomposition diagrams and a data model record the organization's data and activity definitions, entities, and business rules describing the interdependencies. These models functionally decompose the concepts introduced in the architectural level and provide enough detail for analysis.

The *external* layer models system behavior from the end user's point of view. It contains specialized information about the conceptual layer of interest to the user, such as screen layouts and function key assignments.

The *implementation* layer is a specialization of the external layer. It maps system characteristics to specific hardware and software requirements.

The *execution* layer is the physical application of the model developed in the previous layers.

The premise of IE methodology is a consistent framework on which many methods and techniques can be applied and coexist. Conceived with software automation tools in mind, information engineering methodology incorporates a systems development framework on which to build and possesses the following characteristics: a central repository of modeling objects with stored meanings and defined relationships; graphical techniques to represent modeling objects in diagrams; clearly identified relationships among diagrams; and correlated definitions of modeling objects across diagrams, offering multiple perspectives of the same object.

> The most important purpose of the information engineering methodology is to provide a framework within which an integrated set of software tools can exist in harmony. The framework describes the logical connections and constraints across the architectural, conceptual, external, implementation, and execution layers of the development life cycle. The task order, task

> structure, diagramming conventions and semantics employed are secondary considerations. (IEF™ Technological Description, 1992)

It is entirely acceptable for practitioners to build alternate task lists that conform to a different development paradigm and still function within the underlying framework. Points of departure generally hinge on a preference for some practice rather than a major difference in vision. (IEF™ Technological Description, 1992)

2. Information Engineering Pyramid

With the abstract framework established, Martin illustrates the information engineering methodology as a pyramid which has seven stages or levels: information strategy planning (ISP), business area analysis (BAA), business system design (BSD), technical design (TD), construction, transition, and production. Figure 2 illustrates the levels of IE. Detail increases and scope decreases as stages are accomplished. The methodology is iterative and stages 2 through 6 must be repeated for each of the business areas defined in stage 1. Stage 7 is not reached until the enterprise has been reengineered.

Stage 1: *Information Strategy Planning (ISP)* - During this stage, the organization is examined at the enterprise level to determine information needs and build an information strategy plan that is aligned with the business plan. Two models are created: a data model, indicating what data items are needed to perform the organizational mission, and a high-level model of the enterprise. The enterprise model is divided into *business areas* that support the organizational mission.

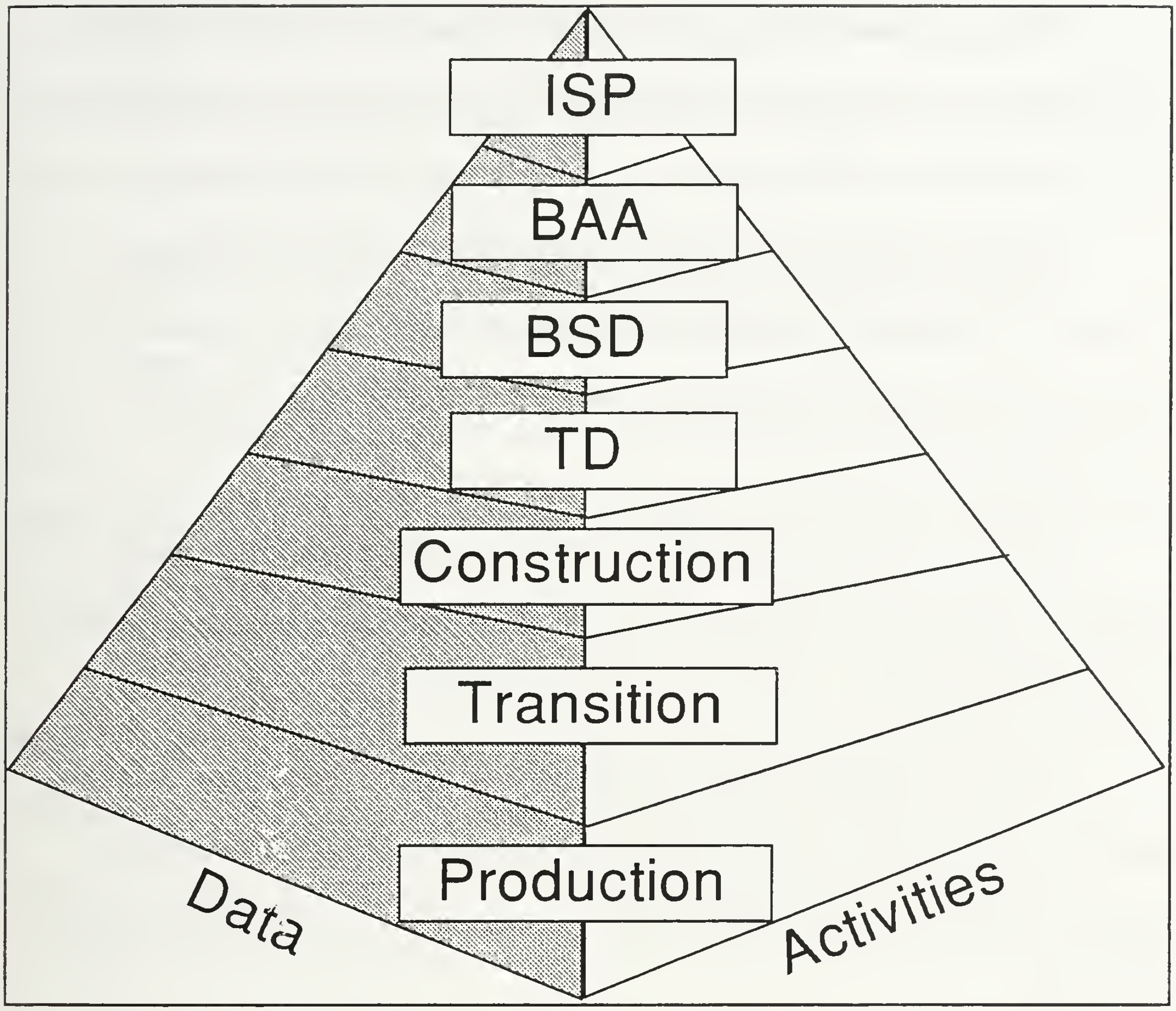

Figure 2. The Information Engineering Pyramid. After Martin, 1990A.

Stage 2: *Business Area Analysis (BAA)* - An As-Is process model is developed using process decomposition techniques for one of the business areas. The model is technology independent.

Stage 3: *Business System Design (BSD)* - During this stage, a business system is detailed within the chosen business area. Consideration is given to how the user will interact with the business system, however, the model remains technology independent.

Stage 4: *Technical Design (TD)* - This is the first stage in which the hardware environment, operating system, and database management systems are examined. During this stage the BAA and BSD are tailored to the target computing environment.

Stage 5: *Construction* - During this stage, all executable applications are developed. These include programs, databases, screen formats, and user manuals. These applications will enable the application system to operate on the target computer environment.

Stage 6: *Transition* - During this stage, the new applications are installed in a production environment. This phased installation may involve replacing existing systems or portions of systems.

Stage 7: *Production* - This is the final stage when all of the business areas have been reengineered and the enterprise realizes the full benefit of the improved business system. Execution of this final stage satisfies specific business needs identified during the initial stage.

In addition to the seven stages, the pyramid is divided horizontally. The left side represents data and the right side relates to activities. The horizontal division within each of the stages is useful in dividing the required tasks among members of the reengineering team. For example, the left or data side of the pyramid is associated with the data modeler's tasks of identifying data subjects and entity types, modeling the relationships, and normalizing the entity records. Activity tasks such as business area identification, process decomposition, and matrix development fall on the right side. The first two stages, ISP and BAA, create a framework within which different teams build different parts of the system at different times. To achieve consistency among separate modeling and development teams, the information collected at all levels of the pyramid is stored in a central repository called an encyclopedia.

> Building the framework in the top two stages takes some time. Typically, information strategy planning for the enterprise takes six months. Business area analysis takes four to six months for one area of the enterprise. (Martin, 1990B)

The remaining five stages, BSD, TD, construction, transition, and production serve to design and implement the information system according to the plan devised during the first two stages.

System construction does not wait until the framework is completely finished. Instead, a flexible prototype is quickly built which will allow quick retrofitting as the information engineering framework evolves. An objective of the IE methodology is to rapidly build systems that can be quickly modified by code generating CASE tools.

B. THESIS METHODOLOGY

While the MCI modernization project is concerned with all stages of the MCI enterprise, this thesis pertains only to the activity side, of the top three levels of the information engineering pyramid. Figure 3 illustrates these stages. Appendix A contains a detailed task list for both the data and activity sides. Three team member theses cover data modeling and execution of the remaining IE stages of the MCI modernization project. Integration of all team member's efforts result in the complete modernization plan for MCI. The portions of the ISP and BAA stages of the information engineering methodology that pertain to process modeling include: enterprise level analysis of MCI, business area analysis of SSD, and design SSD To-Be information system model.

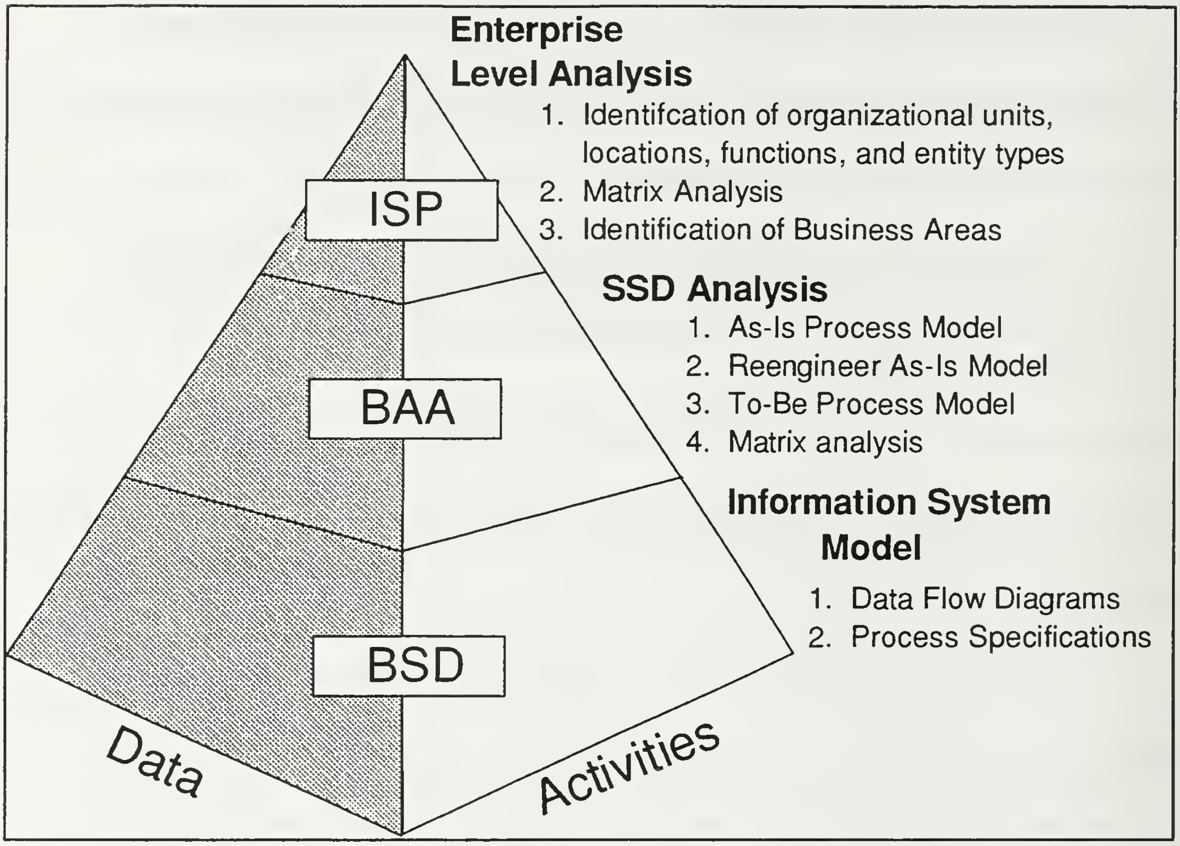

Figure 3. The Top Three Levels of the Information Engineering Pyramid, After Martin. 1990B.

C. ENTERPRISE LEVEL ANALYSIS OF MCI

Enterprise level analysis results in an overview of the organization. This overview is used by top level managers and reengineering team to decide how to proceed with the modernization plan. The overview should not be too detailed. It is used to establish a broad overview in a short time. Detail will be added later during the business area analysis stage.

> The top level [of the pyramid] might be thought of as being like an author planning a book and creating its table of contents. He surveys the overall contents of the book and divides it into parts and chapters. He decides which chapters he should write first. Similarly, at the overview modeling stage he scopes out the overall structure and information needs of the enterprise, divides it into areas, and decides which area should first be analyzed in detail. (Martin, 1990B)

The overview information is stored in the CASE tool encyclopedia so it can be updated over time and used for further analysis as detail is added.

To create an overview for the enterprise, data and process information must be integrated with the business strategy. The reader will recall that the information engineering pyramid is divided horizontally with data information on the left and process information on the right. Thus an enterprise level model is created when the data model information on the left and the process model on the right are mapped together with the strategic information. Mapping is achieved with matrices. The matrices are analyzed and clustered to define the business areas. There are three steps to this process: (1) identification of organizational units, locations, functions, and entity types, (2) matrix analysis, and (3) identification of business areas.

1. Identification of Organizational Units, Locations, Functions, and Entity Types

This first step documents the structure of the organization, identifies the functions and locations that perform the functions, and the major data entities. To successfully complete this step, it is important to identify individuals to interview and determine the extent of data and application sharing throughout the organization. Information is collected in several ways. Before the first interview, team members study the existing organizational structure, any existing business models, data dictionaries, task breakdown of the organization, and other documentation available about the organization.

2. Matrix Analysis

Once the information is gathered, matrices are created to help assess the extent of data and application interaction and validate the models for completeness. There are several matrix combinations that can be generated from the gathered information. The four matrices most useful to the MCI modernization project are: organization versus location, organization versus function, location versus function, and data subject versus function. These matrices, as they pertain to MCI, are discussed in Chapter VI.

Of the four matrices, the data subject versus function matrix is the most revealing. This matrix maps the data subjects, developed in the data model, to the functions of the enterprise. The matrix is created by listing the data subjects horizontally and the functions vertically. Each intersection is marked to indicate whether the data subject is created, read, updated, deleted, or archived by the functional area. The intersections are marked with a "C," "R," "U," "D," or "A," respectively. For this reason the matrix is often referred to as a CRUD diagram.

A CRUD diagram is useful for two reasons. First, several problems will be highlighted immediately. For example, there may be functions that do not use any of the data subjects or, a data subject may be created by more than one functional area. Secondly, a CRUD matrix may be modified and clustered to reveal business areas.

Clustering is a technique used to show which functions and data subjects fit naturally together. Before a CRUD matrix can be clustered it must be modified. First, the rows of functional areas are rearranged in life-cycle order (e.g., a course is first planned, then developed, managed, and finally archived). Next, the CRUD matrix is simplified and condensed into a "CR matrix." A CRUD matrix is converted to a CR matrix, by creating an identical function axis and data subject axis on a blank matrix. However, when filling in the intersections, all "C," "U," "D," and "A" entries from the CRUD diagram are replaced with "C" entries. All 'R" entries from the CRUD matrix retain an "R" on the CR matrix. The CR matrix can now be clustered.

Clustering arranges the order of the data subjects so that as they are read across the horizontal axis, the data subject that is created, updated, deleted, or archived by the first function (reading down the function axis) is moved to the left. Then the data subject created, updated, deleted, or archived by the second function is moved to the left. This continues for all data subjects. This process can be automated with some CASE tools. The resulting matrix has all the "Cs" arranged on a diagonal line running from the top-left to the bottom-right. The data subjects can now be grouped by boxing the clusters as shown in Figure 4. The boxes represent logical information subsystems with responsibility for creating and maintaining the data subjects. When data use falls outside of any box, the functions inside the box must access the data subject elsewhere, or the data must flow from one subsystem to another. These subsystems will later be defined as business areas.

3. Identification of Business Areas

As a result of clustering, eight business areas were identified for MCI: personnel administration, ceremonial support, program and course management, program and course development, student service support, warehouse and distribution, information systems management, and unit interaction. These business areas are described in Chapter VI. At this point business area analysis (BAA) techniques are applied to develop the process model and reengineer the business processes.

Data Subject / Functional Areas	MCI Personnel *Information*	SSD Personnel *Information*	Events *Information*	Financial *Information*	Training *Information*	Advertisement *Information*	Program *Information*	Program Developers *Information*	Course *Information*	Course Developers *Information*	Program Copy Material *Information*	Exam *Information*	Copy Material *Information*	Course Copy Material *Information*	Components *Information*	Job Aid Copy Material *Information*	Job Aid *Information*	Student *Information*	Customer *Information*
Headquarters	C	C			R			R		R									
Support			C																
	R		C																
				C			R		R						R		R		
	R			R	C		R						R				R		
Course				R		C	R		R								R		
Management						R	R	R	R	R	R	R	R	R	R			R	
						R	R	R	R	R	R	R	R	R	R				
						R			R	R		R	R	R	R	R	R		
				R	R	R	C	C	C	C	R	R	R	R	R				
					R		C	R	C	R	C	C	C	C	C				
Course					R		C	R	C	R	C	C		C	C				
Development					R		R	R	R	R	C	R	C	C	C	C	R		
					R		R	R	R	R	C	C	C	C	R	C	R		
				R	R	R			C	C		R	R	R	R	R	R		
					R				C	R		C	C	C	C	C	C		
					R				C	R		C		C	C	C	C		

Figure 4. Portion of a Clustered CR Matrix.

D. BUSINESS AREA ANALYSIS OF SSD

The heart of business area analysis is development of the process model. The enterprise level analysis resulted in business area identification. Once the business areas are identified, one of them must be selected as the first to be analyzed. If resources are not available to analyze them concurrently, the others will be analyzed in turn until the entire enterprise has been searched for reengineering opportunities. The selection of the first business area for analysis is left up to the reengineering team and should be based on the following factors. (Martin, 1990B)

- Demand: pressure of demand from senior end users for new or improved systems, assessed need, and political overtones
- Organizational impact: number of organizations and people affected, whether the organization is geographically dispersed, and qualitative effect
- Existing systems: adequacy or value of existing systems, relationship with existing systems, and estimated cost of future maintenance
- Potential benefit: return on investment, achievement of critical success factors, achievement of goals, and solution to serious problems
- Likely success: complexity, degree of business acceptance, length of project, prerequisites, and risks
- Resources required: whether existing data or process models exist, whether a suitable CASE tool is installed, quality of available analysts, and funds required
- Concurrent implementation: whether multiple BAA projects can proceed concurrently, whether one project will train people who can quickly move onto other projects, and whether an existing data administration function has already done adequate data modeling

Development of the process model is accomplished through functional decomposition. Process modeling and functional decomposition are discussed in Chapter V.

1. As-Is Process Model

The As-Is process model emerges from the process decomposition of each business area. Much of the material gathered during the enterprise level analysis (e.g., MCI department briefs, user interviews, training manuals, and management reports, etc.) is further scrutinized to define the lower level processes in detail. Business areas are broken down to their primitive level processes with the aid of a CASE tool which provides a repository for all of the processes, their definitions and relationships. The process model includes both manual and automated processes. The As-Is model consists of three parts: (1) process node tree diagrams indicating process hierarchy, (2) process decomposition diagrams depicting the processes and the data or material they share, and (3) definitions of all of the symbols on each of the diagrams. IDEF0 techniques are used for As-Is process modeling and discussed in Chapter V.

2. Reengineer the SSD As-Is Process Model

Once the As-Is process model is created and validated by the process owner, the reengineering principles that best fit the situation, are applied. The goal of reengineering is to reorganize the organization around the key processes performed by the business. Most reengineering methodologies investigate ways to eliminate non-value-added processes, minimize redundant data entry and storage, integrate or combine similar processes, implement data sharing, and automate manual processes. Business process reengineering methodologies are discussed in Chapter IV.

3. To-Be Process Model

The To-Be process model is the result of reengineering the As-Is process model. The To-Be model is often a streamlined version of the As-Is process model, but in all cases represents a more efficient reincarnation of the former organization. Like the As-Is process model, the To-Be process model is modeled using an appropriate modeling technique and consists of three parts: (1) process node tree diagrams indicating process hierarchy, (2) process decomposition diagrams depicting the processes and the data or material they share, and (3) definitions of all of the symbols on each of the diagrams. IDEF0 techniques are used for To-Be process modeling and discussed in Chapter V.

4. Matrix Analysis

Matrix analysis techniques are again applied to validate the process and data models and lay the ground work for the next level of the information engineering pyramid, business system design. Once the To-Be process model and the data model are complete, a matrix is created that shows the relationship between business processes and data model entities. The matrix is first generated as a CRUD, converted into a CR matrix and then clustered as described earlier. The matrix analysis is used for three purposes: (1) to ensure that all of the data model entities are created, read, updated, deleted, and archived by the process model, (2) to ensure that the data model contains only the entities required by the process model, and (3) to support the clustering of related processes into groups that reveal candidate *applications* to be distributed to the workstations in the overall client/server system. Five applications were identified for SSD during this step: student servicing, unit servicing, grading, registrar, and executive summary information.

E. SSD TO-BE INFO SYSTEM MODEL

The information system model represents that portion of To-Be process model that transfers or transforms data within the system. Manual processes are not included. Like the case of the As-Is and the To-Be business models, a visual presentation is more useful than a verbal description. IDEF0 can be used for modeling the information system. However, a more common form of information system model depiction is with a logical data flow diagram (DFD). The information system model integrates the data model details with the automated processes and presents them in a form that can be interpreted by a programmer developing code for a prototype system. The information system model consists of three parts: (1) DFDs depicting information system process decomposition, (2) definitions of all of the symbols on each of the diagrams, and (3) process specifications at the primitive process level. Data flow diagramming is discussed in Chapter V.

F. CASE TOOL

Information engineering is made practical by the use of a CASE tool. It is important to choose a tool in which planning, analysis, design, modeling, and construction modules are integrated and share the same encyclopedia. The metadata in the encyclopedia resulting from the ISP study is a valuable asset and should be updated periodically. As the strategic goals or objectives of the business change, the information in the encyclopedia should also be changed. In this way, the business model remains current and available for periodic review. The ISP should be reviewed periodically along with goals, problems, critical success factors, and technology impact effects to ensure they remain in synch with the strategic vision and business plan. A suitable CASE tool facilitates this analysis. CASE tools are discussed in Chapter V.

IV. BUSINESS PROCESS REENGINEERING METHODOLOGY

This chapter presents a discussion and comparison of business process reengineering (BPR) methodologies and their relevance to the MCI modernization project. The first section introduces business process reengineering concepts. The second section briefly describes four prominent BPR methodologies. The third section compares the methodologies. Finally, the fourth section evaluates each of the BPR methodologies in the context of MCI and selects the BPR methodology best suited for reengineering the Student Services Department of the Marine Corps Institute.

A. REENGINEERING METHODOLOGY OVERVIEW

There are many accepted reengineering methodologies. Some of the more notable methodologies include: Process Innovation, Business Process Improvement, Business Process Redesign, and Business Process Reengineering. Each methodology's approach differs by the degree of change and duration of implementation. Although the techniques of execution vary, the goal is ultimately the same: reorganize the organization around the key processes performed by the organization. Most reengineering methodologies investigate ways to eliminate non-value-added processes, utilize information technology to minimize redundant data entry and storage, integrate or combine similar processes, implement data sharing, and automate manual processes.

The generic term *business process reengineering* has evolved from Michael Hammer's original radical overhaul methodology to include the full spectrum of many less severe process improvements. Figure 5 illustrates the fact that as the process modifications become more significant there is a also an increase in project cost,

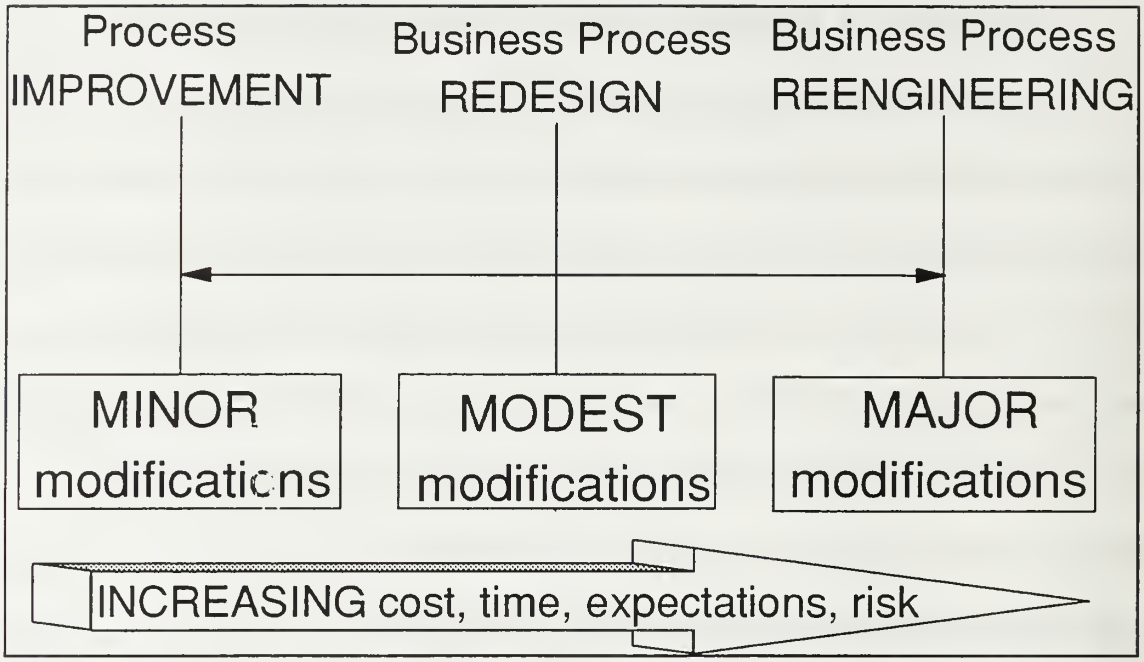

Figure 5. BPR Spectrum.

expectations, risk of failure, and time to complete the venture. A survey of four methodologies provides a broad spectrum of possibilities and capabilities for reengineering the Student Services Department at MCI. Four methodologies are briefly discussed in the succeeding section. While each methodology is unique in its detailed execution, they all share common elements: organizing, team building and planning, documentation of the current process, analysis, redesign, information technology application, implementation and, monitoring.

B. REENGINEERING METHODOLOGY REVIEW

Four BPR methodologies were reviewed as candidates for the MCI modernization project: Hammer and Champy's Business Process Reengineering, Thomas Davenport's Process Innovation, H. James Harrington's Business Process Improvement, and DoD's Functional Process Improvement (FPI). Each is briefly described below. The order in which the methodologies are discussed represent the operationalism of the BPR process, beginning with Hammer and Champy's principles and progressing to the Functional Process Improvement designed to be implemented with an integrated suite of CASE tools. Details of each methodology can be found in Appendix A.

1. Hammer and Champy

Michael Hammer was the first to popularize the concept of reengineering when he wrote the article, "Reengineering Work: Don't Automate, Obliterate" (Hammer, 1990) for the Harvard Business Review. Hammer maintains that traditional "total quality" approaches to process improvement are insufficient in today's competitive market. Hammer's point is actually a caution to all reengineering projects not to blindly apply technology before analyzing the business process first. Misapplication of information technology is often a hindrance and Hammer counters that an organization must first recognize its problems and then "dramatically" overhaul the way it does business. This dramatic overhaul requires a completely fresh approach in order to accomplish the objective. All preconceived notions of organizational structure, decision making, and final product delivery must be ignored and a new way of doing business must be conceived.

In 1993, Hammer co-authored *Reengineering the Corporation* with James Champy. In the book they formally defined reengineering as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed" (Hammer and Champy, 1993). Reengineering requires the organization to consider the final product of its efforts, and include information technology as a requirement of success. While information technology can be very useful, it should not be applied haphazardly.

Hammer and Champy's approach to reengineering is to start with a clean slate and concentrate on goods and services producing processes, seeking to provide orders-of-magnitude level improvement as opposed to incremental improvements through total quality management principles. Their approach stresses the need for competition analysis, customer feedback, and strong organizational desires to succeed. While they lay out the principles of reengineering and provide numerous examples of corporations that successfully diagnosed and corrected their own quality and market performance deficiencies, Hammer and Champy shy away from individual business task analysis and do not provide many concrete techniques that reengineering teams can apply to their own organizations. While the case studies illustrate the successful application of Hammer and Champy's reengineering principles, each of the corporations is different and the individual techniques applied by each to turn itself around may not be appropriate for another.

2. Thomas Davenport

Thomas Davenport's Process Innovation concentrates on process analysis. Process Innovation is divided into five phases: identify processes for innovation, identify change levers, develop process vision, understand existing processes, and design and prototype the new process. Davenport's five phases guide the reengineering team through a thorough search for processes in need of streamlining, with particular interest in the application of information technology. Like Hammer and Champy, Davenport uses a "clean slate" approach and stresses that incremental improvements to business processes are not enough in today's intensely competitive global markets (Davenport, 1993). Davenport's goal is to make the organization more profitable, efficient and more satisfying to customers by any means, be it organizational structure changes, application of information technology, or changing the very nature of the business. Davenport's methodology contains more techniques than does that of Hammer and Champy.

Phase I, *identify processes for innovation*, begins with developing a list of the 10 - 20 key organizational processes, defining these processes and noting any interdependence between them. Each process on the list is then examined to determine its strategic value to the organization's goals, health, and the political and cultural pressures associated with it. Phase I concludes with a prioritized list of candidate processes for reengineering. The process that is most central to the company's overall goals, most problematic, and has the political backing of organization leaders should be the first entry on the list. The other processes will follow as resources permit.

Phase II, *identify change levers*, surveys the potential technological and human opportunities available to change the process. An important aspect of this phase also examines potential constraints and barriers to process change. Examples of constraints and barriers include, "strict hierarchical structures, cultures unreceptive to innovation, and general organizational rigidity or inability to accommodate change" (Davenport, 1993). Both opportunities and constraints are considered and the best change lever is selected.

Phase III, *develop process vision*, includes identification of measurable objectives and characteristics of the process, and formulation of specific process attributes. First, the organization's current vision and business strategy are compared to the company's desired future state. Second, customer feedback is collected to correlate effort and results. The process is then benchmarked against similar processes of competitors. New performance measures are then created for the process that will satisfy current customers, take the organization where it wants to be, and meet or exceed competition quality.

Phase IV, *understand existing processes,* documents and models the existing process to use as a baseline for evaluating proposed process improvements. To accomplish this, the current process is assessed with the improved process criteria developed from the previous phase. Shortcomings not only in process work flow, but organizational structure, information infrastructure, and employee skill levels are identified and short term improvements are explored.

Phase V, *design and prototype the new process*, is the implementation stage. Design alternatives are enumerated. After assessing each alternative for feasibility, risks, and benefits, the preferred redesign is prototyped. Following successful prototype evaluation, a migration strategy is developed and the improved process is implemented.

3. H. James Harrington

H. J. Harrington's five phases of Business Process Improvement (BPI) are less radical than that of Hammer and Champy, or Davenport and reflect more of a total quality approach. Harrington theorizes that management spends too much time correcting problems that should not have occurred in the first place. Business managers should now be responsible for developing business and manufacturing processes that work error-free. Existing business processes should be redesigned to error-free standards. Throughout the entire methodology, Harrington emphasizes the necessity of proper training for those executives and employees who perform the analysis and process reengineering. Harrington addresses five phases: organizing for improvement, understanding the process, streamlining, measurement and control, and continuous improvement.

Harrington's objective of Phase 1, *organizing for improvement*, is to ensure success by building leadership, understanding, and commitment (Harrington, 1991). During this phase, the organization appoints an executive improvement team to act as a steering committee and a business process improvement czar to be responsible for overseeing the project through to fruition. This high-level management group determines the scope of the project, establishes the level of organizational commitment, and appoints the process improvement team (PIT). Members of the PIT are appointed from the departments who own the processes being reengineered. The PIT members carry out the modeling, analysis, and reengineering of each business process.

Phase II, *understanding the process*, is the data collection and modeling stage of the methodology. PIT members examine business strategy, interview customers, define and model business processes with flow charts and documentation to develop what is known as an As-Is business model.

Phase III, *streamlining*, is where the actual reengineering takes place. PIT members seek to identify process improvement opportunities by eliminating bureaucracy and no-value-added activities, simplifying the process, reducing process time, upgrading equipment, standardizing data, or automating activities (Harrington, 1991).

The objective of phase IV, *measurement and control*, is to implement a system to control the process for ongoing improvement (Harrington, 1991). Once the process has been reengineered, process targets are established by which performance of the improved process will be measured.

Phase V, *continuous improvement*, embraces total quality principles by continuously monitoring the improved business process for continued excellence. Periodic examination of the process performance is benchmarked against the best practices in industry and if need be, the process improvement cycle is repeated.

4. DoD Functional Process Improvement (FPI)

The functional process improvement program was established in January 1992 by the Corporate Information Management (CIM) Information Technology Policy Board to assist Department of Defense agencies in making improvements to their business processes. FPI is the most comprehensive of the BPR methodologies discussed thus far. The CIM mandates that FPI create As-Is process models with the IDEF0 technique. The FPI also evaluates potential process improvement alternatives using activity based costing techniques. During the final phase of the FPI methodology, a functional economic analysis (FEA) is prepared by the reengineering team for the decision makers. A FEA is a "business case" that presents the alternatives in business and economic terms more understandable to the majority of senior executives.

FPI attempts to integrate six underlying principles: strategic/business planning, activity modeling, data modeling, activity based costing, economic analysis, and best business practices. Six major steps describe the FPI methodology. The methodology is further subdivided into enabling tasks described in Appendix A.

a. Underlying FPI Principles

Strategic/Business Planning - Strategic planning provides a set of business goals and defined requirements expressed in terms of customer needs within the context of agency mission, vision, values, and beliefs. A strategic plan defines what an organization is all about, who it will serve, what needs it will fulfill, and under what terms it will operate. A unique requirement of the governmental hierarchy is that the strategic plan must be consistent with those of higher authority, and no element of the strategic plan can conflict with the mission, vision, values and beliefs expressed by higher authority. On the other hand, business planning provides a set of business objectives with appropriate performance measurements and a comprehensive list of required output product and service features that will meet the customer needs defined in the strategic plan. The business plan should focus on what the organization will do to satisfy the goals, needs and requirements expressed in the strategic plan.

Activity Modeling - Activity modeling is a technique used to understand the business process. Process decomposition is used to decompose a process into activities. The result is a multi-level diagram representing the business process with all of the inputs, outputs, controls, and mechanisms affecting the final product or service. This final model is referred to as the As-Is process model. The As-Is model will be reengineered to become the To-Be process model. The To-Be model will eventually be used to develop a prototype and implement the improved business process.

Data Modeling - Data modeling is a technique for systematically describing what information the organization needs to perform its business process. Like activity modeling, an As-Is model is first produced, describing the current data environment. The As-Is data model is then analyzed and compared with the As-Is process model to ensure that all required data is included and conversely, that no redundant or unused data is collected or maintained. A data model shows all of the entities, attributes, and relationships among the entities. Entities are objects which an organization values enough to keep data about. Attributes are the data items recorded about the entities. Relationships between and among entities are often expressed as business rules. To ensure compatibility with the process modeling technique, FPI mandates that data modeling be done with the IDEF1X technique. A complete description of data modeling is contained in *A Relational Database Model and Data Migration Plan for the Student Services Department at the Marine Corps Institute* (Slaughter, 1997).

Activity Based Costing - Activity-based costing (ABC) is a technique that allows unit cost determination of producing goods and services. ABC is an extension of activity modeling. IDEF0 activity modeling is designed to record activity cost data. Unit cost figures resulting from ABC are the basis for economic analysis.

Economic Analysis - Economic analysis provides the capability to assess the costs and benefits associated with each process improvement, taking into account the life cycle characteristics of each investment. The As-Is process model is used as a baseline by which all competing alternatives are compared. Economic analysis presents the decision data in equally valued dollars (taking the time value of money into consideration), as well as the risks associated with making decisions about future conditions and performance. Economic analysis is presented as a FEA.

Best Business Practices - Benchmarking proposed process improvements against recognized industry leaders is the technique used to ensure the proposed improvements are up to par with the best alternatives available.

b. FPI Methodology

The functional process improvement methodology consists of these steps: define, analyze, evaluate, plan, approve, and execute. Each of the steps integrates the underlying principles to cover the entire BPR project from start to finish.

Define - During this phase, a framework is established by defining baselines, objectives, and strategies for the process. Activity and data modeling begin in preparation for the analysis phase from which to begin process improvement.

Analyze - This phase proposes the improved process alternatives. The As-Is process model is analyzed to examine all processes that make the current process more effective and efficient. ABC data is gathered and modeled for each activity of the process decomposition.

Evaluate - Alternatives are compared against the baseline processes in terms of both function and cost.

Plan - A migration plan is developed for each of the contending improvement alternatives. The plan should be comprehensive and cover the impact on costs, benefits, risk, and the effect on the organizational structure.

Approve - Pertinent data from the definition, analysis, evaluation, and planning phases are assembled for presentation of each of the improvement alternatives to the highest level executive decision makers. This presentation is in the form a Functional Economic Analysis (FEA). A FEA is similar to a traditional economic analysis. Both evaluate the economic feasibility of a project using classic economic analysis techniques. The primary difference between them is scope. While an economic analysis usually covers a single initiative an FEA covers the life-cycle aspects and the overall effect of the intended change on the entire organization.

Execute - Once approved, the new system is implemented in accordance with a DoD-wide technical integration and migration strategy.

C. SELECTION CRITERIA

The selection of a reengineering methodology is based on perceived conditions of the business environment and often depends on the degree of interest by senior management and the amount of risk the organization is willing to take toward implementing redesign efforts. Understanding the business environment and the organization will aid the reengineering team in the selection of a methodology. Before selecting a methodology, the organization and analyst must consider reengineering categories, reengineering ideals, reengineering principles, and reengineering roles.

1. Reengineering Categories

Reengineering methods can be grouped into three categories: crisis, goal oriented and life-cycle. (Koulopoulos, 1995)

Crisis reengineering is a response to pressures, internal or external, which necessitate a change to current business operations. This type of redesign is less likely to follow a formal methodology. High level sponsorship within the organization is not required because change must be effected regardless of the method. Crisis reengineering carries a high degree of risk since it is often unplanned.

Goal oriented reengineering seeks to substantially change the fundamental business objectives. This strategy radically transforms the organizational processes by disregarding all present processes and designs how the company will function in the future. This method requires high level sponsorship due to the inherent risk of eliminating familiar processes and implementing futuristic procedures.

Life-cycle reengineering is strategic and continuous. Incremental changes are made constantly to alter the business direction. The redesign effort establishes a baseline assessment of how business is conducted. Managers then use metrics to establish value for each task and examine alternatives that will improve the processes. Improvements, radical or conservative, to current processes are made where necessary. This category of reengineering requires a high-level champion to provide continuity and ensure adequate program funding. Life-cycle reengineering is considered the safest for organizations without the resources or the capacity to assume the higher levels of risk inherent in the other categories.

2. Reengineering Ideals

Hammer and Champy list four themes that are preeminent in successful reengineering efforts (Hammer and Champy, 1993): process orientation, ambition, rule-breaking, and creative use of information technology. All four reengineering ideals have application to the MCI modernization project. However, due to cultural and budgetary constraints, reengineering at MCI was narrowly focused within the Student Services and Information Systems Departments, the primary creator and administrator of the data.

Process Orientation - Organizational perspective is influenced by the management theory in vogue. The industrial age focused on task organization and work simplification in an assembly line. The information age centered on gathering and distributing information. The current trend in "down-sizing" or "right-sizing" leads to a perspective focusing on processes and process improvement.

Task-oriented jobs in today's world of customers, competition, and change are obsolete. Instead, companies must organize work around process. To achieve significant productivity and quality improvement, an entire process must be analyzed, not just the work steps within a department of an organization. (Hammer and Champy, 1993)

Ambition - All business processes within an organization must be considered candidates for reengineering. Reengineering teams must be ambitious, seeking innovative ways to improve all business processes. No area should be protected from this scrutiny. As noted, only one third of the whole business would be considered for reengineering as part of this modernization project.

Rule-breaking - Business rules are efforts by an organization to standardize operating procedures. Reengineering teams should consider new ways to significantly improve productivity without allowing existing rules to limit their consideration of alternatives. This requires a commitment by management to sever their reliance on the comfort of established procedures. Considerable effort by MCI was put into eliminating or streamlining the business rules and regulations attached to student's course enrollment. This reduction in business rules simplified prototype coding and will simplify implementation coding and code maintenance in the future.

Creative use of information technology - Information technology (IT) and its rapid advances play a significant role in BPR. Thomas H. Davenport identifies nine areas where BPR can benefit from IT (Davenport, 1993):

1. Automation - IT can automate tasks reducing redundancy of data entry improving quality, integrity and speed.

2. Information - Electronic transfer of information and documents via telecommunication systems or networks decreases process completion time and facilitates enhanced work coordination.

3. Sequence - IT, using databases and groupware, allows parallel work accomplishment, improving the sequencing of tasks and decreasing overall business cycle time.

4. Tracking - IT enables the close monitoring of process objects and their completion status.

5. Analysis - The data manipulation, storage and presentation capabilities of IT allow for the critical analysis of processes and their supporting information.

6. Geography - Telecommunications networks allow the sharing and transfer of information between geographically dispersed organizations.

7. Integration - Database and groupware technologies allow multiple personnel to work together on a single project.

8. Intellect - IT, such as expert systems, allow the capture and preservation of corporate knowledge and procedures.

9. Disintermediation - Electronic data interchange decreases the requirement for person-to-person interactions and reduces the number of people involved in a process.

3. Reengineering Principles

Reengineering principles represent the best reengineering practices collected from the industry and distilled to their very essence. Principles are not limited to manual and automated processes but may also be applied to the cultural aspect of reengineering.

Process Principles - In any organization, there will be manual and automated processes subject to improvement. These principles are general and can guide the reengineering team (Hammer and Champy, 1993):

- Combine several jobs into one to involve fewer people in the completion of a process.

- Let the worker make decisions.

- Perform the steps of a process in a natural order.

- Designate a person who will be responsible for controlling and improving each process.

- Create multiple versions of a process. Each version should be dependent upon a particular outcome of a decision made by the person performing the task.

- Perform work where it makes the most sense.

- Reduce checks and controls on work. Only perform tasks that add value to the overall process.

- Provide a single point of contact to business customers.

Russ Linden delineates these additional principles (Linden, 1993):

- Substitute parallel for sequential processes to decrease business cycle time.

- Capture information once, at the source.

- Bring "downstream" information "upstream" so that all required information for the entire process is gathered and entered into the system at the start. This will decrease data gathering and communication times.

- Ensure a continuous flow of value-adding activities. Get rid of tasks that do not produce something of value to the customer.

- Organize around outcomes, not functions. Ensure there is an important business reason for conducting a process or task.

- Redesign first, then automate. Do not automate first and simply speed up a faulty procedure.

- Know why a piece of paper enters the system. Substitute technological interfaces where face-to-face interactions are not required.

Cultural Principles - Effective application of these principles during the reengineering process will result in the transformation of numerous aspects of the organization (Hammer and Champy, 1993):

- Jobs change from simple tasks to multidimensional work.

- Organizational structures change from hierarchical to flat.

- Managers change from supervisors to coaches, shifting emphasis from oversight and control to facilitator, enabler and educator.

- Executives change from scorekeepers to leaders.

- Values change form protective to productive.

- People's roles change from controlled to empowered.

- Job preparation changes from training to education.

- Focus of performance measures and compensation shifts from activity to results.

- Advancement criteria change from performance to ability.

4. Reengineering Roles

Finally, the organization itself determines the outcome of any reengineering effort. A BPR consultant may be used to advise the organization on how to accomplish a reengineering project but it is the personnel within the organization who actually reengineer the business processes. Employees know and understand the business and these personnel fill key roles during the redesign project. (Hammer and Champy, 1993)

> *Leader* - The leader is an executive level manager with oversight responsibility. The leader must be able to influence reluctant employees to embrace the change program. The leader is the steward, creating the corporate vision while ensuring managerial and financial continuity.
>
> *Steering committee* - The steering committee is a group of senior managers who define the reengineering strategy, determine project priority, allocate resources and assist the reengineering teams problem resolution.
>
> *Reengineering czar* - The reengineering czar is the organizational expert on reengineering procedures and tools and must be able to oversee the project from beginning to end. The czar must support each process owner and the reengineering team as well as coordinate all reengineering activities. The czar is the technical interface between the reengineering team members and the leader. (Hammer and Champy, 1993)

Process owner - The process owner is a senior leader responsible for the effective and efficient function of a particular business process. The owner provides the reengineering team with process information during the change effort and becomes responsible for its implementation and continued optimization.

External consultant - The use of an external consultant during a reengineering is often recommended for several reasons. It may be difficult for managers inside the enterprise to take a detached view point. A skilled external consultant can often clearly see and diagnose problems in an organization that would go unnoticed by a manager busy with day to day operations. Consultants are also useful as experts in reengineering methodology application, prototype development, data and process modeling, critical success factor analysis, and other aspects of reengineering that organic organizational mangers may not possess. Not only is it important for a consultant to have technological expertise but they should also exhibit the personal relationship skills necessary for them to integrate with top management and the reengineering team. Together they will accomplish the reengineering.

The actual reengineering process is performed by the reengineering team. The team should be comprised of personnel from various functional areas, especially one experienced in current information technology advances. There should be members from outside the process under review to provide objectivity and interface awareness. Process analysis, modeling, and redesign are time consuming efforts and should be done as quickly as possible to avoid "paralysis by analysis." The team members should be assigned to the project on a full-time basis, but not less than 75% commitment level is required. (Hammer and Champy, 1993)

D. BPR TECHNIQUE COMPARISON

All of the surveyed methodologies are similar in composition, but differ in sequence and level of detail during execution. Figure 6 places the surveyed methodologies on the BPR spectrum introduced earlier in the chapter. Each of the methodologies has individual merits but there is not one methodology perfectly suited for every situation. For

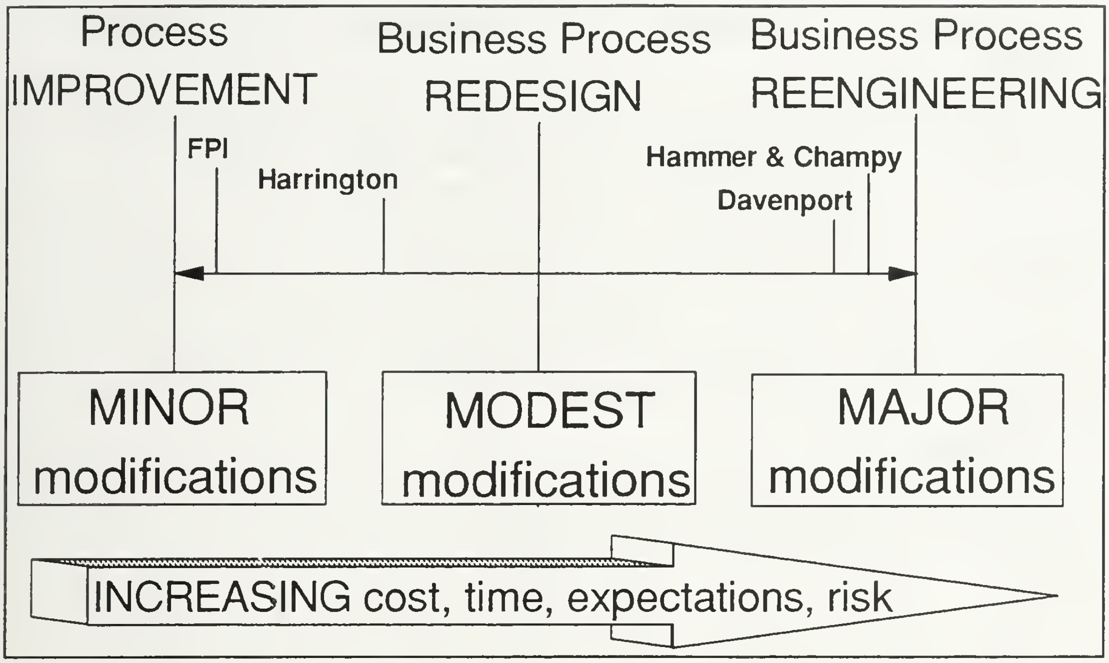

Figure 6. BPR Spectrum with Selected Methodologies in Place.

comparison, Table 1 summarizes the main stages of each methodology. Each has strengths, weaknesses, and other characteristics that are worthy of analysis before selecting the most appropriate methodology for the MCI modernization project.

The common thread running through all of the methodologies is that each of them accomplishes the basic steps of traditional system development stages: planning, analysis, external design, internal design, and construction. The difference in the methodologies is the degree of detail they prescribe. Table 2 compares the methodologies and serves to highlight the similarities and differences between them.

The methodologies can be grouped into two categories of reengineering: radical and incremental. *Radical* reengineering "...means disregarding all existing structures and procedures and inventing completely new ways of accomplishing work (Hammer and Champy, 1993). *Incremental* reengineering, considered by Hammer and Champy to not

Hammer and Champy	Davenport	Harrington	DoD
Develop Business Strategy	Identify Processes For Innovation	Organizing For Improvement	Define
Identify Change Levers	Identify Change Levers	Understanding Process	Analyze
Identify Reengineering Teams and Leaders	Develop Process Visions	Streamlining	Evaluate
Identify Processes with Change Potential	Understand Existing Processes	Measurement And Control	Plan
Implement the New Process	Design And Prototype	Continuous	Approve
	The New Process	Improvement	Execute

Table 1. BPR Methodology Summary.

even qualify as "reengineering," is based on the total quality approach introduced by Demming in the 1950s. Incremental methodologies analyze existing processes and seek to improve productivity with more conventional, less radical changes to organizational structure and application of information technology. Both radical and incremental reengineering methodologies prescribe process improvement but differ in the scope of their methods.

The methodologies of Hammer and Champy, and Davenport both fall into the radical methodology category. The methodology of Hammer and Champy is the most radical and the least detailed. Hammer and Champy strive for dramatic improvement and

	Hammer and Champy	**Davenport**	**Harrington**	**DoD**
Methodology Name	Business Reengineering	Process Innovation	Business Process Improvement	Functional Process Improvement
Scope	Blank sheet of paper	Baseline improvement	TQL approach	TQL
Target Audience	CEO	CEO	CEO Practitioner	Practitioner
Synopsis	Radical Unstructured	Radical Structured	Incremental Structured	Incremental Highly structured
Techniques	None specified	Process modeling	Process modeling Data modeling	Process modeling, Data modeling, Technology modeling
Strength in MCI Modernization Context	Motivational	1. Strategic analysis 2. Process identification 3. Stresses IT solutions	Comprehensive	Comprehensive
Weakness in MCI Modernization Context	1. Lacks detailed techniques 2. Radical approach	1. Lacks detailed techniques 2. Radical approach	No CASE specified	Focus on lifecycle cost
Modeling Technique	None specified	None specified	None specified	IDEF0 IDEF1X
CASE Tool Support	None specified	None specified	None specified	TurboBPR2.5 FEA Modeler ABC

Table 2. BPR Methodology Comparison.

"dramatic improvement demands blowing up the old and replacing it with something new" (Hammer and Champy, 1993).

While Hammer and Champy fail to provide techniques that reengineering practitioners might use to accomplish the task, their methodology has been distilled into the principle pillars that all other reengineering methodologies are built on. Hammer and Champy's intended audience is the chief executive level and is full of motivating rhetoric and successful examples from the business world. At the CEO level, detailed knowledge of techniques are not necessary. One of Hammer and Champy's reengineering principles is that reengineering projects often fail due to lack of top management support. Hammer and Champy serve to educate and motivate, top executives empowering them to ask questions and champion their own reengineering cause. The importance of IT application into the re-invented corporation and reengineering team is also emphasized.

Davenport also advocates IT application and provides more detail than Hammer and Champy but not enough for a reengineering team to rely on for complete reengineering. Like Hammer and Champy, Davenport' *process innovation* expects reengineering to net substantial increases in productivity and profit by starting with a "clean slate" and effecting a one-time, top-down, broadly cross-functional fundamental change to the way the organization conducts business (Davenport, 1993). Davenport suggests detailed techniques to be used for analyzing business environment, identifying candidate processes for innovation, gathering performance objectives, and applying IT solutions. Davenport's methodology briefly mentions the role of top management during reengineering and list industry success stories but does not elaborate on techniques to foster reengineering leadership or organizational reengineering roles.

The risk of failure for such radical and sweeping changes during a short time to an organization is much higher than the less radical, total quality based incremental process improvement methodologies: business process improvement, and functional process improvement. Both of these methodologies are rich in practical techniques that can be readily applied by reengineering practitioners.

Harrington's methodology offers comprehensive coverage from planning to implementation. He furnishes guidance on how to organize the organization, select teams, collect and analyze data, reengineer the process, and continue monitoring the improved process after implementation. Harrington emphasizes the importance of training the reengineering team and executive leaders prior to beginning the project to reduce the risk of failure. Specific techniques are augmented by examples of analytical methods (e.g., graphs, charts, matrices, etc.) to assist the practitioner with decision making throughout the process. It is implied that these tools could be implemented with computer software but Harrington does not specifically address the use of any CASE tools.

The last methodology surveyed, functional process improvement relies on CASE tools for smooth operation. The use of CASE tools that model processes in IDEF0, linked with ABC analyzing software are mandated as is software specifically developed to prepare a FEA.

In typical Department of Defense fashion, the functional process improvement model with its 25 steps prescribing still more detailed and specific tasks could be labeled the most comprehensive methodology. Like BPI, FPI offers comprehensive coverage from planning to implementation. Flexibility is limited, however, by the hierarchical constraints inherent in government bureaucracy. For example, FPI planning tasks include briefing the upper echelon about reengineering theory, principles, risks, and benefits but do not mention reengineering team composition or reengineering leadership roles. FPI presumes that the innate hierarchy will suffice. FPI data gathering and analysis techniques focus on activity based cost accounting principles and culminates with the presentation of the FEA to the top level of the hierarchy. Once the ultimate decision as to which alternative to choose is made, the innate hierarchy again is presumed to oversee the execution stage. This methodology appears to be driven by the process and all reengineering decisions made exclusively in terms of lifecycle costs with inadequate attention to implementation and monitoring. Although the methodology is inflexible, the concept is sound and is well supported in terms of software support and training.

E. REENGINEERING METHODOLOGY SELECTION

Central to the success of the modernization project is selection of a suitable BPR methodology. Of the many methodologies available four candidates were evaluated. When assessing a methodology's fit to the MCI modernization project, each of the BPR methodology selection criteria, discussed in the second section of this chapter, was considered in the business environment context at MCI.

1. Reengineering Methodology Characteristics

Before selecting the reengineering methodology best suited for the particular business environment, it is useful to specify criteria with which the reengineering team can compare competing methodologies. The DoD Manual for BPR identifies the following characteristics of an effective methodology for change management (DoDInst 8020.1-M, 1993):

> *Completeness* - The methodology must provide steps that direct a business process improvement procedure from establishment to implementation.
>
> *Applicability* - The methodology must be able to be used on any process of the business.
>
> *Friendliness* - The procedure must be easy for all personnel, including non-technical workers and managers, to learn and understand.
>
> *Consistency* - It must be the only methods used to conduct reengineering within the organization. This will allow in-house reengineering expertise to be developed.
>
> *Supportable* - The reengineering procedure must include detailed documentation, training courses and project management tools.
>
> *Successful* - The methodology should have a record of success and these cases should be available to guide the actions of the reengineering team.
>
> *Documentable* - The procedure must produce process documentation as it is used.
>
> *Enabled by Tools* - The method must be supported by automated tools that help to ease the reengineering workload and enable process documentation and measurement.

2. BPR Technique Selection for MCI Modernization Project

As initial information was gathered about the current information system and business process at MCI, research was initiated into the most appropriate business process reengineering methodology, modeling technique, and supporting CASE tool. After considering all of the factors, there was no one single BPR methodology that exactly fit the MCI situation at face value. Elements of each were used in the end and will be discussed in detail in Chapter VII.

The methodologies of Hammer and Champy, and Davenport were both ruled out as the business culture at MCI would not support sweeping changes to their current business process. Although Hammer and Champy do not offer specific techniques, their reengineering principles and ideals are crucial to successful reengineering. Davenport provided sound guidance at the strategic vision level, establishing a need for reengineering, and determining where in the organization to look, but lacked techniques for conducting the reengineering.

In contrast, DoD's functional process improvement provided too much detail. It is not necessary to conduct all of the FPI tasks to successfully accomplish organizational reengineering. FPI was not selected due to the distinct lack of accurate cost data available at MCI necessary to drive the ABC cost models.

The authors felt that Harrington's business process improvement methodology, based on continuous process improvement and offering comprehensive and detailed techniques, provided the best fit for MCI modernization. Combining Harrington's BPR methodology with Martin's information engineering offers a strong overall methodology for analyzing MCI at the enterprise level. Additionally, the integrated philosophy espoused by information engineering offered more flexibility and potential for application to the remaining business processes at MCI not included as part of this research.

V. TECHNIQUES AND TOOLS

This chapter discusses in greater detail some of the techniques and tools used during the analysis of previous chapters. The first section discusses process modeling, functional decomposition, and IDEF0 modeling methodology. The second section discusses data flow diagramming and its relevance to the business system design level of the information engineering methodology. The final section discusses CASE tool evaluation and selection for the MCI modernization project.

A. ACTIVITY MODELING

There are many different modeling and diagramming techniques in use for process modeling. Techniques have been borrowed from finance, software or systems engineering, and product engineering. Examples of modeling techniques include: entity-relationships (ER), structure charts, flow charts, data flow diagrams, and IDEF modeling. Many of the techniques are variations of one another and may share semantic structures but vary in their graphic presentation to convey different aspects of the organization to different audiences. For instance, a business may be modeled with an entity-relationship diagram for the database designer while the same business may be presented to the programmer as a series of data flow diagrams. Different views of the business require different modeling techniques.

1. Process Modeling and BPR

The main objective of business process reengineering is to transform an organization around the key processes performed by the business to improve productivity and efficiency. Since BPR was popularized in the early 1990s by Michael Hammer, many similar but competing BPR methodologies have been published. Although they vary in scope and complexity, the common thread among them is the use models to represent the interdependent and often complex relationships that exist between the elements of a modern organization (i.e., business rules, processes, stakeholders, inputs and outputs). Effective BPR can not be conducted without first understanding the organization. Models enable understanding by structuring business information in a way that individual components can be visualized and interdependencies can be analyzed.

Models are more than diagrams. While the diagram of a model may depict a process as a series of activities with inputs and outputs, many details about the process need to be defined. Information such as the activity's name, definition, owner, inputs, outputs, etc. are stored in a central repository known as a data dictionary or data encyclopedia. The data contained in a data encyclopedia is also known as *metadata*. This collection of metadata ensures consistency throughout the modeling process.

2. Process Modeling Technique

A process or activity model is a tool used by an analyst to understand a business' current environment and provides a framework with which a business may be systematically dissected and analyzed with an eye to improve the business process in some way. "A process…is a specific ordering of work activities across time and place, with a beginning , an end, and clearly identified inputs and outputs: a structure for action" (Davenport, 1993). These activities are the building blocks of process models. The process model makes business area analysis possible.

A completed process model graphically depicts the individual steps, information, and resources needed to perform a business process as well as how sub-processes may be interdependent. Additionally, activity modeling is an important step in validating information requirements within an organization, because the activity model shows the relationship between an activity and the information that it uses or produces. This level of detail is necessary to conduct effective redesign analysis.

A process or activity model is used to describe business activities and their relationships. It is hierarchical and starts with a high-level view of the process. The model then breaks a process into sub-processes. Sub-processes may also be divided into sub-sub-processes and so on providing increasing levels of detail. This technique is known as *functional decomposition*. For this reason, individual activity model diagrams are often known as decomposition diagrams. Functional decomposition is further explained in the next subsection.

The IDEF series of modeling methodologies offer easily interpreted diagrams, data sharing capabilities between data and process models, and a standardized format well suited for computer aided analysis. IDEF0 was mandated by MCI for process modeling, and IDEF1X was mandated for data modeling. IDEF modeling techniques are the modeling standard for agencies within the Department of Defense.

IDEF0 is one of the most useful process modeling techniques and was used for this analysis for two reasons. First, IDEF0 is the modeling technique mandated by the Department of Defense (DoD) business process reengineering initiative, an agenda item of the Corporate Information Management (CIM) program. CIM was initiated in the early

1990s when Paul Strassmann was the director of the Defense Information Systems Agency (DISA). CIM's goals were to maintain DoD mission capabilities despite downsizing and budget reductions by implementing improved business processes which: (1) are enabled by technology, (2) substantially increase productivity, (3) decrease cost, and (4) do not sacrifice quality. Secondly, the IDEF0 modeling technique has unique and powerful features not found in any other single process modeling technique. Figure 7 is an example of a decomposition diagram using the IDEF0 modeling technique.

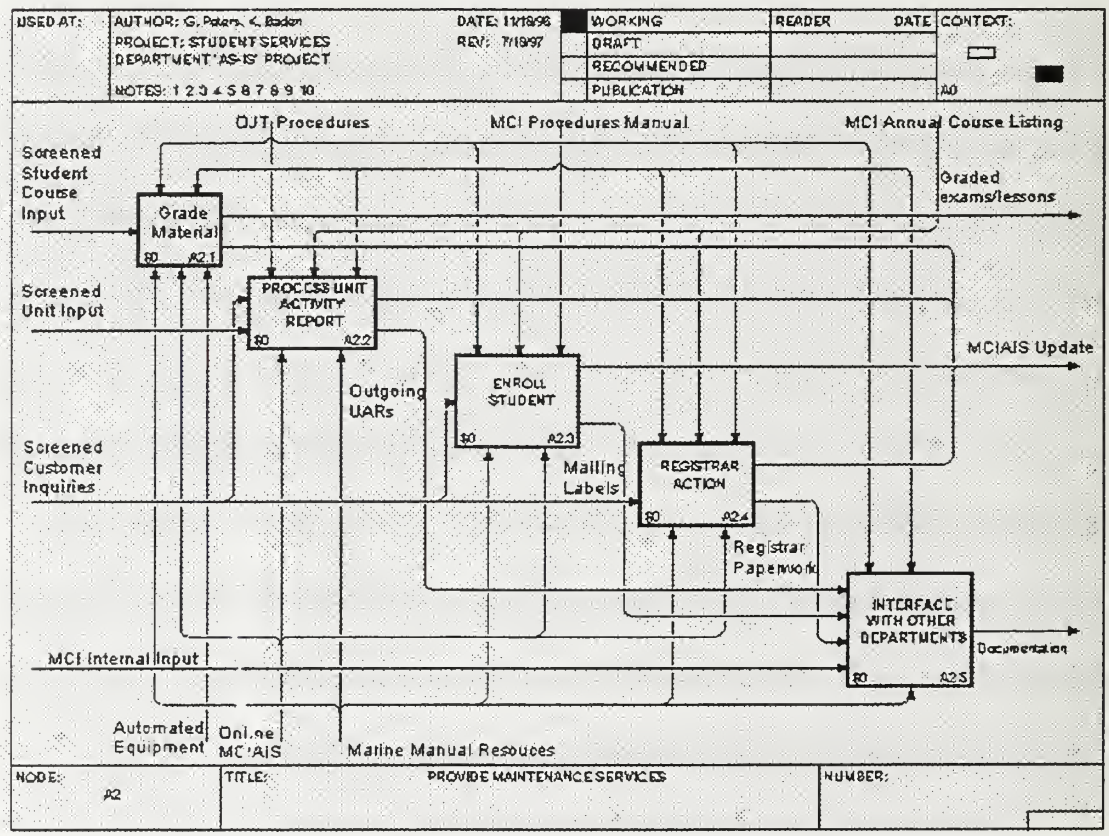

Figure 7. IDEF0 Activity Diagram.

3. Functional Decomposition

The process model is developed using a technique known as *functional decomposition.* Functional decomposition is a method of moving from the *functional* *areas* at the enterprise level through the *business areas* and finally exploding the *business processes* to their primitive level. Figure 8 graphically depicts functional decomposition. The figure is useful in helping the reader to distinguish between several related terms.

Functional areas are defined at the enterprise level and exist to define the business functions of the organization as a whole. Functional areas are the very essence of the

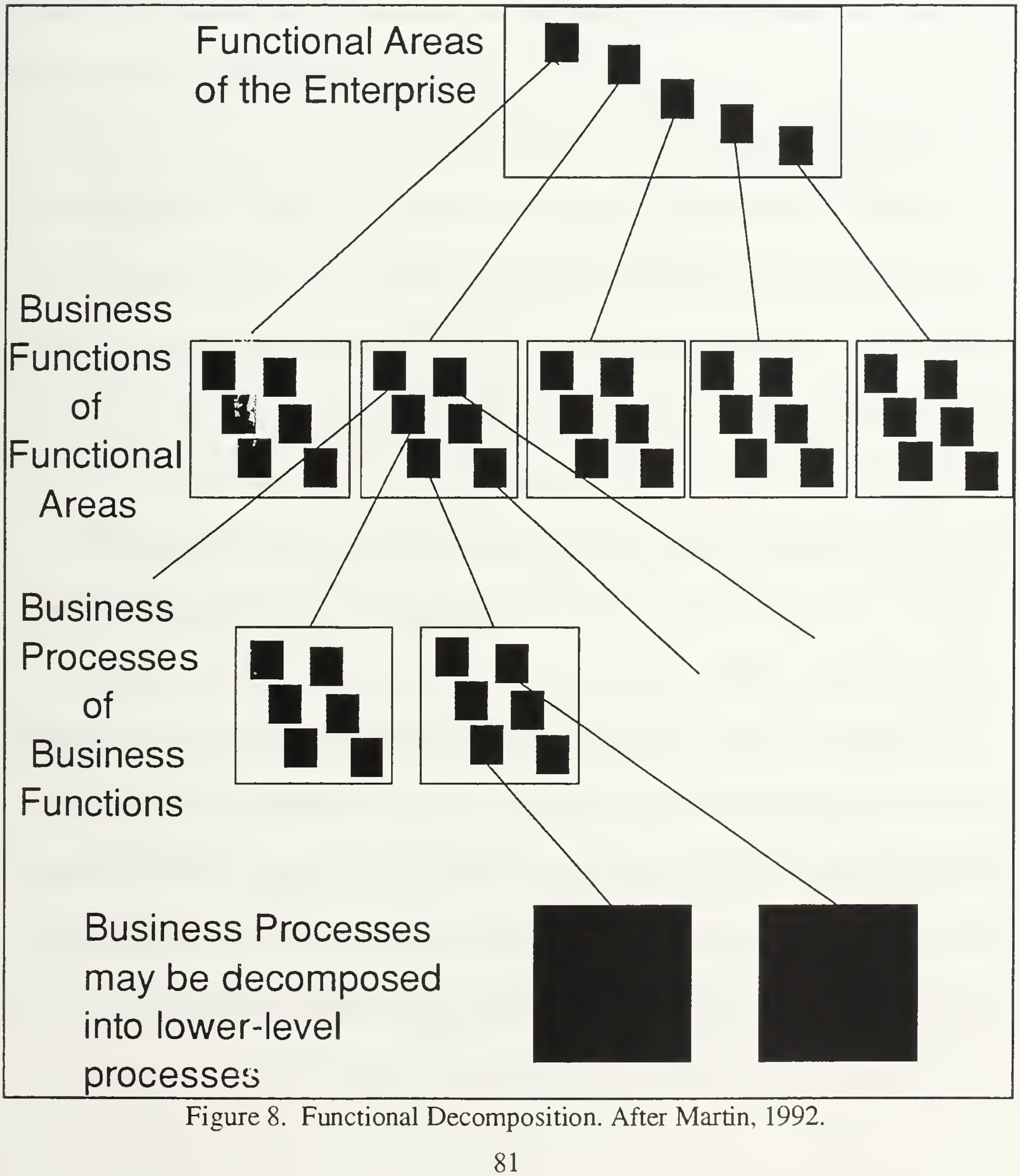

Figure 8. Functional Decomposition. After Martin, 1992.

business and refer to major areas of activity, but do not include sufficient granularity for a detailed analysis. For example, when developing the MCI enterprise model, seven functional areas were identified that represent the business activity of MCI (described in Chapter VI). These include headquarters support, course management, course development, student servicing, information systems management, warehouse and distribution, and unit interaction. These functional areas define the business of MCI but do not provide enough detail to describe the detailed processes performed by MCI personnel. Functional areas are subdivided into business functions.

Business functions are a collection of activities which together support a functional area by furthering the mission of the organization. A business function is continuous and ongoing and is concerned with *what* is to be done but not *how*. For example, four business functions support the *functional area* student servicing, identified in the MCI enterprise business model. These business functions include customer servicing, student activity transactions, grading, and registrar servicing. Like the functional areas, these business functions lack sufficient detail for analysis. Business functions are subdivided into business processes. (Martin, 1990B)

A *business process* is a specific act with a definable beginning and end, identifiable inputs and outputs, and is performed repeatedly. It is at this level that sufficient detail is added to the model to allow for analysis and reengineering. Complex processes may be further subdivided into simpler processes until a primitive level process is reached when any further decomposition would yield no greater understanding of the process.

Enterprise level modeling tends to emphasize the terms *functional area*, *business function*, and *business process*. Once the business area analysis stage begins, functional areas are known as business areas, business functions are known as functions, and business processes become processes. The terms are often used interchangeably in reengineering text books. The term activity is a generic term often substituted for a process at any level of analysis. The similarity of the terms can be confusing. Table 3 maps the term to the information engineering stages.

Enterprise Analysis (Information Engineering Stage 1)	←→	Business Area Analysis (Information Engineering Stage 2)
functional area	of the enterprise is known as	business area
business function	of the enterprise is known as	function
business process	of the enterprise is known as	process

Table 3. Terminology Map Between the First Two Levels of IE.

4. Evaluation of IDEF0 Technique

IDEF0 was developed in the late 1970s as a by-product of the U.S. Air Force's Integrated Computer Aided Manufacturing (ICAM) Program. The Integration Definition for Information Modeling (IDEF for short) technique resulted in several graphical modeling conventions, each used for a different purpose. For example, IDEF1X is used for data modeling and IDEF0 is used for functional modeling. Although IDEF0 was originally used to document manufacturing processes and to show what information and resources were needed in each step, it was proven to be well suited for modeling any application that uses information and resources. IDEF0 modeling has been used in both government and private industry since 1985 and has become the DoD standard for process modeling.

An IDEF0 model represents business activities from a functional point of view. The model depicts how the activities interrelate, the inputs used by each activity during activity execution, and the output of each activity. The model itself is hierarchically composed of decomposition diagrams and the data repository which contains the definitions of, and relationships between, each of the activities, inputs, outputs, controls, and mechanisms. The acronym ICOM is used collectively to describe any of the possible information flows into or out of an activity: inputs, controls, outputs, or mechanisms. The IDEF0 activity modeling technique represents the business process with four types of diagrams in addition to the metadata encyclopedia.

1. Node trees diagrams graphically portray activities in a hierarchical form.
2. A context diagram is a single diagram that illustrates the highest level activity.
3. Decomposition diagrams represent the detailed sub-processes of an activity.
4. FEO (For Exposition Only) diagrams are used to focus attention on a particular portion of a node tree, context, or decomposition diagram and do not have to conform to all of the modeling rules.

IDEF0 process models integrate smoothly with activity based costing techniques to provide a powerful all-encompassing model to accelerate the reengineering process. ABC is a powerful tool for measuring business performance, determining the business process costs, and as a means of identifying ineffective and inefficient activities. Because the IDEF0 activity model provides a structured approach detailing an activity's information input and output, the addition of process cost details (e.g., the cost of labor, materials, and overhead) associated with accomplishing the task, the value of each individual task's contribution to the whole can be assessed. Activities that are not cost effective, or add no value to the business product, but do incur costs, become early targets for elimination when streamlining the business process.

5. IDEF0 Terminology and Constructs

This section presents a brief overview of IDEF0 terminology, symbols, and constructs to assist the reader in interpreting IDEF0 diagrams. Figure 9 illustrates the IDEF symbols.

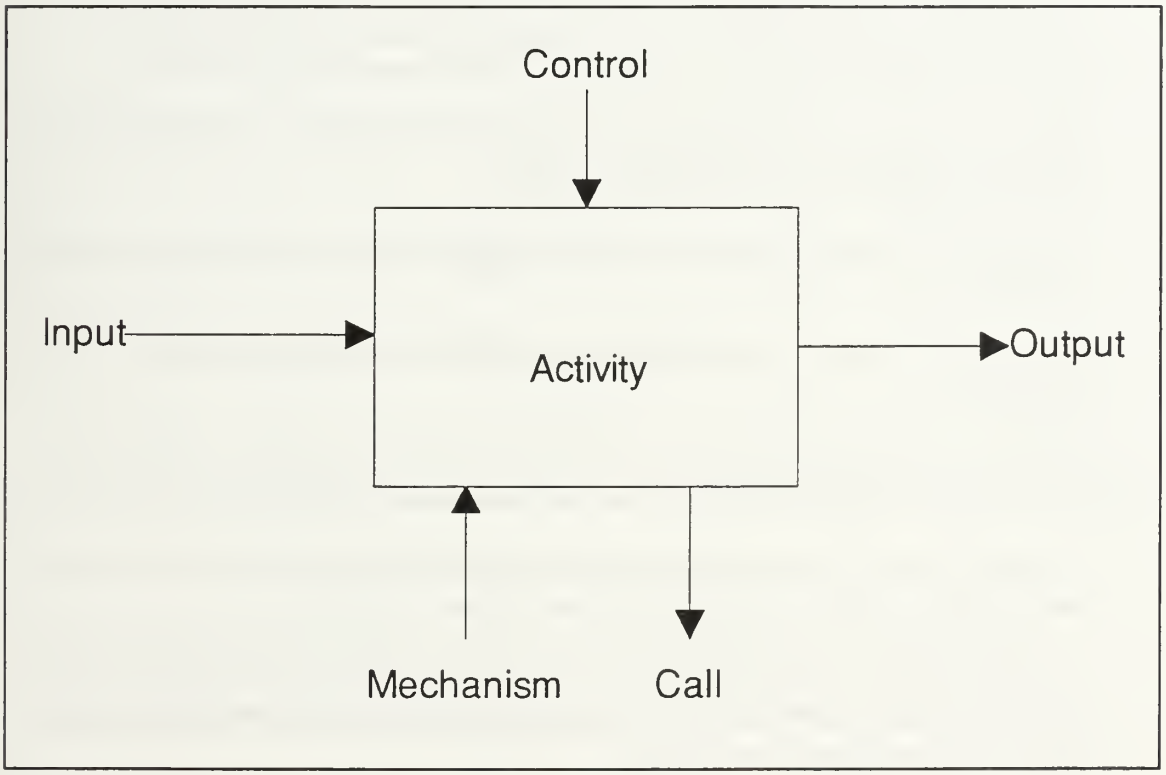

Figure 9. IDEF0 Symbols.

Activity - a function or process that must be accomplished and produces output. Activities are represented by a box, are numbered hierarchically, and are named with a verb phrase to describe what they do. Activities are numbered hierarchically with each decomposition retaining the parent's number followed by a decimal point and its own number beginning with one. (e.g., the parent activity numbered A-1.2 could have two children numbered A-1.2.1 and A-1.2.2).

Primitive Activity - an activity that is not decomposed further (i.e., has no children activities). In a decomposition diagram, a primitive level process is distinguished by a small diagonal slash, known as a leaf, in the top left corner of the activity box.

Context Diagram - the model diagram representing the highest level activity or process. It contains only one activity box with the model subject as its name. It is the starting point for the decomposition of the entire model. The context diagram is numbered A-0.

Decomposition - a method of moving from general to specific through decomposition diagrams by separating activities into components.

Decomposition Diagram - a diagram representing a more detailed look at an activity. The top level provides overview while each succeeding diagram provides greater detail of the previous diagram. Decomposition diagrams are numbered hierarchically with each subsequent diagram retaining the parent's number followed by a decimal point and its own number beginning with one. (e.g., the parent diagram numbered A2 would have a child diagram numbered A2.1)

Parent Diagram - any decomposition diagram that contains an activity that has been decomposed (i.e., has children diagrams).

Child Diagram - any decomposition diagram that represents the details of a parent activity.

Node Tree Diagram - shows the activities arranged hierarchically in a tree structure.

Input (Arrow) - represent data or objects consumed by the activity. Input arrows always enter the diagram from the left and terminate at an activity.

Output (Arrow) - represent data or objects produced by the activity. Output arrows always exit an activity and exit the diagram to the right.

Control (Arrow) - represent data or objects that specify conditions that must exist for the activity to work correctly. Control arrows always enter the diagram from the top and terminate at an activity.

Mechanism (Arrow) - represent data or objects that assist the activity in performing its task. Mechanism arrows always enter the diagram from the bottom and terminate at an activity.

Call (Arrow) - a type of control arrow that calls on another activity. Call arrows always exit an activity and exit the diagram at the bottom.

B. DATA FLOW DIAGRAMS

Data flow diagrams are another representation of the process model. Specifically, DFDs are used to depict the information system model. Once the process model has been reengineered, the business system designer must develop a prototype. Input and output information depicted on the activity model is too abstract to aid the programmer in prototype development and coding. A programmer must retrieve the data from the database tables, manipulate it according to the process model and business rules, and finally, route the output data to another process or database table. For this reason even the lowest level process decomposition diagram is of little use to the programmer because the process model does not indicate the precise source or destination of the data. A DFD maps the data sources and sinks (i.e., database tables) to the data elements that flow to and from each process. Data flow diagrams serve as the interface between the data modeler, process developer, and GUI/prototype designer.

Data flow diagrams start at the highest level with a context process designated as the *context diagram. Diagram level zero* then decomposes the context diagram into major activities. Decomposition continues to a level that allows the programmer to map individual data elements to specific process activities. Figure 10 is an example of a primitive level DFD showing the information system designer which data elements are required and from which database table they originate.

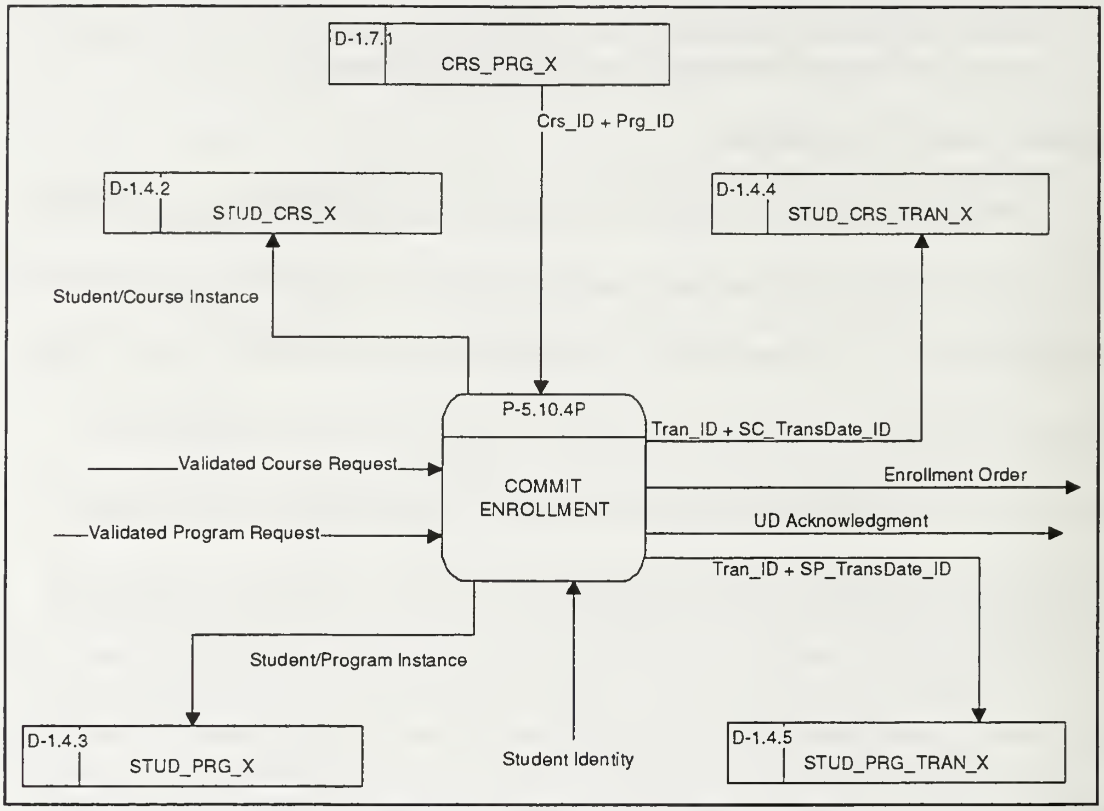

Figure 10. Primitive Level Data Flow Diagram.

1. Similarities Between DFDs and Activity Models

Because activity models and data flow diagrams represent the same process and data elements, there are similarities between them. Properties that process models and DFDs share include: functional decomposition, hierarchical numbering, and parent/child relationships.

Functional Decomposition - The functional decomposition concept is the same. In DFDs a context diagram, numbered "0" forms the basis for the system and all decompositions stem from it.

Hierarchical Numbering - The hierarchical numbering scheme for DFDs is similar to that used in the activity models. DFD process numbers are prefixed with a "P." DFD data store numbers are prefixed with a "D." DFD processes are numbered hierarchically with each decomposition retaining the parent's number followed by a decimal point and its own number beginning with one (e.g., the parent process numbered P-1.2 could have two children numbered P-1.2.1 and P-1.2.2). Primitive level processes are denoted with a "P" suffix (e.g., P-2.3.2.1P).

Parent/Child Relationships - Child processes and data stores are considered to be part of their parent and serve to reveal more detail. For example, it is assumed that when referring to a parent data store all information contained in its children is included.

2. Data Flow Diagram Symbols

Although DFDs are a similar to the process decomposition diagrams of the As-Is and To-Be IDEF0 models they use different notation. There are three data flow diagramming symbol conventions in contemporary use: Gane and Sarson, Yourdon and DeMarco, and Ward and Mellor. Each depicts data flows within a information system using different symbology. Data flow diagrams for this project are created in the Gane and Sarson convention. DFDs depict only four symbols: (1) external entity, (2) process, (3) data flow, and (4) data store. Figure 11 depicts Gane and Sarson DFD symbols. All DFD objects are defined in the central data repository.

External Entity/Source or Sink (not to be confused with entity in the data model terminology) - a data source from outside the information system that either sends data to the system or receives data from the system. It is not considered to be part of the information system although it interacts with the system. Outside entities are labeled with a noun. They may be duplicated on different diagrams and are depicted on the diagram as a double square box.

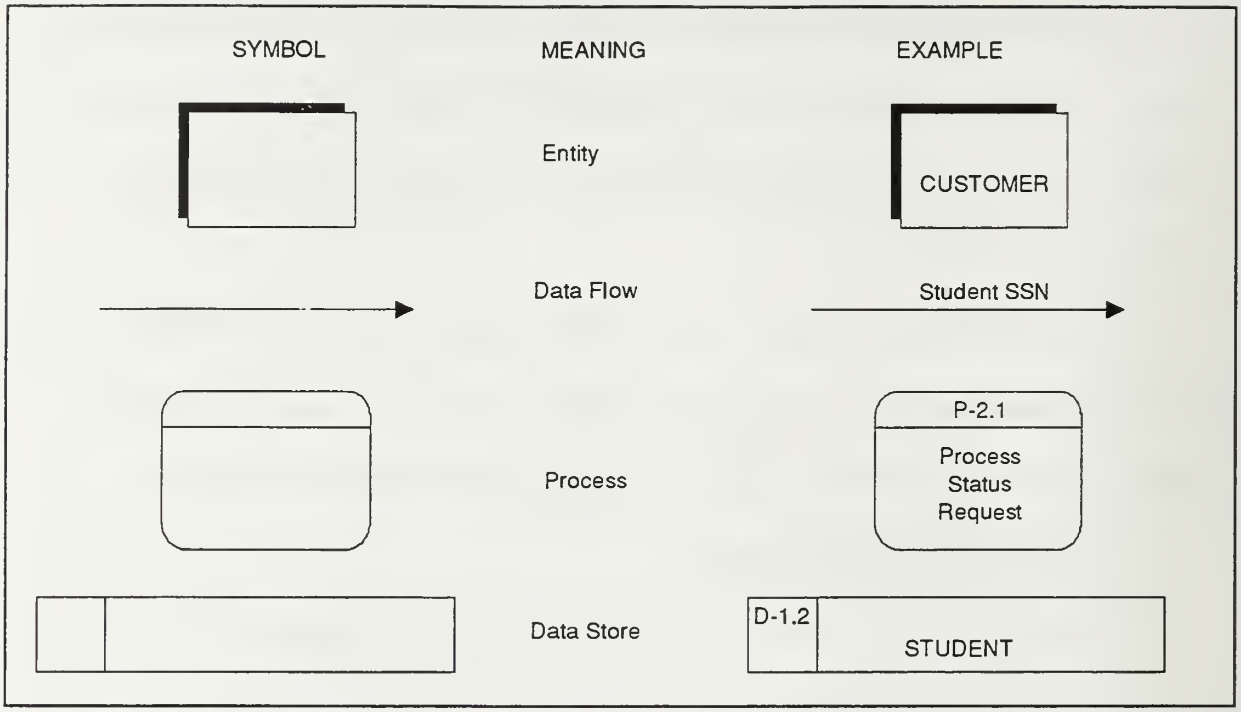

Figure 11. Gane and Sarson Data Flow Diagram Symbols.

Process - represents an activity that transfers or transforms data within the system. Processes are labeled with a verb-adjective-noun and numbered hierarchically. They may be duplicated on different diagrams and are depicted on the diagram as a box with rounded corners. The hierarchical process number is shown in the top portion of the box.

Data Flow - data that is created, read, updated, or deleted by the system. Arrowheads denote the source and destination of each piece of data. Data flows are labeled with a noun. They may be duplicated on different diagrams and are depicted on the diagram as an arrow.

Data Store - may represent a computerized file, a database, a manual store, or a logical collection of data. Temporary files created by processes within the system are not considered in the data flow diagrams. Data stores are labeled with a noun and numbered hierarchically. They may be duplicated on different diagrams and are depicted on the diagram as a rectangle.

3. Process Specifications

Process specifications are a verbal description of the process. Process specifications accompany DFDs and provide a concise summary of each activity. They aid the prototype developer in interpreting the data flow diagrams. Examples of process specifications include: process name, process number, data inputs, data outputs, structured English description of the process logic.

C. CASE TOOLS

Information engineering is a flexible methodology supported by many generic software CASE tools. Initially, Texas Instruments developed a mainframe based CASE tool specifically supporting Martin's planning, documentation, modeling, analysis, and reporting techniques. As information technology evolved from mainframes to networked PC architecture, a variety of generic BPR CASE tools supporting central data repositories, process modeling, data modeling, structured design, and code generation have been developed to support the methodology. IE methodology is comprehensive, covering all phases of system the life cycle. The reader will recall that the specific techniques used in the IE methodology are not specified and secondary to the integration and application of the underlying framework. This flexibility allows IE methodology to be tailored to achieve the best possible match of situation to technique. For example, a variety of process modeling techniques can be used such as IDEF0, entity-relationships, structure charts, or data flow diagrams. Each modeling methodology is used to show different views of the same process.

Many CASE tools have been designed specifically to support business process reengineering, data, and process modeling. Choosing an appropriate CASE tool to assist the analyst early in the reengineering effort reduces the length of time to complete the project.

1. Selection Criteria

CASE tool selection should be done after a reengineering methodology is selected. Tool choice should be based on its ability to support all aspects of the reengineering methodology. If one tool will not satisfy all of the requirements, the ability for multiple tools to share data becomes an overriding consideration. Careful scrutiny of the advertised data sharing procedures and interfaces is also advised to enhance seamless integration between the tools. Regardless of the reengineering methodology chosen, a CASE tool should possess the following capabilities.

- Capture, visualize, and monitor end-to-end processes
- Represent process rules and exceptions
- Dynamically re-plan and reschedule activities
- Simulate discrete events
- Analyze the tradeoffs in hypothetical scenarios of process redesign
- Proactively manage and learn from day-to-day events

2. CASE Tool Evaluation

There are many CASE tools available to support business process reengineering. The authors initially considered four such tools: System Architect/BPR Professional, BPwin®, Information Engineering Facility™, and TurboBPR.

Information Engineering Facility™ (IEF™) was developed with James Martin by Texas Instruments to support Martin's information engineering methodology. Although, IEF™ offered the most comprehensive support package of the CASE tools, its use was rejected outright because both its own operation and the code it generated is based on mainframe technology.

TurboBPR 2.5 is a Windows-based business process reengineering support tool developed for the Office of the Secretary of Defense by SRA Corporation. TurboBPR is designed specifically to support the DoD functional process improvement methodology. TurboBPR consists of five modules to assist with enterprise level information storage, strategic planning, activity based cost accounting, and preparation of the functional economic analysis. In spite of a formidable reporting feature, TurboBPR 2.5 was not used for this research because it lacked integral data and process modeling modules.

The remaining two competitors, System Architect/BPR Professional (SA/BPR Pro), by Popkin Software & Systems Incorporated, and BPwin® (BPwin), by Logic Works, Incorporated, are windows based modeling and simulation software designed to support a variety of business process reengineering methodologies by documenting complex business processes. Both CASE tools offer comparable performance and share common features:

- A common data repository, ensuring model consistency
- Structured analysis & design techniques for creation of DFDs, STDs and structure charts in standard or real-time methodologies
- Process modeling techniques including IDEF0
- Object oriented design techniques
- Forward and reverse engineering capabilities
- Project documentation facility offering desktop publishing features used to create reports and analyze data stored in the central repository
- Additional features such as common word processor interface, rules checks and balancing, import and export capabilities, etc.

The major difference between SA/BPR Pro and BPwin is that SA/BPR Pro has data modeling capability and can generate database schemata in a variety of popular databases. BPwin has no data modeling capability of its own.

Both SA/BPR Pro and BPwin have excellent on-line tutorial support. BPwin's tutorial was particularly relevant to this research because IDEF0 modeling examples are used to illustrate the tool's features. An inherent disadvantage of SA/BPR Pro's additional features is the required diversity of the on-line tutorial. Despite comprehensive coverage, the tutorial is more complex and leaves the user with a sense that BPwin is more intuitive and easier to operate. To fully exploit all of SA/BPR Pro's many features, considerably more time must be devoted to learning to operate the tool.

SA/BPR Pro has a more versatile graphics package for developing data flow diagrams. BPwin's structured analysis and design screen graphics package limits the user to a single 8.5 by 11 inch page, often resulting in cluttered diagrams. SA/BPR Pro allows diagramming on multiple pages.

An attractive characteristic of both SA/BPR Pro and BPwin is the advertised data sharing capability with the competition. In theory, this feature would permit parallel development of the data and process models using the premier CASE tool for each and allow maintenance of a virtual metadata encyclopedia. The choice of closely integrated tools that allow data models and process models to share data sounds appealing and was attempted. However, as parallel model development progressed, the authors discovered that in order to "share" data between models required exporting the data into Microsoft Word, converting the file into a comma delimited format, and finally importing it into the other model. As the number of activities, arrows, relationships, entities, and attributes continued to grow, this import/export routine became quite cumbersome. Unfortunately, this procedure was necessary even for minor changes to maintain model consistency. SA/BPR Pro's single data repository would have eliminated this inconvenience.

A feature BPwin has that SA/BPR Pro does not have is an advertised compatibility with a sibling data modeling product, ERwin. ERwin was the CASE tool chosen for data model development. Their common manufacturer claimed seamless data sharing between the two products by building identical data structures within the encyclopedia of each tool. However, as parallel model development progressed, it was discovered that a similar import/export routine was necessary to transfer data model information from ERwin into BPwin. This process did not require the exported file to be comma delimited before import, but the two data encyclopedia structures were not identical. Initially, definitions generated and stored by ERwin could not be imported into BPwin. In spite of this fault process model development was not impeded because data element and data table names were imported and could be used. Deficiencies in the BPwin data dictionary were overcome by a software patch distributed by the vendor which enabled the data dictionary file of both tools to produce one encyclopedia containing all model information.

3. CASE Tool Selection

CASE tool selection for the MCI modernization project is based on supportability of the information engineering methodology and the IDEF0 modeling technique. In spite of the fact that Texas Instruments' Integrated Engineering Facility™ CASE tool was developed specifically to support the IE methodology, its mainframe theme made it unsuitable for MCI modernization use. TurboBPR2.5, too, was unsuitable because it did not support process modeling with an integrated module. CASE tool contenders were quickly narrowed to System Architect/BPR Professional and BPwin®. BPwin® was selected over to System Architect/BPR Professional for several reasons.

- Advertised interoperability with its sibling data modeling product, ERwin®. ERwin® was the CASE tool selected for the data modeling portion of the MCI modernization project.
- Intuitive functionality made BPwin® easier to learn than System Architect/BPR Professional.
- Economically, the BPwin®/ERwin® combination was more affordable than System Architect/BPR Professional.

VI. MCI ENTERPRISE ANALYSIS

This chapter describes the process modeling effort in support of the MCI modernization project. The chapter begins with a detailed description of the enterprise analysis. It includes a survey of the data collected with an explanation of its analysis. The chapter concludes with the presentation of the enterprise business model.

A. ENTERPRISE ANALYSIS OVERVIEW

An enterprise analysis provides a high-level overview of the information requirements of an organization. The objective of this effort defines an architectural framework for future development. The framework consists of three major components: information, business system and technical architecture. The three architectures lay the foundation from which the organization can build an information system to manage its information resources and support its business activity. (Martin, 1990B)

A high-level perspective provides a basis from which detailed analysis in subsequent stages can be pursued. It serves as a mechanism to identify interdependency and redundancy of business activities within the organization. The first stage of Martin's IE methodology provides a technique to identify, evaluate, plan and manage the use of information to meet the organization's information system requirements.

B. MCI ENTERPRISE ANALYSIS

The enterprise analysis conducted for MCI was accomplished in two parts. The first part identified the organizational units, locations, functions and data subjects for MCI. This was a data collection effort directed at defining the architectural framework of development of MCI's information system. The second part focused on analyzing the data collected to document an enterprise overview of MCI. The documentation analyzes the relationships between organizational units, locations, functions and data subjects, as illustrated in Figure 12, using charts and matrices.

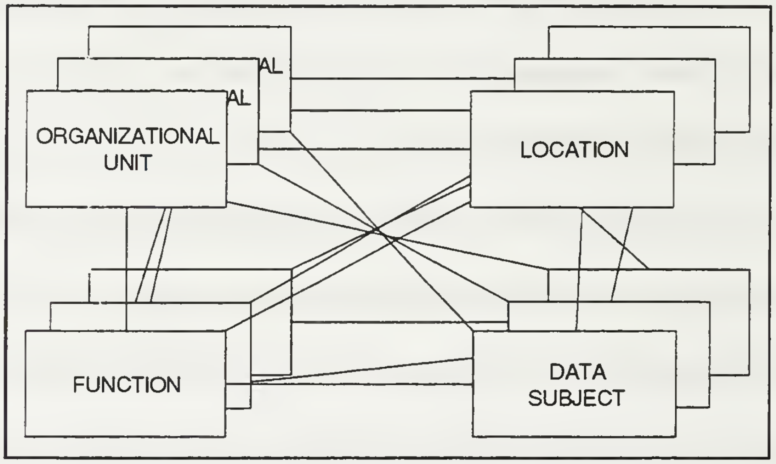

Figure 12. Enterprise Analysis Components.
After Martin, 1990B.

C. IDENTIFY INFORMATION SYSTEM REQUIREMENTS

The NPS team traveled to the Marine Corps Institute in Washington, DC for the MCI Redesign kick-off meeting held August 26-29, 1996. Prior to the meeting, the NPS team received a read-ahead package from MCI. The package included a description of the existing organizational structure, an incomplete business model previously prepared by an independent contractor, an existing data dictionary, a task breakdown of Student Services Department, historical briefing packages and background documentation on Marine Corps Institute. Each department head presented a brief that identified the department's organization, key personnel, mission and functions. The meeting provided a means to observe the business culture and political environment of MCI. Additional documentation, such as training manuals, SOPs, existing input screen shots, and management reports, was obtained during interviews and in response to requests following the initial meeting.

MCIAIS is a mission-critical system to MCI. The Student Services Department is the chief beneficiary of the information stored within MCIAIS. This is primarily due to the lost functionality of various sub-systems over time. It was apparent that each department head was frustrated because the current MCIAIS was driving the way they did business, instead of enabling improvements to process efficiency.

1. Organization Structure

Chapter II described the organizational structure into which MCI fits. The enterprise analysis focuses on MCI's reporting structure. An understanding of the MCI in this context was important to identify stakeholders to interview and provided a basis for determining responsibilities for the activities of the enterprise (Martin, 1990B).

The Director of Marine Corps Institute is also the Commanding Officer of Marine Barracks, Washington, DC. This billet is staffed by a Marine Corps Colonel. The position as Commanding Officer carries the responsibility for the activities of the Marine Barracks companies, one of which is the MCI Company. (MCI In-Brief, 1996)

The Deputy Director is accountable to the Director of MCI. This billet is staffed by a Marine Corps Lieutenant Colonel. This position is responsible for the performance of MCI Company in executing the seven MCI mission tasks identified in Chapter II. (MCI In-Brief, 1996)

MCI Company is composed of six departments: Headquarters Department, Professional Military Education Department, Occupational Skills Department, Logistics

Department, Student Services Department and Management Information Systems Department. The authors also considered Marine Corps unit's Training Departments to be a department because of its functions in the administration of student records. (MCI In-Brief, 1996)

The Headquarters Department is composed of four sections: Administration Section, Operations and Training Section, Edit Division and Performance Improvement Requirements (PIR)Section. Headquarters Department exercises staff cognizance over the MCI's departments for the production and support of distance education and training materials. (MCI In-Brief, 1996)

The Professional Military Education Department (PMED) consists of six divisions: Command and Staff College Nonresident Program Division, Amphibious Warfare School Nonresident Program Division, Warfighting Skills Nonresident Program Division, Sergeants Nonresident Program, Staff Non-Commissioned Officer (SNCO) Career Nonresident Program and Staff Non-Commissioned Officer (SNCO) Advanced Nonresident Program Division. PMED provides distance education that is a prerequisite for, or parallels, Marine Corps resident school curricula. (MCI In-Brief, 1996)

The Occupational Skills Department (OSD) is comprised of seven divisions: Command and Control Division, Combat Operations Division, Combat Support Division, Combat Service Support (CSS) Operations Division, Administration/Finance Division, Job Aids Division, and Graphics/Layout Division. OSD develops and maintains nonresident courseware and military occupational specialty (MOS) specific job aids, to include the

Marine Battle Skills Training and the Battle Drill Guide for use by the active and reserve components of the Marine Corps.(MCI In-Brief, 1996)

The Logistics Department is comprised of six divisions: Stock Control Division, Demands/Fiscal Division, Property Control/Support Division, Warehousing Division, Postal Division, and Reproduction Division. Logistics Department procures, stocks, packages, and distributes courses and training products, produces and manages the fiscal plan, provides postal services, organizational supply, logistical support, printing and reproduction services to MCI and Marine Barracks. (MCI In-Brief, 1996)

The Student Services Department (SSD) is comprised of five sections: Immediate Assist Section, Enrollment Section, Grading Section, Unit Activity Report (UAR) Section, and Registrar Section. SSD is responsible for the enrollment, grading, and management of student records for MCI's distance education and training programs. (MCI In-Brief, 1996)

The Management Information Systems Department (MISD) is comprised of two sections: Information System Management (ISM) Section and Programming Section. MISD provides information systems support to the Marine Barracks and to MCI in the enrollment, grading, and management of student records. (MCI In-Brief, 1996)

The Marine Corps unit Training Department is normally one person, the unit Training NCO. The Training NCO is a MCI representative within the Marine Corps unit, in much the same way as Lieutenant Colonel Harllee set up when correspondence courses were first offered 77 years ago.

2. Business Locations

The physical location of each organizational unit is important to the development of technical architecture. It provides a basis for determining the physical attributes the information system must satisfy for the business activities of the enterprise. (Martin, 1990B)

A tour of MCI during the initial brief revealed the location of the MCI offices and work spaces where the various business activities take place. The office for Director of MCI is located at the Marine Barracks, 8th and I streets. This is approximately six blocks from the MCI buildings. The office for the Deputy Director is located on the second floor in building 220, Lejeune Hall, at the Washington Navy Yard. MCI Headquarters Administrative and PIR sections, PMED, SSD and MISD are also located on the second floor of Lejeune Hall. OSD, Operations and Training section, and the Edit Division are located on the first floor of Lejeune Hall. The Logistics Department is located, across the street from the rest of MCI, in building 169 of the Washington Navy Yard. The Marine Corps unit's Training Department is located in literally hundreds of operating locations around the world.

3. Business Functions

The enterprise business functions were decomposed from seven high-level functional areas. Functional areas refer to the major business activities and serve as the starting point for further decomposition in the subsequent Business Area Analysis. The functional decomposition of MCI's enterprise activities is illustrated in Figure 13.

- Headquarters Support - The functions that provide planning, parade support and personnel administration for MCI.

- Course Development - The functions that support the design, writing, revising, staffing, and production of MCI courses, programs, and job aids.

- Course Management - The functions that support the advertising, budgeting, training and analysis of MCI courses, programs, and job aids.

- Student Services - The functions that support data entry for student record management, student servicing, grading, and course completion certification.

- Information System Management - The functions that support the network management, programming and database administration for MCI.

- Warehouse and Distribution - The functions that support purchase, receipt, storage, inventory, packaging, distribution and disposal of MCI courses, programs, and job aids.

- Unit Interaction - The functions performed by the Marine Corps unit training departments in support of the administration of MCI courses, programs, and job aids.

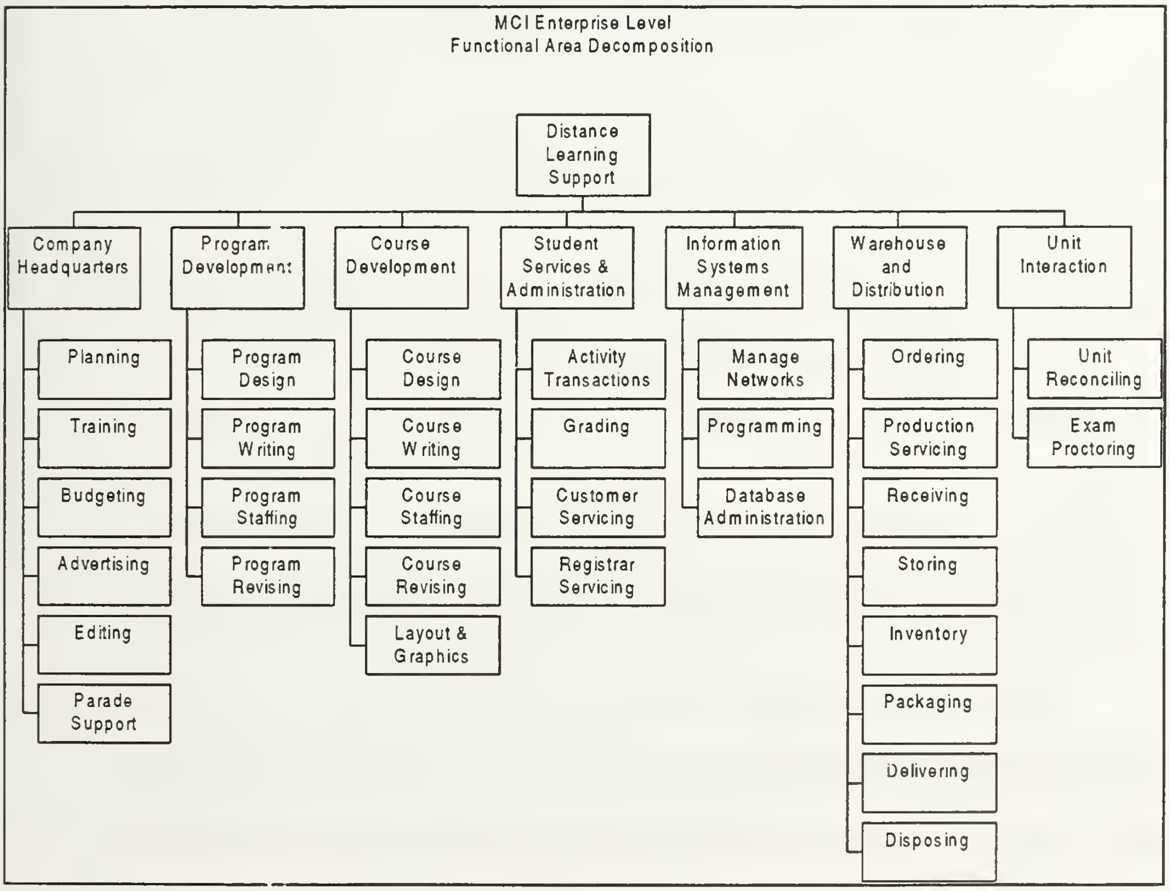

Figure 13. MCI Enterprise Level Functional Area Decomposition.

A business function is a collection of related activities which completely support one aspect of furthering the enterprise's mission (Martin, 1990B). Figure 14 provides an overview of many functions performed by the various organizational units in the development, distribution and management of the distance training and education courses and programs. The functions represented in the flowchart were used to generate an initial candidate list of business functions performed by the MCI enterprise. The business function candidate list was revised several times as each organizational unit was analyzed.

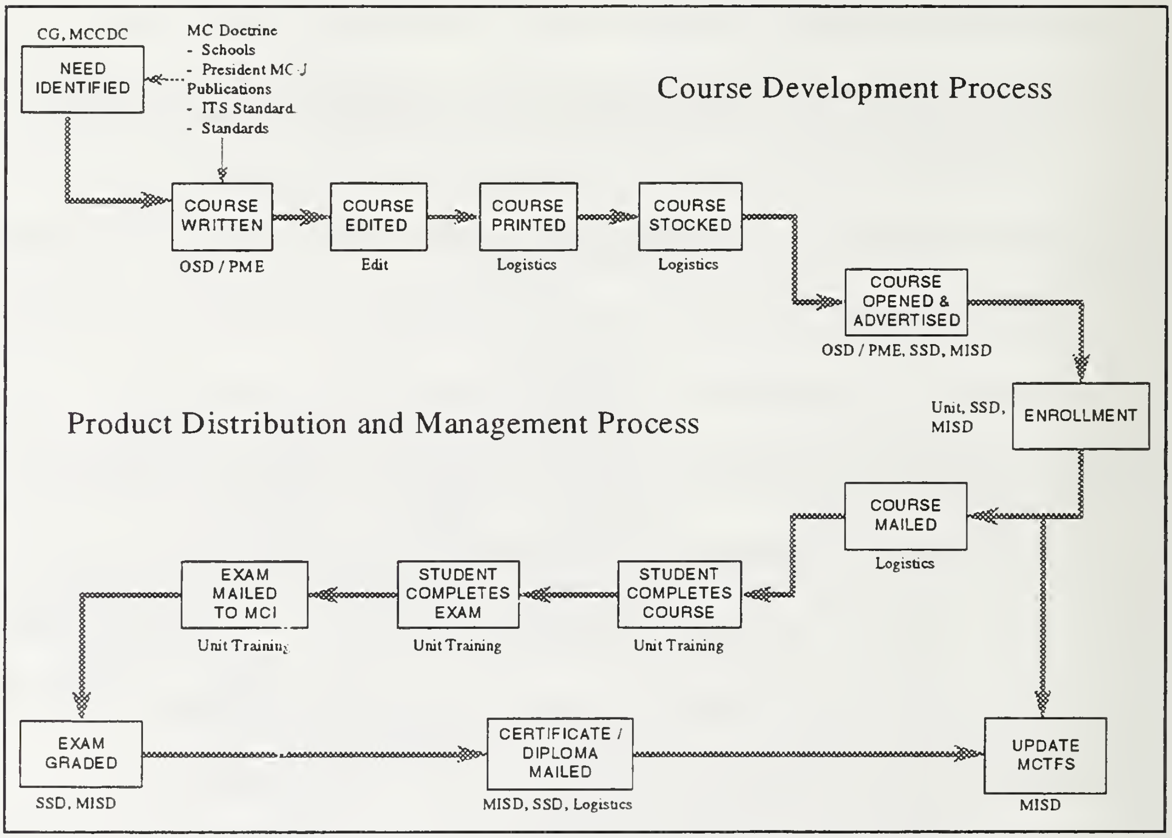

Figure 14. Product Development, Distribution, and Management Flowchart.

Business functions were then defined. Defining the business functions is important to understanding the business process as a whole. However, at the enterprise level, business function definitions are independent of the organizational structure (Martin, 1990B). The definitions were not linked directly to an MCI organizational unit or its location because the reporting structure may change but the functions still must be performed. A total of 33 candidate business functions were identified and defined during the enterprise analysis.

- Advertising - To publish or announce the availability of Programs, Courses and Job Aids in the MCI Course Catalog, military newspapers, ALMARs, MARINE magazine, etc.

- Analysis Of Effectiveness - To collect data from returned exams and student feedback sheets, and analyze data in order to revise exam questions or Program and Course text.

- Budgeting - To manage budget categories for developing, producing and distributing MCI Programs, Courses and Job Aids.

- Course Design - To identify and establish the design specifications, schedule and prerequisites for MOS Courses and Job Aids to meet Marine Corps training and education requirements for target audience.

- Course Revising - To revise Job Aids and MOS Course text, examinations and related material based on feedback from students, Course sponsors, CG, MCCDC and internal analysis of effectiveness.

- Course Staffing - To allow newly designed MOS Courses and Job Aids to be reviewed by all of the agencies and departments responsible for its production and distribution.

- Course Writing - To research and write the MOS Course text, components, examinations and Job Aids.

- Customer Servicing - To respond to customer inquiries of any nature (as it relates to the MCIAIS) and process customer requests for MCI action (enrollment, material request, update information, etc.). This service supports inquiries received by telephone, electronic mail, U.S. Mail, or over the counter.

- Database Administration - To download and upload TFS and unit diary information into the MCIAIS; to upload and service the automated telephone Conversant system database. To commit daily transaction files; to troubleshoot database or related problems; to backup database.

- Delivering - To deliver Program materials, Course materials, Job Aids, Diplomas, Course Completions certification and course components to students.

- Disposing - To purge obsolete Program and Course materials, Job Aids and course components.

- Editing - To review new and revised Programs, Courses and Job Aids for Instructional System content and quality.

- Exam Proctoring - Monitoring examinations to Marines in the fleet to ensure compliance with the MCI Procedures Manual.

- Grading - To record the scores of examinations, in the MCI student database, graded by both automated & manually means.

- Inventory - To manage on-hand quantities and locations of on-hand material.

- Layout & Graphics - To create new graphics, improve existing graphics, and maintain library of appropriate graphics and artwork for Program text, Course text, and Job Aids.

- Manage Networks - To install, manage and maintain telephone and data network equipment.

- Ordering - To requisition Program and Course materials, Job Aids and course components distributed by MCI.

- Packaging - To assemble and shrink wrap Program and Course materials, Job Aids and course components for distribution and storage.

- Parade Support - To coordinate MCI personnel to support the ceremonial activities at the Marine Barracks.

- Planning - To schedule and coordinate all planning associated with MCI Parades and Ceremonial Details involving MCI personnel.

- Program Design - To identify and establish the design specifications, schedule and prerequisites for PME courses to meet Marine Corps training and education requirements for target audience.

- Program Revising - To revise PME Program text, examination and related material subject to feedback from students, Program sponsors, CG, MCCDC, and internal analysis of effectiveness.

- Program Staffing - To allow a newly designed or revised PME Program content to be reviewed by all of the agencies and departments responsible for its production and distribution.

- Program Writing - To research and write the PME Program text, components and examinations.

- Programming - To write program source code that corrects or enhances database administration.

- Receiving - To receipt for materials that will be stored in the warehouse.

- Registrar Servicing - To research and produce diplomas, completion certificates and transcripts for students.

- Reproduction Servicing - To prepare negatives, camera-ready originals, and print specifications for contract orders to commercial printers, maintain negatives and camera-ready copy for MCI courses; to reproduce/print original documents for MCI or Marine Barracks in quantities less than 25,000.

- Storing - To stock received materials.

- Student Activity Transactions - To manage student records and monitor the transaction processing system.

- Training - To coordinate training of MCI course writers and programmers.

- Unit Reconciling - To provide MCI with feedback from units so MCIAIS can be validated and updated if required.

4. Data Subjects

Data subjects refer to a higher level grouping of data entities. A candidate list of data subjects, provided in Table 4, was developed by the NPS team data modeler. The candidate list of data subjects, their definitions, attributes and relationships are detailed in the *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Preliminary Report*, (Kamel et al., 1997). The data subjects were decomposed in the subsequent Business Area Analysis.

Advertisement Information	Job Aid Information
Component Information	Job Aid Copy Material Information
Copy Material Information	MCI Personnel Information
Course Information	MCTFS Personnel Information
Course Copy Material Information	Order Information
Course Developers Information	Program Information
Customer Information	Program Copy Material Information
Events Information	Program Developers Information
Exam Information	Purchase Information
Financial Information	SSD Personnel Information
Inventory Information	Student Information
IS Equipment Inventory Information	Training Information
Issue Complaint Information	Warehouse Information

Table 4. Candidate List of Data Subjects.

D. DOCUMENT THE ENTERPRISE

The second part of the ISP stage documents the information requirements, identified during the first part. Graphic representations helped to summarize the collected data. The enterprise analysis of MCI was documented with an organization chart and several planning matrices which illustrate the relationships of MCI's organizational units, locations, business functions and data subjects.

1. Document Current MCI Organization

The reporting structure of MCI Company was documented using an organizational chart. The organization chart, Figure 15, illustrates the hierarchical structure common among traditional military organizations. The sections are logically arranged to report to the respective departments. The dashed lines represent indirect operational support. In one case, the MCI Company provides parade and logistical services to the Marine Barracks operations. In the other case, Marine Corps units provide enrollment processing and reconciliation services necessary for MCI distance training operations.

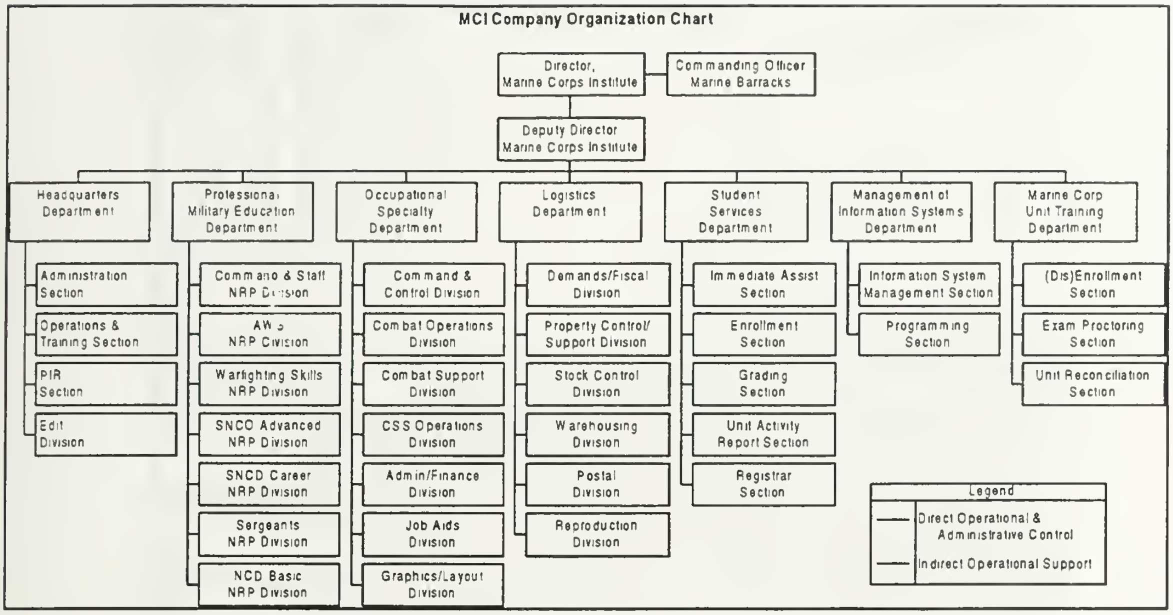

Figure 15. MCI Company Organization Chart.

2. Document Current Locations, Functions, and Data Subjects

The relationships between the organizational units, locations, functions and data subjects define the architectural framework of the enterprise. A common technique used to document and analyze such relationships is to develop a series of planning matrices that cross reference and validate the various elements of the organization. Eight matrices were used to define the information and business system architecture for the MCI enterprise analysis: Organizational Unit versus Location, Function versus Organizational Unit, Function versus Location, Data Subject versus Organizational Unit, Data Subject versus Location, Data Subject versus Function (CRUD Matrix), Function versus Data Subject (CR Matrix) and Function versus Data Subject (Clustered CR Matrix).

The Organizational Unit versus Location matrix, provided as Figure 16, summarizes the MCI organizational units and the locations where their business activity takes place. The matrix validated the organizational units with their locations. This

@ - Included
  - Not Referenced

Organizational Unit \ Location	Marine Barracks	MCI Building 2nd Floo	MCI Building 1st Floor	MCI Warehouse	Using Unit
Headquarters	@	@			
Professional Military Education Department		@			
Student Services Department		@			
Management Information Systems Department		@			
Training & Operations Department			@		
Occupational Specialty Department			@		
Logistics Department				@	
Unit Training Representative					@

Figure 16. Organizational Unit versus Location Matrix.

validation ensured all organizational units were accounted for in the analysis. Their locations would be considered in the technical architecture development. The “@”marks in the same columns depict organizational units which operate from the same location. The marks in the same rows indicate organizational units which operate in different locations.

The Function versus Organizational Unit Matrix, provided as Figure 17, summarizes the functions performed by each MCI organizational unit. The Function versus Location, provided as Figure 18, summarizes the locations in which the functions are performed. These two matrices validated the functional decomposition by ensuring that every function was mapped to an organizational unit and that every organizational unit was involved in an identified function. The matrices also show the extent to which departments share data and perform redundant functions.

- Major responsibility
O - Major involvement
\ - Some involvement

Functional Area	Function	Headquarters	Training and Ops Dept	Prof Military Educ Dept	Occupational Specialty Dept	Student Services Dept	Mgmt Info Systems Dept	Logistics Department	Unit Training Representative
HQ Support	Personnel Administration	#	\	\	\	\	\	\	
	Parade	O	#	\	\	\	\	\	
	Planning	O	#						
Course Management	Budgeting	O	#	\	\		O	O	
	Training		#	\	\		\		
	Advertising	\	#	\	\	\			
	Analysis of Effectiveness		#	\	\	\			
Course Development	Program Design		O	#					
	Program Writing			#					
	Program Staffing			#					
	Program Revising			#					
	Course Design		O	#	#				
	Course Writing			#	#				
	Course Staffing			#	#				
	Course Revising			#	#				
	Editing		#	O	O				
	Layout & Graphics		O	O	#				
	Reproduction Servicing			O	O			#	
Student Service	Student Activity Transactions					#	O		
	Grading			O	\	#	O		
	Customer Servicing					#	\	\	
	Registrar Servicing					#	\	\	
Information Management	Manage Networks						#		
	Programming						#		
	Database Administration						#		
Warehouse and Distribution	Ordering		\	\	\	\		#	
	Receiving		\					#	
	Storing							#	
	Inventory					O		#	
	Packaging			\	\			#	
	Delivering					O		#	
	Disposing			O	O			#	
Marine Unit	Unit Reconciling					#	\		O
	Exam Proctoring		#						O

Figure 17. Function versus Organizational Unit Matrix.

Two other matrices were produced by the NPS data modeler to illustrate the relationship between the data subjects with the organizational units and the locations.

@ - Included
 - Not Referenced

Functional Area	Function (Location →)	Marine Barracks	MCI Building 1st Floor	MCI Building 2nd Floor	MCI Warehouse	Using Unit
HQ Support	Personnel Administration	@	@			
	Parade	@	@	@	@	
	Planning	@	@	@		
Course Management	Budgeting		@	@	@	
	Training		@	@		
	Advertising		@			
	Analysis of Effectiveness		@			
Course Development	Program Design			@		
	Program Writing			@		
	Program Staffing			@		
	Program Revising			@		
	Course Design		@	@		
	Course Writing		@	@		
	Course Staffing		@	@		
	Course Revising		@	@		
	Editing		@	@		
	Layout & Graphics		@			
	Reproduction Servicing				@	
Student Service	Student Activity Transactions			@		
	Grading			@		
	Customer Servicing			@		
	Registrar Servicing			@		
Information Managment	Manage Networks	@		@		
	Programming			@		
	Database Administration			@		
Warehouse and Distribution	Ordering				@	
	Receiving				@	
	Storing				@	
	Inventory				@	
	Packaging				@	
	Delivering				@	
	Disposing				@	
Marine Unit	Unit Reconciling					@
	Exam Proctoring					@

Figure 18. Function versus Location Matrix.

Together, these five matrices served to cross reference and validate the candidate data subjects and business functions and improved the project team's understanding of MCI's current strategy for conducting business.

The relationship between business functions and the data subjects revealed the Information Architecture. Three matrices were used to group business functions and data subjects into natural business systems and natural data stores. These groupings identify the division of business areas in preparation for further detailed analysis.

Each function was evaluated to determine if it would *create*, *read*, *update*, *delete*, or *archive* the corresponding data subject. A "C", "R", "U", "D" and/or "A" was placed in the row-column representing that data subject and function analyzed. Collating each combination produced the Data Subject versus Function CRUD Matrix given as Figure 19.

A CR Matrix, provided as Figure 20, was used as an intermediate step to generate the groupings necessary to identify the business areas. A "C" was substituted for every "C", "U", "D" or "A". The columns and rows of the CR Matrix were arranged to create clusters of related functions that create, update, delete and archive associated data subjects. The resulting Clustered CR Matrix revealed natural groupings that verify the natural division of sub-systems in preparation for the Business System Design stage.

3. MCI's Current Business Model

The Clustered CR Matrix, provided as Figure 21, revealed eight business sub-systems that directly influence the MCI information requirements: Personnel Administration, Ceremonial, Program and Course Development, Program and Course Management, Student Service Support, Information System Management, Warehouse and Distribution, and Unit Interaction.

The Clustered CR Matrix revealed two details worthy of discussion. First, the Personnel Administration and Ceremonial sub-systems influence business activity of MCI but actually have no direct interface with MCIAIS. Second, the Unit Interaction sub-

C - Create
R - Read
U - Update
D - Delete
A - Archive

FUNCTION / DATA SUBJECT	Headquarters Support			Course Management				Course Development									
	Planning	Parade	Personnel Administration	Budgeting	Training	Advertising	Analysis of Effectiveness	Program Design	Program Writing	Program Staffing	Program Revising	Course Design	Course Writing	Course Staffing	CourseRevising	Editing	Layout & Graphics
Advertisement *Information*						CRUD	R	R		R		R		R			
Components *Information*				R			R	R	CRUD	R	RU	R	CRUD	R	RU	R	RU
Copy Material *Information*					R		R	R	CRUA	R		R	CRUA	R	RU	RU	CRUA
Course *Information*				R		R	R	CRUA	RU	R	RU	CRUA	RU	R	RU	R	R
Course Copy Material *Information*							R	R	CRUD	R	RU	R	CRUA	R	RU	RU	RU
Course Developers *Information*			R				R	CRUD	R	R	R	CRUD	R	R	R	R	R
Customer *Information*																	
Events *Information*	CRUD	RU															
Exam *Information*							R	R	CRUA	R	RU	R	CRUA	R	RU	RU	R
Financial *Information*				CRUD	R	R		R				R					
Inventory *Information*							R										
IS Equipment Inventory *Information*				R													
Issue Complaint *Information*																	
Job Aid *Information*				R	R	R						R	CRUD	R	RU	R	R
Job Aid Copy Material *Information*												R	CRUD	R	RU	RU	RU
MCI Personnel *Information*	R		CRUD		R												
MCTFS Personnel *Information*																	
Order Information				R													
Program *Information*				R	R	R	R	CRUA	RU	R	RU					R	R
Program Copy Material *Information*							R	R	CRUD	R	RU					RU	RU
Program Developers *Information*			R				R	CRUD	R	R	R					R	R
Purchase *Information*				R		R				R				R			
SSD Personnel *Information*			CRUD														
Student *Information*							R										
Training *Information*			R		CRUD			R	R		R	R	R		R	R	R
Warehouse *Information*				R													

Figure 19. Data Subject versus Function (CRUD) Matrix.

C - Create
R - Read
U - Update
D - Delete
A - Archive

	Student Service				Information Management			Warehouse and Distribution							Marine Unit		FUNCTION
Repro Servicing	Student Activity Transactions	Grading	Customer Servicing	Registrar Servicing	Manage Networks	Programming	Database Administration	Ordering	Receiving	Storing	Inventory	Packaging	Delivering	Disposing	Unit Reconciling	Exam Proctoring	DATA SUBJECT
			R				R										Advertisement *Information*
R	R		R			R	R	R	R	R	R	R	R	R			Components *Information*
R						R											Copy Material *Information*
R	R	R	R	R		R	R			R	R	R	R	R	R	R	Course *Information*
R						R	R										Course Copy Material *Information*
							R										Course Developers *Information*
	R		CRUD			R	R						R		R		Customer *Information*
																	Events *Information*
R	R	R	R	R		R	R					R	R	R		R	Exam *Information*
R				R	R	R		R	R		R	R	R				Financial *Information*
	R		R			R		RU	RU	RU	CRUD	RU	RU	RU			Inventory *Information*
					CRUD	R	R										IS Equipment Inventory *Information*
			CRUD			R	R										Issue Complaint *Information*
R	R		R			R	R	R	R	R	RU	R	R	R	R		Job Aid *Information*
R						R											Job Aid Copy Material *Information*
						R											MCI Personnel *Information*
	R	R	R	R		CRUD	R										MCTFS Personnel *Information*
	RU		CRUD			R	R				R	R	R		R		Order Information
R	R	R	R	R		R	R			R		R			R		Program *Information*
R						R	R							R			Program Copy Material *Information*
							R										Program Developers *Information*
CRUD	R		R			R	R	CRUD	RU	R	RU						Purchase *Information*
						R	R										SSD Personnel *Information*
	CRUA	RU	CRUA	RU		R	R						R		R	R	Student *Information*
						R	R										Training *Information*
						R				RU	CRUD			R			Warehouse *Information*

Figure 19. Data Subject versus Function (CRUD) Matrix continued.

C - Create, Update, Delete, Archive
R - Read / Retrieve

Functional Areas	Functions	Advertisement *Information*	Components *Information*	Copy Material *Information*	Course *Information*	Course Copy Material *Information*	Course Developers *Information*	Customer *Information*	Events *Information*	Exam *Information*	Financial *Information*	Inventory *Information*	IS Equipment Inventory *Information*	Issue Complaint *Information*	Job Aid *Information*	Job Aid Copy Material *Information*	MCI Personnel *Information*	MCTFS Personnel *Information*	Order Information	Program *Information*	Program Copy Material *Information*	Program Developers *Information*	Purchase *Information*	SSD Personnel *Information*	Student *Information*	Training *Information*	Warehouse *Information*
Headquarters Support	Personnel Administration						R										C					R		C		R	
	Parade								C																		
	Planning								C								R										
Course Management	Budgeting		R		R						C		R		R				R	R			R				R
	Training			R							R				R		R			R						C	
	Advertising	C			R						R				R					R			R				
	Analysis of Effectiveness	R	R	R	R	R	R			R		R								R	R	R			R		
Course Development	Program Design	R	R	R	C	R	C			R	R									C	R	C				R	
	Program Writing		C	C	C	C	R			C										C	C	R				R	
	Program Staffing	R	R	R	R	R	R			R										R	R	R	R				
	Program Revising		C		C	C	R			C										C	C	R				R	
	Course Design	R	R	R	C	R	C			R	R				R	R										R	
	Course Writing		C	C	C	C	R			C					C	C										R	
	Course Staffing	R	R	R	R	R	R			R					R	R							R				
	Course Revising		C		C	C	R			C					C	C										R	
	Editing		R	C	R	C	R			C					R	C				R	C	R				R	
	Layout & Graphics		C	C	R	C	R			R					R	C				R	C	R				R	
	Reproduction Servicing		R	R	R	R				R	R				R	R				R	R		C				
Student Servicing	Student Activity Transactions		R		R			R		R		R			R			R	C	R			R		C		
	Grading				R					R								R		R					C		
	Customer Servicing	R	R		R			C		R		R		C	R			R	C	R			R		C		
	Registrar Servicing				R					R	R							R		R					C		
Information Systems Management	Manage Networks										R		C														
	Programming		R	R	R	R		R		R	R	R	R	R	R	R	R	C	R	R	R		R	R	R	R	R
	Database Administration	R	R		R	R	R	R		R			R	R	R			R	R	R	R	R	R	R	R	R	
Warehouse and Distribution	Ordering		R								R	C			R								C				
	Receiving		R								R	C			R								C				
	Storing		R		R							C			R					R			R				C
	Inventory		R		R						R	C			R				R				C				C
	Packaging		R		R					R	R	C			R				R	R							
	Delivering		R		R			R		R	R	C			R				R						R		R
	Disposing		R		R					R		C			R					R							R
Unit Interaction	Unit Reconciling				R			R							R				R	R					R		
	Exam Proctoring				R					R															R		

C - Create, Update, Delete, Archive
R - Read / Retrieve

Figure 20. CR Matrix.

C - Create, Update, Delete, Archive
R - Read / Retrieve

Functional Areas	Functions	MCI Personnel Information	SSD Personnel Information	Events Information	Financial Information	Training Information	Advertisement Information	Program Information	Program Developers Information	Course Information	Course Developers Information	Program Copy Material Information	Exam Information	Copy Material Information	Course Copy Material Information	Components Information	Job Aid Copy Material Information	Job Aid Information	Student Information	Customer Information	Order Information	Issue Complaint Information	Purchase Information	Inventory Information	Warehouse Information	MCTFS Personnel Information	IS Equipment Inventory Information	Sub-Systems
Headquarters Support	Personnel Administration	C	C			R			R		R																	Personnel Admin
	Parade Support			C																								Ceremonial
	Planning	R		C																								
Course Management	Budgeting				C			R		R						R		R			R		R		R		R	Program and Course Management
	Training	R			R	C		R						R				R										
	Advertising				R		C	R		R								R					R					
	Analysis of Effectiveness						R	R	R	R	R	R	R	R	R	R			R					R				
	Program Staffing						R	R	R	R	R	R	R	R	R	R							R					
	Course Staffing						R			R	R		R	R	R	R	R	R					R					
Course Development	Program Design				R	R	R	C	C	C	C	R	R	R	R	R												Program and Course Development
	Program Writing					R		C	R	C	R	C	C	C	C	C												
	Program Revising					R		C	R	C	R	C	C		C	C												
	Layout & Graphics					R		R	R	R	R	C	R	C	C	C	C	R										
	Editing					R		R	R	R	R	C	C	C	C	R	C	R										
	Course Design				R	R	R			C	C		R	R	R	R	R	R										
	Course Writing					R				C	R		C	C	C	C	C	C										
	Course Revising					R				C	R		C		C	C	C	C										
Student Servicing	Customer Servicing						R	R		R			R			R		R	C	C	C	C	R	R		R		Student Service Support
	Student Activity Transactions							R		R			R			R		R	C	R	C		R	R		R		
	Grading							R		R			R						C							R		
	Registrar Servicing				R			R		R			R						C							R		
Warehouse and Distribution	Inventory				R					R						R		R			R		C	C	C			Warehouse and Distribution
	Reproduction Servicing				R			R		R		R	R	R	R	R	R	R					C					
	Ordering				R											R		R					C	C				
	Receiving				R											R		R					C	C				
	Storing							R		R						R		R					R	C	C			
	Delivering				R					R			R			R		R	R	R	R			C	R			
	Packaging				R			R		R			R			R		R			R			C				
	Disposing							R		R			R			R		R						C	R			
Information Systems Management	Programming	R	R		R	R		R		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	R	Information Systems Management
	Database Administration		R			R	R	R	R	R	R	R	R		R	R		R	R	R	R	R	R			R	R	
	Manage Networks				R																						C	
Unit Interaction	Unit Reconciling							R		R								R	R	R	R							Unit Interaction
	Exam Proctoring									R			R						R									

Figure 21. Clustered CR Matrix.

system uses data produced by MCIAIS and generates data input through MISD, but does not actually create or read a data subject directly. These three sub-systems were left in the matrix to give a complete representation of the business system architecture to consider during the reengineering phase.

The MCI Preliminary Business Model, Figure 22, represents the division of the enterprise into lower level business areas and functions. Subsequent analysis of each business area can be performed independently based on priorities determined during this initial evaluation to satisfy the organizational requirements. MCI management determined the business activities of Student Service Support should receive the highest priority based on the information requirements and its role in the MCIAIS-II implementation plan.

The boundaries of the business area analysis for Student Service Support adds definition to the MCI Modernization Project scope. The analysis did not focus on how the

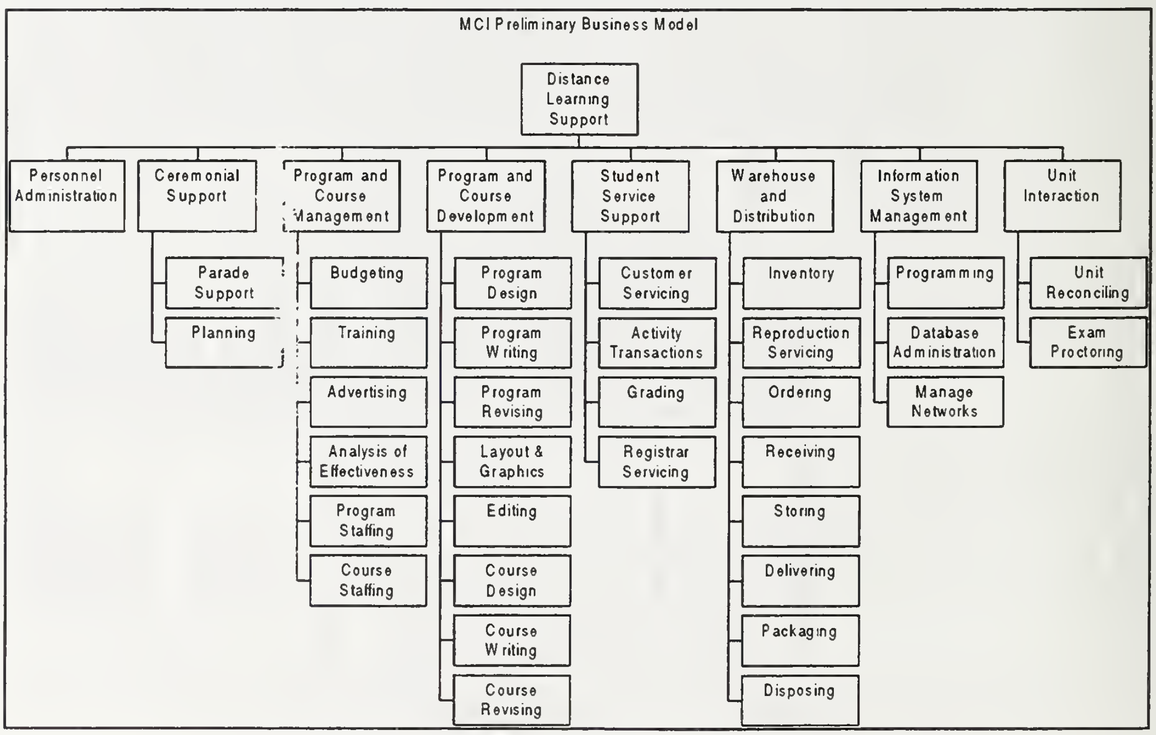

Figure 22. MCI Preliminary Business Model.

database was populated, but on the data with which it would be populated, the SSD processes that use the data, and the interaction between the two. The key business areas, functions, and data subjects, identified during the MCI enterprise analysis, are illustrated with Figure 23. The business areas are represented by large rounded boxes. The functions are represented are contained within the respective business area. External entities are represented with rectangles. The arrows represent interaction. The dashed line represents the boundary, and focus of the BAA. Migration of the legacy system's functionality required identification of the data entities encountered with each interaction. The As-Is process model was developed to identify those details.

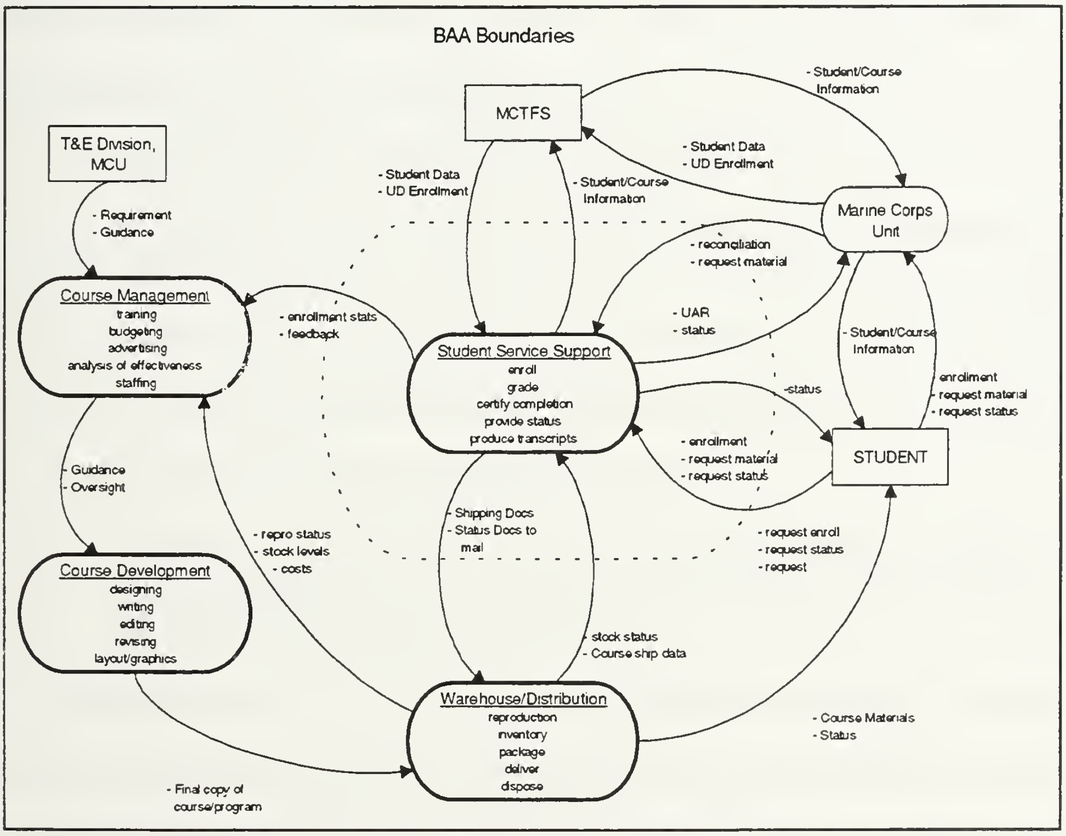

Figure 23. BAA Boundaries.

VII. MCI BUSINESS AREA ANALYSIS

This chapter further describes the process modeling effort in support of the MCI modernization projec . The chapter begins with a detailed description of the Business Area Analysis and the subsequent development of the As Is Model for the Student Services Support business area. The detailed description of the tailored application of Business Process Reengineering follows. The chapter concludes with the presentation of To Be Process and Information System Models for the Student Services Department.

A. BUSINESS AREA ANALYSIS OVERVIEW

The Business Area Analysis (BAA) is the second stage of Information Engineering. The BAA is a refinement to a specific subset of the enterprise analysis. There are six objectives of a BAA project (IEF Guide, 1990):

1. To fully identify and define the type of data required
2. To identify and define the business activities that make up each business function
3. To define the data required for each business activity
4. To identify the necessary sequence of business activities
5. To define how business activities affect the data
6. To produce a plan for Business System Design (BSD) within a prioritized sequence of business systems. Normally, several business systems will be defined to support a single business area.

The ultimate goal is to refine the business areas identified during the enterprise analysis. The ISP stage targeted the Student Service Support as the first business area for detailed analysis. Boundaries were established to identify the resources required to support development of a new information system that will, at least, maintain the same functionality provided by the current MCIAIS in a new relational database. The detailed analysis focused on definition and refinement of the business activities performed by SSD, the objects that generate the activity, and the interaction between them.

B. MCI BUSINESS AREA ANALYSIS

The BAA for Student Service Support is built upon the information gathered during the ISP stage. Having already identified the functional areas and the business area to analyze, the NPS team initiated development of the As-Is Process Model. A detailed functional decomposition of the Student Service Support business area was done. The As-Is process model was presented as node tree and process decomposition diagrams and circulated for review. Business Process Reengineering techniques were applied. A To-Be process model was developed using IDEF0 modeling technique. The proposed To-Be Process Model was circulated again for review. The refined model was validated using matrices and clustering as performed during the ISP stage. Once validated, an information system model was developed using data flow diagrams. The products of this analysis provided the necessary information to develop a system architecture plan, a To-Be Data model, a To-Be Process model, an information system model, and a prototype that validated the methodology.

1. SSD BAA Implementation

The As-Is process model represents the business activity of the Student Services Department in August 1996. Model development began with functional decomposition. The student service support business area was decomposed eight levels into 499 activities. A process decomposition diagram and node tree diagrams were developed to document the analysis. This technique provided sufficient detail to obtain a thorough understanding of SSD business.

The process decomposition and node tree diagrams were developed with the BPWin® CASE tool. BPWin® was useful for the development of the metadata encyclopedia. It proved to be very simple to use and, after receiving a software patch, integrated well with its sibling data modeling CASE tool, ERWin®.

A complete IDEF0 model was not produced for the As-Is processes. The authors felt that too much time would be spent developing naming conventions for activities, relationships and entities of the non-relational database, which would detract from the reengineering effort. However, the activities that were likely to apply in the To-Be process model were defined and then refined when applied.

During the reengineering phase it became apparent that an As-Is process should also include selected processes from other functional areas. Sufficient information had been obtained during the ISP stage to create high-level As-Is process models for other business areas: Course and Program Management, Course and Program Development, Warehouse and Distribution, and Information System Management.

These decomposition diagrams were useful in the data model development. The enterprise level CRUD matrix revealed a significant amount of data retrieved by SSD but owned by other business areas. Course or program information, stock status, MCTFS information are just a few examples. The data model needed to reflect those data subjects for MCIAIS-II to retain the same functionality.

2. As-Is Model Details

All of the activities depicted in the SSD process model are prefixed with "SSD" to distinguish it from models developed for other areas. Since the SSD As-Is process model is too large to print as a single document, it was broken into modules for readability. Only selected material will be presented to illustrate specific points. The model is provided in its entirety as Appendix B.

The number of activities clearly demonstrates the level of detail pursued in the BAA of Student Services. This detail provided the NPS team with a thorough understanding of SSD activity. Additional model details must be gleaned from careful study of the process decomposition diagram or the node tree diagrams included as exhibits to Appendix B of the *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Final Report*, (Kamel et al.,1997).

a. Functional Decomposition

The business area of Provide Student Support was decomposed eight levels down to the primitive processes - a total of 499 activities. The first level identified six functions: OBTAIN CUSTOMER INPUT, MAKE CHANGES TO STUDENT'S COURSE ACTIVITY RECORD, GRADE STUDENTS EXAMINATIONS, PROCESS UNIT ACTIVITY REPORTS, PROCESS REQUESTS FOR MATERIAL, and PROCESS REQUEST FOR REGISTRAR ACTION. Figure B-1, Appendix B is a node tree diagram of the top three levels.

The OBTAIN CUSTOMER INPUT- SSD1 function was decomposed into four processes: *PROCESS INCOMING PHONE CALLS, SORT INCOMING U.S. MAIL,* *SORT INCOMING ELECTRONIC MAIL*, and *PROCESS WALK-IN CUSTOMERS*. This function represents the front end of customer service by receiving and replying to customer requests. One other method of customer processing is through the Marine Corps Unit Diary System. This method however is a process performed within the Information System Management business area and requires no student services interface.

The MAKE CHANGES TO STUDENT'S COURSE ACTIVITY RECORD - SSD2 function was decomposed into four processes: *PROCESS REQUEST FOR ENROLLMENT*, *PROCESS CHANGE TO STUDENT INFORMATION*, *PROCESS REQUEST FOR ADMINISTRATIVE ACTION*, and *PROCESS STANDARD REQUEST FOR MATERIAL*. This function represents most of the user interface with MCIAIS. This activity is replicated as sub-processes below OBTAIN CUSTOMER INPUT. In developing the As-Is model, the authors intended to use the replicated processes to model the different modes of access to MCI as a target for reengineering.

The GRADE STUDENTS EXAMS - SSD3 function was decomposed into four processes: *PROCESS PRE-SLUGGED DP-37s*, *PROCESS GENERIC DP-37s*, *PROCESS OPSCAN ERROR LISTING REPORT*, and *PROCESS HAND GRADED EXAMS*. This function represents processing student lessons and examinations and products resulting form the activity.

The PROCESS UNIT ACTIVITY REPORTS - SSD4 function was decomposed into two processes: *WORK RETURNED UARs* and *PROCESS OUTGOING UARs BY US MAIL*. This function represents the reconciliation processes between MCI and the Marine Corps unit Training NCO.

The PROCESS REQUEST FOR MATERIAL - SSD5 function was decomposed into four processes: *SEGREGATE REQUEST FOR REGISTRAR ACTION, SEGREGATE STANDARD REQUESTS FOR MATERIAL, PROCESS "REQUEST FOR MATERIAL" FORMS*, and *SEGREGATE "OFF-LINE REQUEST"* FORMS. This function represents the processes to satisfy customer requests for new or replacement materials. Many of these activities are replicated as lower level sub-processes in SSD1.

The PROCESS REQUESTS FOR REGISTRAR ACTION - SSD6 function was decomposed into two processes: *ISSUE (REISSUE) DIPLOMA* and *PROCESS TRANSCRIPT REQUEST*. This function represents the activities of issuing diplomas and transcripts.

b. Detailed Analysis

The detailed analysis was done by reviewing each provided SSD task breakdown sheet and modeling the activities described. Additional details were obtained from the MISD's Standard Operating Procedures manual, the Marine Corps Institute Procedures Manual, telephone interviews, and replies to our specific requests.

Model development revealed a significant number of manual activities. This drew a lot of attention because the manual processes seemed to cause a bottleneck to production flow. Modeling manual activities effectively during the As-Is effort simplified the subsequent reengineering effort.

OBTAIN CUSTOMER INPUT, activity number SSD1, models the process of receiving customer input. Figure B-2, Appendix B is a node tree diagram which illustrates four levels of that function's decomposition. The figure depicts the flexibility

MCI applies to servicing customers by receiving their input in various forms: telephone, walk-in, electronic mail, and U.S. Mail. The model also demonstrates a relatively standard method of handling the input. Telephone and walk-in customers receive immediate attention while all other input is sorted and segregated for assembly line processing.

U.S. mail processed by the Student Services Department is opened and the contents manually segregated for subsequent distribution. MCI administrative procedures specify that enrollment requests are submitted with an MCI Enrollment Application Card (R-1 Card). Other requests are submitted with a Student Request/Inquiry Form (R-11 Card). Lessons and examinations are submitted on two different sized forms of an optical character recognition (OCR) capable form (DP-37). One form was pre-formatted with student and course information and distributed with the course materials when enrolled. The other is a generic form which the student completes when the examination is returned for evaluation. Course materials are distributed with a feedback form which is submitted when a lesson or exam is completed. Many of the Non-Resident Program examinations are essay type and not OCR capable. All requests for transcripts must also be written. Consequently, there is a single point of entry to process customer input by U.S. Mail.

Electronic mail addressed to MCI is received in one electronic, organization mailbox (OMB), unless addressed to an individual. Electronic mail processing has not been standardized except for electronic Unit Activity Reports. Regardless of the subject matter, all electronic mail received in the OMB is printed, segregated and distributed for subsequent processing. The content of electronic messages cover the same variety of input as U.S. mail minus lesson and course examinations, without the convenience of a standard format.

A student or Marine Corps unit representative, i.e., Training NCO, First Sergeant, section non-commissioned officer in charge, can obtain course status through an MCI automated voice recognition system (AVRS) called Conversant. The caller contacts MCI's toll free number, inputs the student's social security number and course number, and Conversant returns the student' course status. Conversant accesses a copy of the MCI student database resident on a remote server.

MAKE CHANGES TO STUDENT'S COURSE ACTIVITY RECORD, activity number SSD2, models the processing transactions that effect a student's record within MCIAIS. Figure B-3, Appendix B is a node tree diagram which illustrates four levels of that function's decomposition. Once an enrollment, inquiry, or other request is received, segregated and distributed, processing is the same as would be administered for a telephone or walk-in customer. The same screens are used to access data from MCIAIS in the same sequence regardless of customer entry mode. Transaction codes are entered by the user to reflect input that changed student activity records. A list of transaction codes are maintained near each user terminal. One interface characteristic identified user-entered data is not carried forward when transitioning between screens. This required multiple entries of the same information and increased the likelihood of user error.

GRADE STUDENTS EXAMS, activity number SSD3, models the processing of lessons and examinations received from students and the output generated. Figure B-4, Appendix B is a node tree diagram which illustrates four levels of that function's decomposition. Two types of DP-37s are processed: pre-slugged DP-37s which are formatted prior to distribution course material issue, and generic DP-37s which are not. The DP-37s contain the same information but are different sizes. They must be segregated prior to processing. The DP-37s are scanned by an OCR reader, Scantron, and the data is collected in a file on a disk. The DP-37s successfully read are placed in a pending file. Those not read must be hand graded. DP-37s failed scanning because of form damage or key fields weren't completed. The disk is delivered to MISD for batch processing during the nightly cycle.

The OPSCAN Error Report, a list of all lessons and exams not processed by MCIAIS, is produced after the cycle is run. The DP-37s on that list must be pulled from the pending file and manually processed according to the error code. The remaining scanned DP-37s are moved to a completed file. The generic DP-37 increased the likelihood of incomplete forms, forms completed incorrectly, and forms received from individuals who hadn't been enrolled. The generic form was created to simplify course material packaging and reduce distribution delays.

Hand graded examination and PME examination scores are entered into MCIAIS manually. Corrected DP-37s from the OPSCAN Error Report are either processed through the Scantron again or entered into MCIAIS manually.

PROCESS UNIT ACTIVITY REPORTS, activity number SSD4, models the process of reconciling MCIAIS student record activity with the records maintained by the Marine Corps unit. Figure B-5, Appendix B is a node tree diagram which illustrates four levels of that function's decomposition. Unit Activity Reports (UARs) are generated during a mid-month and monthly cycle batch process by MISD. UARs are produced in electronic form only during the mid-month cycle and both electronic and paper form at the end of the month. The unit must request, reconcile and return electronic UARs following procedures set forth in the Marine Corps Institute Procedures Manual. Procedures for unit reconciling UARs are the same regardless of the method of distribution. The unit reports the differences with annotations to the UAR and returns it to MCI. MCI processes the changes following the same procedures. Each annotation associated with a student record requires that record to be viewed on a terminal screen and checked to see if that record reflects the remark. If not, the change is entered following the same procedures as described during activity SSD2 - MAKE CHANGES TO STUDENT'S COURSE ACTIVITY RECORD. There is no action required by Student Services to process outgoing electronic UARs. The UARs that are produced in paper form must be packaged, addressed and mailed to units not on electronic distribution.

PROCESS REQUEST FOR MATERIAL, activity number SSD5, models the process of responding to customer and student requests for material. Figure B-6, Appendix B is a node tree diagram which illustrates four levels of that function's decomposition. Material requests fall into four general categories: standard material request, request for material, off-line request for material, and transcripts. Each category entails a greater degree of manual activity. A standard material request has a transaction code that can be entered at the terminal and MCIAIS will generate a mailing label for logistics to complete the distribution process. Material in this category includes: a duplicate issue of job aids, course or program material, issuing course or program material without an enrollment, and a duplicate issue of a completion certificate or diploma. A request for material is for material required to support the Marine Corps unit Training NCO performing MCI liaison functions. Material in this category includes: pre-addressed postage paid envelopes, blank DP-37s, course catalog, Marine Corps Institute Procedures Manuals, R-1 Cards and R-11 Cards. Activities for this type of request include filling out a form, packaging the material from stock maintained in the Student Services, addressing the package and forwarding the package to Logistics for mailing. Off-line request material is for an individual component of a course, program or job aid or course material for a foreign military officer. This requires completion of a different form, approval by operations officer, preparation of an address label, and delivery to Logistics for mailing. A transcript request must be in writing. It is delivered to the registrar for processing in accordance with activity SSD6.2.

PROCESS REQUEST FOR REGISTRAR ACTION, activity number SSD6, models the production of transcripts and diplomas. Figure B-7, Appendix B is a node tree diagram which illustrates four levels of that function's decomposition. One of the MISD grading program batch processes produced a diploma print file. The file is transferred to a disk and delivered to the Registrar. The Registrar produced the diplomas, duplicate diplomas and envelopes from the file by running a program on a local PC connected to a LaserJet printer. Transcripts must be individually researched using active and archived MCIAIS student records and microfiche records. The collected data is put onto a form, typed on a computer terminal, printed and mailed.

Task worksheets provided to the NPS team indicated that a morning report aggregated the number of telephone calls processed daily, the number of examinations processed - successfully and unsuccessfully, the number of transcripts requested and distributed, and the number of diplomas distributed. The morning report was manually collated. However, that process had been terminated and no records available from which to extrapolate historical impact.

c. As-Is Process Model

The As-Is process model documents the business area analysis of the current system. Graphic representations helped to summarize the results. The business area analysis of SSD was documented with a decomposition diagram and several node tree diagrams. These diagrams illustrate the functional decomposition of activities performed to administer student activity records in MCIAIS. The process model is provided as Appendix B.

Manual activities within a process model add definition to the business system architecture. The manual processes however, can lead to discontinuity in the information and technical architecture. A large number of manual activities prevents accurate measurement of throughput and associated cost. This is one reason for targeting their elimination during reengineering.

C. REENGINEERING THE AS-IS PROCESS MODEL

Reengineering approaches and methodologies were discussed in Chapter IV. This section addresses the business environment leading to the selection of Harrington's Business Process Innovation (BPI)as the reengineering methodology best suited for MCI.

Following the assessment, the BPI methodology is discussed as it applies to the current processes at MCI. The section concludes with a summary that leads to the development of the To-Be process model.

1. Assessing the Reengineering Environment

The information gathered during the enterprise analysis and development of the As-Is model was critical to understanding MCI's business environment and the urgency with which reengineering may be applied.

a. Reengineering Category

Initially, the authors believed MCI fell into the crisis reengineering category. Prior to August 1996, the Commandant of the Marine Corps urged MCI to improve its level of customer service. Executive level interest and support were keen and funding was readily available. Some organizational restructuring was already underway and demonstrating marked improvements. In spite of the quick fixes, however, the need for formal reengineering of the information system still existed.

Culturally, MCI is a traditional organizational hierarchy. As a result, MCI exhibited great resistance to notions of radical transformation. For example, MCI was not interested in suggestions of outsourcing the shipping process to a commercial package delivery company or moving to Internet accessible, on-line enrollment procedures for customers. It was evident from the first interviews that radical changes would not receive the support or continuity of personnel necessary to carry radical modernization to fruition. The incremental approach of the life-cycle reengineering category was seen as the best fit based upon the expected turnover of key management personnel and procurement schedule of the replacement system architecture.

b. Reengineering Ideals

An assessment of the reengineering ideals provide perspective on MCI business environment and the degree of commitment to modernization.

Process Orientation- MCI retains much of the outdated management perspective of the industrial age. It is primarily task organized in an assembly line manner. A major reason for this is the prevalence of combat arms personnel staffing key management billets. Transition to the information age is evident and a new information system a key element. Another key element is a paradigm shift from task orientation to process orientation and process improvement.

Three distinctive processes are apparent at MCI. The first is information gathering and distribution: maintaining a course catalog of over 300 items, maintaining the addresses and course history of over one million students, and maintaining examination question banks and answers for over 160 courses. The second process is warehousing and shipping of catalog items. The third process is course development and writing of text books and associated material. Many reengineering opportunities exist with this wide range of processes. Other initiatives, outside the scope of this project, should address the MCI logistics and course development processes, leaving the information gathering and distribution the only function available for reengineering as part of this project. This function is performed by the Student Services and Information Systems Management Divisions at MCI.

Ambition - The degree of ambition is reflected in the number of protected processes. It is also reflected by the amount of resistance encountered when proposing to reengineer a candidate process. This became obvious during the circulation of the SSD As-Is process model.

Rule-breaking - The effort to reduce business rules often requires an understanding of existing rules in place. MCI made a genuine effort to document their current business rules in force. It was discovered during the process that many of the rules were made so that the programmer could code them. While business rules standardize operating procedures, complicated conditions proved difficult for Marine programmers to understand and implement. As a result, considerable effort was put into eliminating business rules attached to student enrollments.

Creative use of information technology - Information technology (IT) plays a key role in BPR. MCI demonstrated considerable interest in this ideal. But due to limited exposure, not all personnel are aware of IT opportunities or their potential benefits. Additionally, the acquisition of IT resources, for the military in general, is often a lengthy process and limits the more immediate results that can be achieved.

The delays associated with procurement of IT resources may provide the time for the reluctant, or undecided, stakeholders to "buy-into" the reengineering effort. This buy-in may facilitate the integration of all the process owners as effective participants in the modernization effort. In the meantime, a continuous process improvement approach is necessary to complement the cultural environment. For these reasons, the selection of

Harrington's BPI methodology was determined to be the best fit for applying business process reengineering techniques to MCI.

2. Reengineering Implementation

Harrington's BPI methodology addresses five phases: organizing for improvement, understanding the process, streamlining, measurement and control, and continuous improvement. The authors application of these five phases discovered that much of the work was already performed. Further investigation found evidence that an external consultant had analyzed MCI and many improvements were already implemented.

Phase I, *organizing for improvement.* This phase provides structure and continuity to a modernization effort by staffing reengineering roles. MCI had already created a Process Improvement Requirements (PIR) Section and formalized its importance by incorporating it into the organizational structure. The deputy director filled the role as *leader*. As MCI's number two position, the deputy director is in the ideal position to influence reluctant employees to embrace the change program, create organization vision, and ensure managerial and financial continuity. He briefed the Commandant, the Commanding General, MCCDC, and the Director, Training and Education Division to muster financial support for the modernization plan. A *steering committee* was already formed as the MCIAIS Redesign Team. The members included the Deputy Director, Executive Director, PMED chief, OSD chief, SSD chief, Logistics chief, and the Computer Systems Analyst. A *czar,* with information systems management experience and previous assignments as SSD and MISD chief, was in place. Department chief filled the role as *process owner.* An *external consultant* had been involved once before and the addition of the NPS team provided a detached perspective as well as technological expertise not possessed by anyone else in the MCI. The personnel assigned to MCI were ready for change.

Staffing the reengineering roles outlined above have the greatest impact on the success of the reengineering effort at MCI. The transient nature of a military unit makes it difficult to sustain long term projects. Personnel rotate through billets within a military organization every one to three years and not all of the personnel rotate at the same time. This staggered rotation lends stability to long term projects in a traditional, non-military organization by allowing personnel and policy continuity. However, the strict hierarchical structure of a military unit may have a destabilizing effect on long-term projects as project teams and objectives are influenced by the more hierarchically senior individuals. For example, the modernization project began in July 1995 and significant progress was made. In May 1997, a new deputy director was assigned and with modernization well underway, enthusiasm waned. The new deputy director is tasked with other time consuming duties and priorities that prevent him from continuing the reengineering leadership of his predecessor. Other reengineering roles at MCI have experienced similar dynamics.

The reengineering czar that began the project retired in June 1997 and was replaced by a civilian contracted project manager. This will enhance the project's potential for success because the project manager has military and database migration experience and is trained in both project management and reengineering techniques. The steering committee composition also changed as members were replaced.

The SSD and MISD process owner are the only roles that remained intact throughout the research portion of the modernization project. The addition of an Internet Interface process owner expected in August 1997 is viewed by the authors as a plus for the potential success of the modernization as the replacement has a masters degree in Information Technology Management and is already familiar with the MCI modernization project.

MCI organizational structure is also unduly influenced more by the government worker placement policy and practice than by sound reengineering principles. In June 1996, the PIR Section was formed with two civilian employees. Their former MCI positions were eliminated as a result of downsizing. These employees were transferred to MCI's operations department and chartered to "improve the MCI process." Steeped in TQL tradition, the "process improvement team" had no concept of process modeling, work flow analysis, or other techniques necessary to conduct reengineering.

With the exception of the project manager, the process improvement team and other members filling reengineering roles, have no formal reengineering technique training. To ensure project success at MCI emphasis must be placed on filling all of the billets on the reengineering team with competent and motivated personnel.

Phase II, *understanding the process*. This phase focuses on data collection and modeling. The process owners had a thorough understanding of what their processes did and what they wanted their processes to do. The objective of the NPS team was to document this awareness. Much of the data collection had already been accomplished, customer interviews, task breakdown worksheets, flow charts, mission statements and models, by the previous consultant. The authors believe that most of the models were not presented to MCI in an expected form, to their understanding and without tools for continued maintenance.

Phase III, *streamlining*. This phase concentrates on the reengineering effort. Process elimination traditionally accounts for a significant contribution to reengineering benefits. When applying the reengineering principles and analyzing the As-Is process model looking to eliminate non-value-added processes, it was discovered that due to the sequential nature of SSD tasks, many of the non-value-added tasks had already been removed. For example, reporting the number of DP-37s, phone calls, or transcript requests processed on a morning report. No one used this information and it was manually intensive to collate.

Most processes had already been simplified. For example, the enrollment procedures for Marines through the unit diary, and pre-packaging a new DP-37 with course material for faster distribution have reduced customer response time. Additionally, SSD functions are sequential because subsequent tasks depend upon completion of the previous ones. Figure 24 illustrates this sequence. As and example, SSD enrolls students in courses; tests their comprehension by issuing and grading examinations; stores student course history; and issues transcripts. Transcripts cannot be issued without course history and exams cannot be graded without enrollment.

The remaining reengineering effort had to focus on automating manual tasks and methods to capture data only one time. The most dramatic impact on this effort will be made by implementing the network accessible relational database technology, MCIAIS-II.

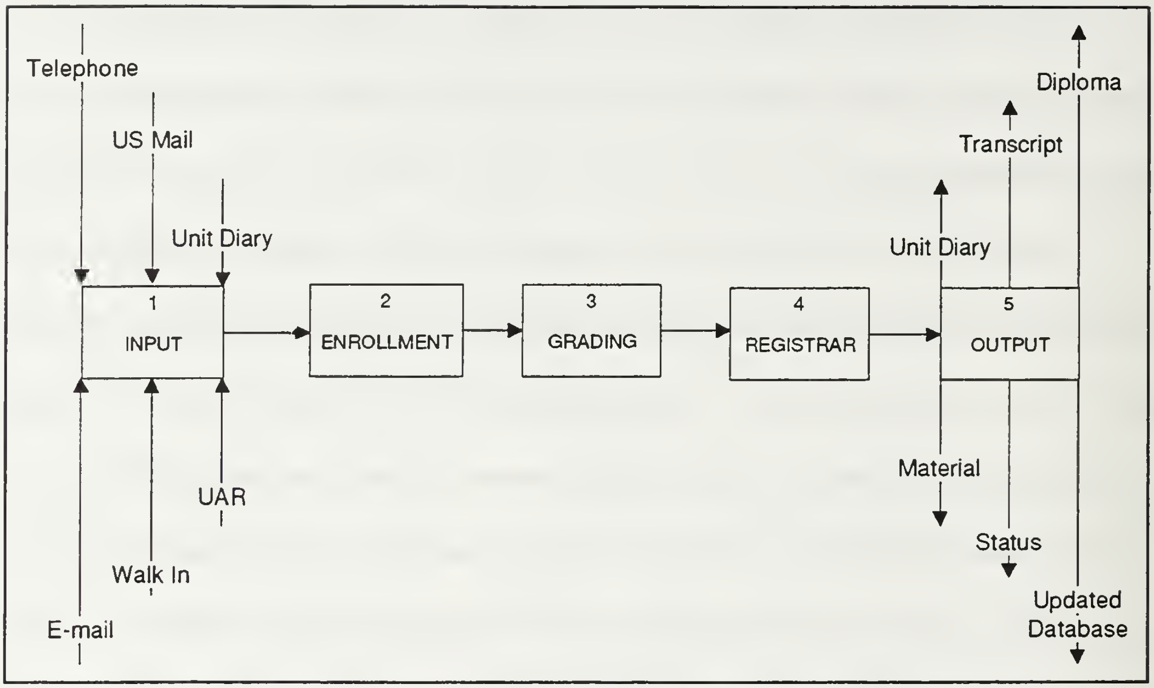

Figure 24. SSD Sequential Process Flow.

The response time of user interaction will be reduced by eliminating multiple entry requirements. Graphical user interface (GUI) will be updated and more responsive to user requirements. The database itself will be more flexible - easier to modify and adjust with the more frequent changes commonly encountered in today's business environment. A relational database provides facilitates flexible query and customized report generating capability.

One method to take advantage of a new relational database is redistribution of selected batch processes. Batch processing is currently used at MCI to update MCIAIS with transactions from the grading program, unit diary transactions downloaded from MCTFS, and input through daily transactions. Other batch processes generate transaction files for yet other batch process to execute: the grading program creates a diploma print file, a completion certificate file and an error listing file; enrollments and standard material requests create a mailing label file; another program creates a motivation card file. Finally, there are batch processes used to produce the output of transaction files: printing mailing labels for material distribution, printing UARs in the monthly cycles, copying the diploma file to disk for the registrar to print. These type of transactions are necessary because of the different paper stock the output requires: mailing labels on a standard 3 ½ inch by 1 ½ inch self-adhesive label, motivation cards and completion certificates are on preprinted stock, diplomas require laser quality print on heavy gauge stock.

Running the grading program "on demand," would allow SSD greater control of their own schedule and possible facilitate faster processing of examinations, diplomas, and error listing. "On demand" processing could prove very productive for the UAR processing. Over 1500 UARs are generated in the monthly close out cycle. Responses to the UAR are received over a short period of time and not much time is available to process all responses prior to the next cycle. The distribution and response load could be distributed more evenly over the month. The SSD clerk would have more time for processing before the next cycle.

Private sector businesses rely heavily on its efficient processing of customer input. That is how orders are received, goods are sold and income is generated. Not only are requests for enrollment processed through A single point of entry, but also grading examinations, requests for materials or information, and processing of unit reconciliation reports. If MCI charged customers for their products and depended on the processed payments, using current procedures, they would go broke.

Modern technology has enabled businesses to cut costs by moving to a paper-less work environment. MCI should take advantage of IT to follow suit. A concentrated effort should be directed at utilizing current IT solutions to replace the manual tasks involved with obtaining customer input by concentrating of the process principle of "*capture information once, at the source.*" Alternate modes of enrollment should be utilized. Student services realized a significant improvement by enrolling Marines through the unit diary. The burden of data entry was shifted from student services clerk to the unit diary clerk and MISD batch processing. Similar improvement can be achieved by utilizing the Internet for enrollment, status query, material requests, examinations, and changes to student information. Many of the same processes can be achieved interactive voice response systems (IVRS). (Currid, 1994)

More efficient processing of electronic mail can be realized by combining a filtering agent and establishing standards for electronic mail sent to the MCI OMB. Most filtering agents allow the user to specify specific words that appear in the "From" or "Subject" fields of the e-mail. On that precept, rules can be designed to sort incoming e-mail's subject line and distribute to the appropriate section's OMB for processing. Subject line standards should be published in the next revision of the Marine Corps Institute Procedures Manual or an MCI Internet Web Page. The Web Page can even pre-format the message for the customer. Filtering agent technology is rapidly advancing, such that enrollments or queries could be done by e-mail and a response generated by the computer without human intervention. (Currid, 1994)

An Internet based web page can used to publish the course, the Marine Corps Institute Procedures Manual, telephone contact directory, as well as a Frequently Asked Question (FAQ) library. Customer access to this information could reduce the number of telephone calls entertained by the immediate assist clerks.

Digitized course materials and electronic distribution upon accepted enrollment could reduce the production, warehouse and inventory overhead. This requires further analysis of the available and required bandwidth, as well as customer access. A deployed Marine, soldier, sailor or airman may have limited or no access to the Internet or a PC to complete a course in digitized form.

Development of a Unit MCI module that automated the manual task of local record keeping would earn praise from training NCO around the Marine Corps. Presently, the training NCO manually prepares a R-5 card when a Marine wants to enroll in a course or program. The form is forwarded to the unit diary clerk for data entry into MCTFS. Automating the form such that it populated the unit MCI database and generated either a standard electronic mail or batched and transmitted to MCI could bypass using MCTFS and the unit diary for enrollment. Include a reconciliation application in the module and UAR could be done with minimal human intervention and improved efficiency.

For those activities that must use paper, apply the process principle: "*Perform work where it makes the most sense*" suggesting, mail sorting and segregation could be left to the postal service prior to distribution within MCI. Utilizing the last four digits of the nine digit zip code could contribute to faster distribution of incoming mail. Faster distribution of customer input translates to more parallel processing. Automated mail handling equipment is another solution that could accelerate distribution of incoming mail, as well as capture and measure the throughput.

Integrating the Logistics Department's inventory and automating additional logistics functions into MCIAIS would improve material distribution and improve SSD's visibility of student material. The use of bar-coding can monitor the progress of material through the packaging and distribution cycle. Shipping status would become available to the SSD clerk when responding to student inquiries. Monitoring the distribution cycle can also identify other candidates activities for improvement.

Phase IV, *measurement and control.* This phase implements a system to control the process for continued improvements (Harrington, 1991). This builds on the process model by adding performance measures for the reengineered processes. Ideally, the process modeling technique and CASE tool selected support reporting the performance criteria. DoD and the FPI methodology emphasize using activity based costing as one measurement method. Additionally, responsibility for model maintenance should be established for continuity.

The PIR Section is ideally suited for the responsibility of model maintenance. It is staffed by civilian personnel which is an uncommon advantage for a military activity. Such staffing can provide necessary continuity to monitor performance. The personnel are well trained in Total Quality fundamentals. They need additional experience with process modeling, process improvement methodology, activity based costing, and information technology opportunities. Their lack of experience in these areas detract credibility from their assignment in the PIR Section.

The IDEF0 modeling technique for process modeling allows for representation of mechanisms, personnel, equipment, etc. in each process. Process modeling can represent performance measures. *Performance measures* describe the work done and the results of that activity (Turney, 1991). Modeling can eliminate the seemingly wasted effort in manual efforts. In addition to IDEF0 modeling, BPWin® can integrate activity based costing categories and represent totals within the model. Activity based costing provides two dimensions to use in process reengineering: cost assignment view and process view. Together they can direct MCI toward a more efficient product and service strategy. Incorporating activity based costing will help MCI realize additional benefits in process measurement for continuous improvement in their modernization effort.

Phase V, *continuous improvement*. This phase emphasizes continuous monitoring of improved processes for continued excellence. This depends on maintenance of the process models by monitoring the reengineered processes and periodically evaluating performance measures. MCI must develop a data and process model, maintain it, and use it for the benefits the models provide. Part of the justification for migrating from the legacy system was based on the lack of code documentation. A new system can experience the same fate if not properly maintained. Additionally, the models enable prototyping which can reduce anxiety of implementing changes without adequate testing.

3. Reengineering Summary

Despite the numerous opportunities identified in the previous section, reengineering the As-Is model focused on migrating the current functionality to MCIAIS-II. The lengthy acquisition process and costs associated with many of the IT solutions would not be achievable prior to the expected delivery of the new computer. The objective shifted to producing a process model that reflected the information system it would immediately represent and an information system model the designers could use to program.

The To-Be process model did not include activity based costing (ABC) because there was insufficient data made available with which to model. The author's felt that ABC would further complicate a process model, a concept not easily appreciated outside of MISD. There was already enough new knowledge required and a new costing paradigm might put the models on a shelf never to be found.

With the majority of processes already streamlined and non-value-added processes dependent on automated equipment not available, reengineering efforts turned to minimizing redundant data entry, integrating similar processes and data sharing. These three problem areas are well suited for information technology solutions. Specifically, these three areas can all be improved with implementation of a relational database application. In effect automating tasks by eliminating the need to re-key a customer's data when fulfilling multiple requests or bouncing between screens. Other reengineering benefits can be reaped by redistributing and eliminating some of the batch processes performed by MIS. Moving the functions of grading, UAR file generation, and diploma printing to SSD workstations allow the user to execute the programs "on demand."

D. TO-BE PROCESS MODEL FOR SSD

The To-Be process model represents the redesigned business activity of the student service support business area. It resulted from reengineering selected processes of the As-Is process model. The implementation of an automated information system based on relational database technology, a dramatic reduction in the number of primitive level processes was realized. Despite the reduced number of processes, SSD customer service response time will decrease because of the data sharing capability. SSD can be further improved by incorporating a portion of the MISD As-Is processes into the SSD To-Be model. As-Is MISD functions that could be run from SSD workstations "on demand" include: the grading application, UAR file generation, and diploma printing.

1. To-Be Model Details

All of the activities depicted in the SSD process model are prefixed with "T." The entire node tree diagram is too large to print as one document so it was divided into several diagrams representing various levels. The remaining model details must be gleaned from careful study of the model components included as Appendix C.

a. Business Area Decomposition

Functional decomposition of the To-Be model started at the business area level from the enterprise analysis. It reconstructed the decomposition of the As-Is model using the reengineered processes. A total of 114 activities and 120 arrows were identified and defined. The business area Student Service Support was decomposed six levels down to primitive processes. The first level identified four functions: CUSTOMER SERVICING, STUDENT ACTIVITY SERVICING, GRADING, and REGISTRAR SERVICING. Figure C-1, Appendix C is a node tree diagram of all the activities of Student Service Support.

The CUSTOMER SERVICING - T1 function was decomposed into two processes: *OBTAIN CUSTOMER INPUT* and *PROVIDE UNIT ACTIVITY*. A significant number of processes were reduced by taking advantage of the capabilities of the relational database. Instead of representing each different type of processing for changing or servicing a student's record, a *CALL* arrow was used to one of the processes represented under activity T2. The As-Is activity representing the Conversant AVRS was removed from SSD processes and moved to MISD. Maintaining AVRS is strictly a database administration process. Servicing a Marine Corps unit reconciliation processes were reduced with the CALL procedure mentioned above and a process to represent the ability to request UAR "on demand" was added.

The STUDENT ACTIVITY SERVICING -T2 function was decomposed into five processes: *PROCESS ENROLLMENT, PROCESS STATUS REQUEST, CHANGE STUDENT INFORMATION, PROCESS ADMINISTRATIVE ACTION* and *PROCESS REQUEST FOR MATERIAL*. All processes representing a change input to change a student's record is represented in this function. The graphical user interface should lead the user to the desired action much quicker than possible in the As-Is model. Transaction codes are no longer required as most relational database have an inherent transaction code log. An measurement feature can be incorporated to indicate the student's mode of requesting the change (i.e., telephone, e-mail, walk-in, UAR, etc.). Material request processing was automated by eliminating the use of manual forms for "Request for Material" and "Off-line Material" requests. Routing for approval can be accomplished by the DBMS application if still required.

The GRADING -T3 function was decomposed into four functions: *PROCESS DP-37'S, PROCESS HAND GRADED EXAMS, RUN GRADING PROGRAMS* and *PROCESS OPSCAN ERRORS*. This process still has a lot of manual processes represented. The OCR readable exams issued and the two different sized forms was a limiting factor. An "on demand" process was added to facilitate running the program to grade exams data collected from the scanned DP-37s. The "on demand" facility provides an added feature to work the OPSCAN error listing "on demand" as well.

The REGISTRAR SERVICING - T4 function was decomposed into two functions: *ISSUE DIPLOMA* and *ISSUE TRANSCRIPT*. An "on demand" feature was added to allow the user to print diplomas at any time following the execution of the grading program. The transcript production reflects automated transcript generation based on user provided information for the transcripts requested by former students whose data has been archived on microfiche. The transcript application would be programmed to draw all student information from MCIAIS to complete a transcript from an internal template.

b. To-Be Process Model

The To-Be process model documents the business system model for the new information system of MCI. Graphic representations helped to summarize the result. The To-Be process model consists of a functional decomposition diagram (Table C-2, Appendix C), an activity dictionary (Table C-3, Appendix C), an arrow dictionary (Table C-4, Appendix C), the node tree diagram (Figure C-1, Appendix C), the context diagram (Figure C-2, Appendix C) and an IDEF0 kit (Figures C-3 - C-37, Appendix C) presenting the process decomposition down to the primitive levels.

Not all of the manual activities could be eliminated. They remain in the process model to provide complete definition to the business system architecture. Future continuous improvement efforts should focus on reengineering principles to further reduce their persistence and increase process efficiency. Additionally, shifting to a process improvement oriented accounting approach, such as activity based costing, would help realize the true cost of delaying further process improvements.

2. Information System Model

The SSD information system model represents what data the system manipulates, captures, and stores in the MCI To-Be process model. While this thesis focuses on the first two stages of the information engineering methodology, a proof-of-concept prototype is an objective of the MCI modernization project. Design and construction of the information model is beyond the scope of this thesis, however, information system prototype development requires a different view of the data and process models. As a result, an information model was developed to facilitate prototype development. As noted in Chapter V, there are three parts to the model: (1) DFDs depicting information system process decomposition, (2) definitions of all of the symbols on each of the diagrams, and (3) process specifications at the primitive process level. The information system model serves as a bridge between the data and process modelers and the prototype developer.

a. DFDs

As noted in Chapter V, the first step in developing an information model is to remove the manual processes from the To-Be model. The SSD system context diagram, shown in Figure 25, shows the *SSD System* and the outside entities. A context diagram is the highest level of the DFD.

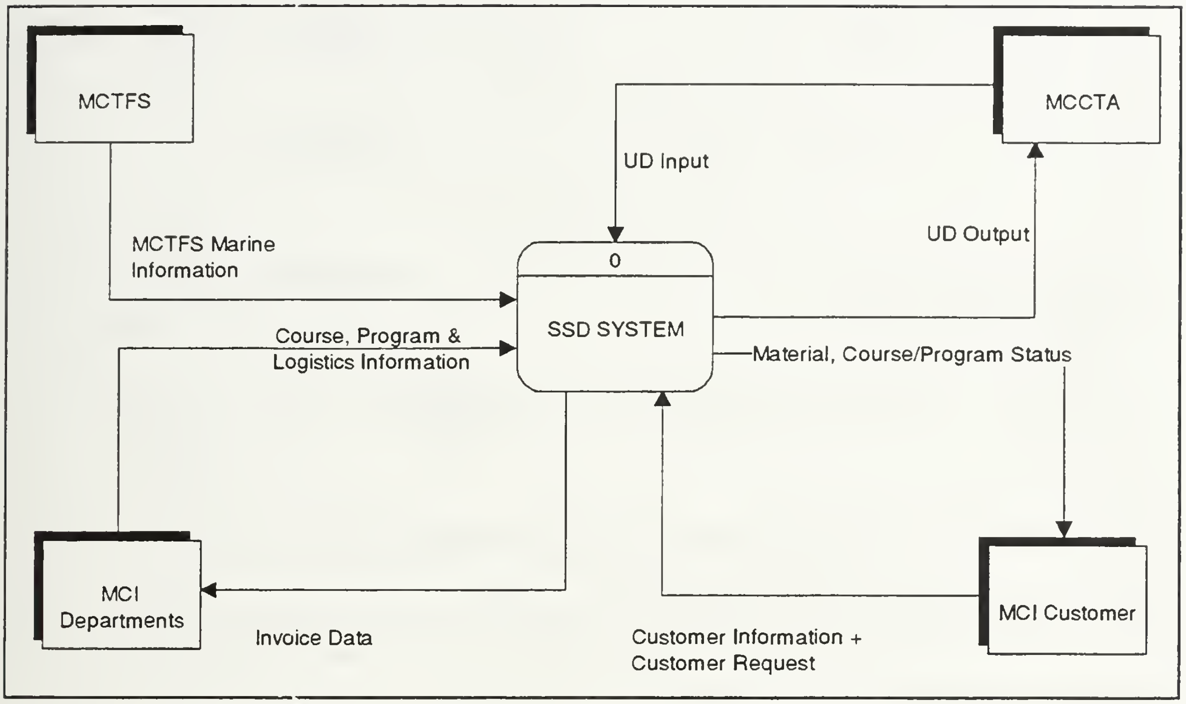

Figure 25. SSD System DFD: Context Diagram.

Functional decomposition techniques, described in Chapter V, are applied to the context diagram to create the next level of the DFD, diagram 0. Figure 26 shows the five major automated processes of the SSD information system model: (P-1P) Display Catalog, (P-2P) Update Marine Information, (P-3P) Interface with Unit Diary, (P-4) Order Material, and (P-5) Service Student. Each of these processes is further decomposed to the primitive level. The prototype developer uses these diagram in conjunction with the symbol dictionary and process specifications to code the prototype.

All of the processes hierarchy numbers depicted in the SSD information system model are prefixed with "P" for process. All of the data store hierarchy numbers depicted in the SSD information system model are prefixed with "D" for data store. The

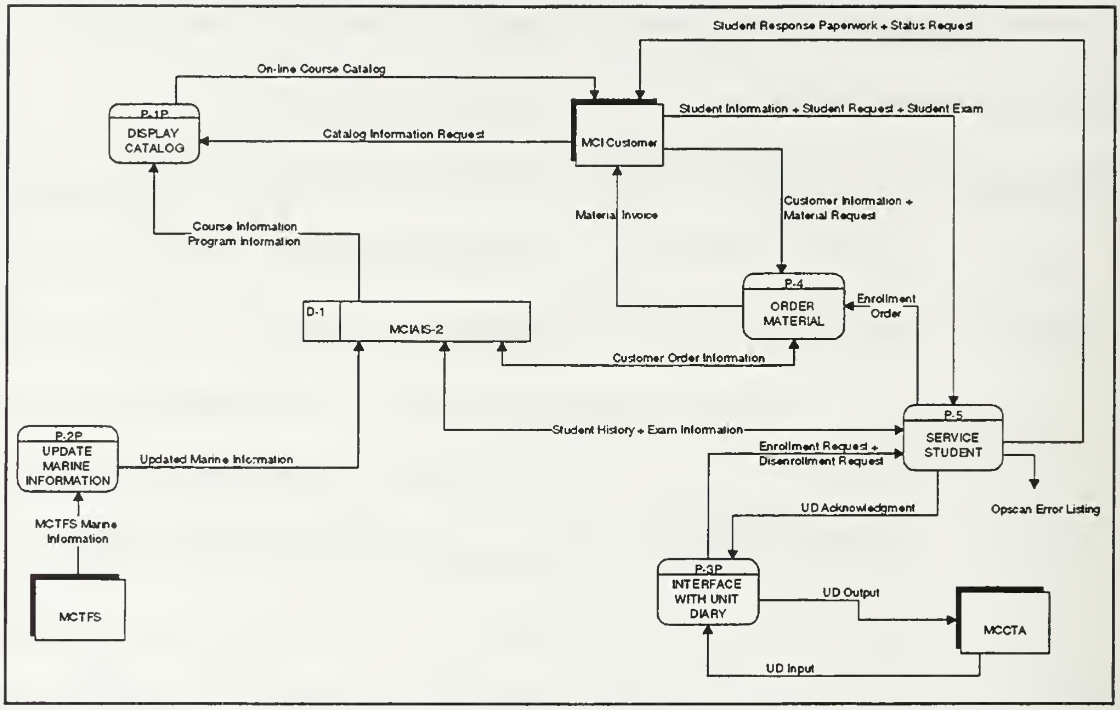

Figure 26. SSD System DFD: Diagram 0.

suffix "P" indicates primitive level processes. Figures 27 and 28 illustrate two of the primitive level DFD diagrams for the SSD processes illustrating DFD techniques. The remaining decomposition diagrams are too large for inclusion in this thesis but may be viewed in NPS-SM-97-006: *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Final Report* (Kamel et al., 1997).

Data stores are also decomposed in a way similar to processes. The technique was devised to aid developers and analysts working with large numbers of database tables. The same parent/child relationships that apply to processes also apply to data stores and its use prevents cluttered and confusing diagrams. Figure 29 shows how the SSD database, MCIAIS-2, is decomposed into subordinate data stores. This first subordinate decomposition diagram is a logical grouping of data entities. Decomposition

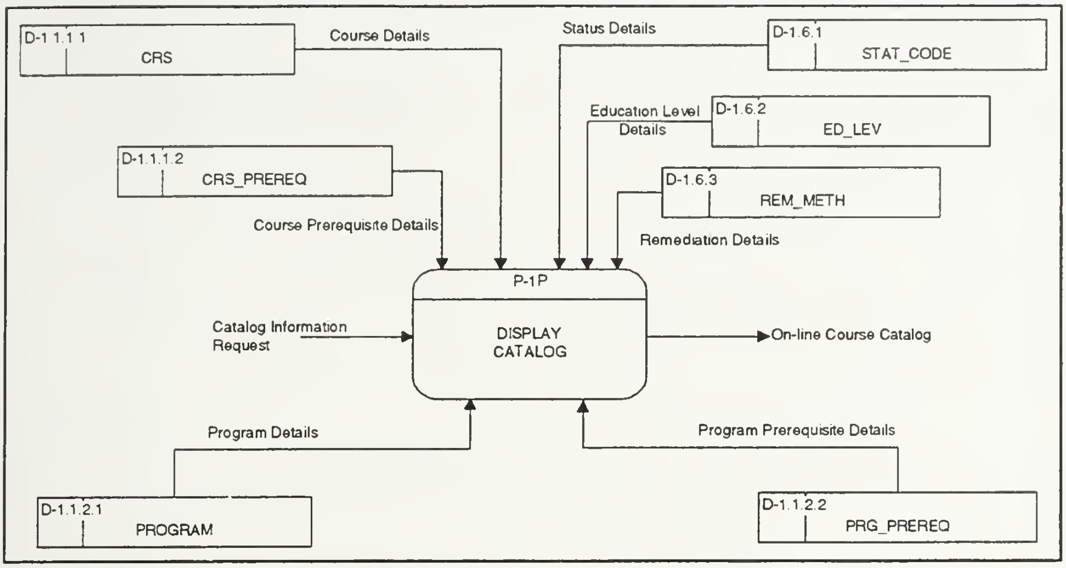

Figure 27. SSD System DFD: (P-1P) Display Catalog.

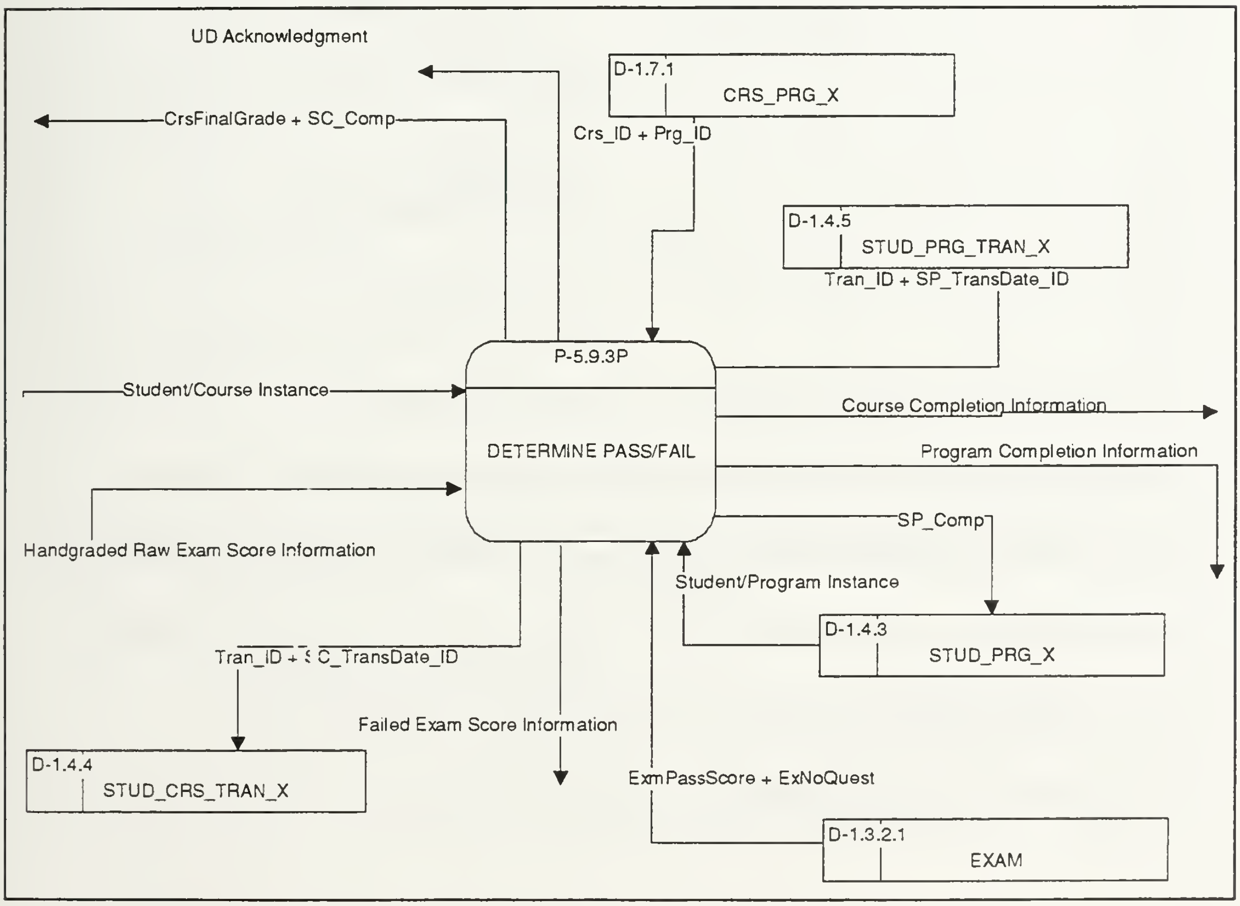

Figure 28. SSD System DFD: (P-5.9.3P) Determine Pass/Fail.

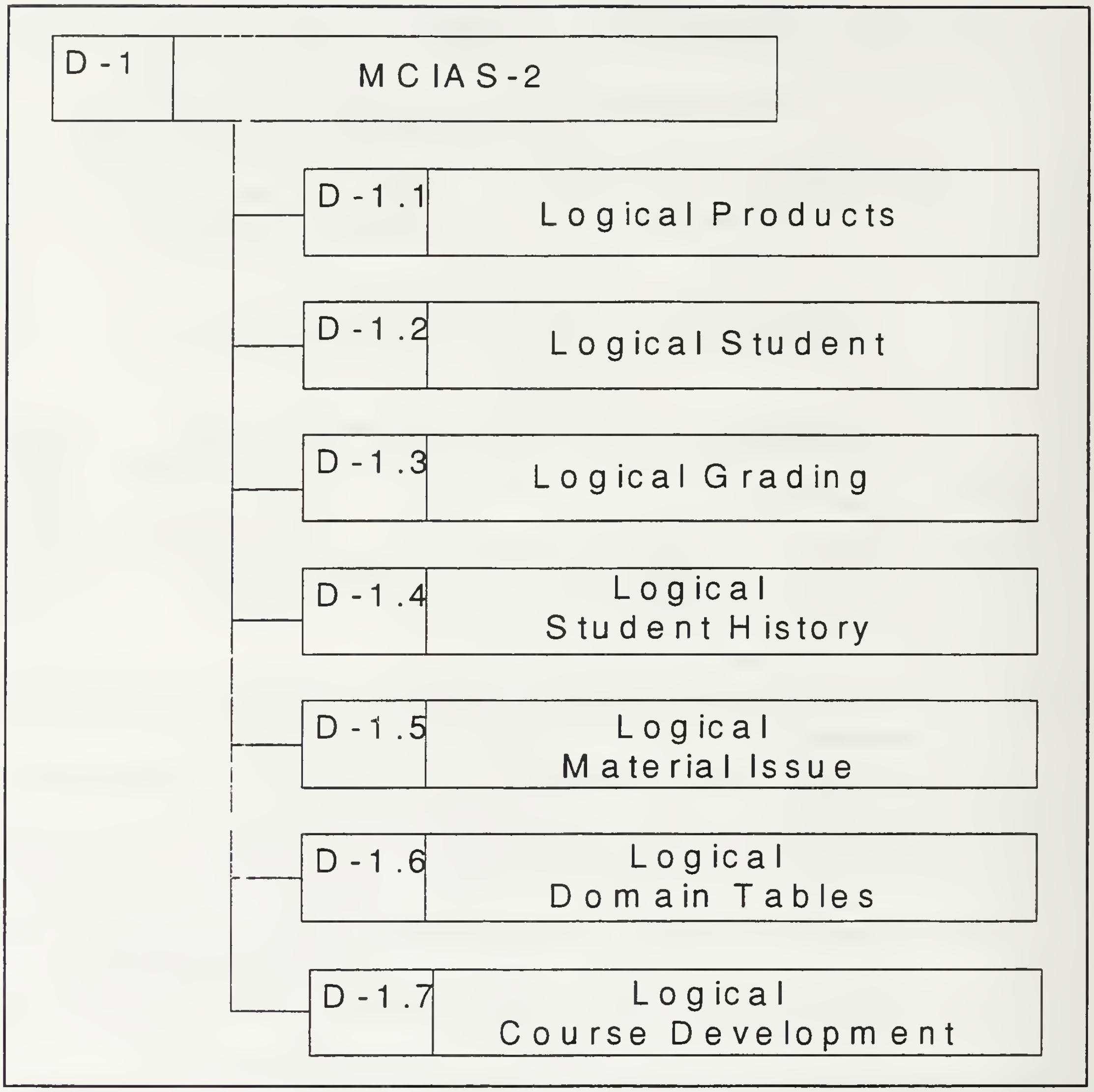

Figure 29. MCIAIS-2 Data Store Decomposition.

continues until actual data model table names are identified and assigned a hierarchy number. Figure 30 illustrates how the logical data store (D-1.4) Logical Student History is decomposed further into five actual database tables: (D-1.4.1) STUD_CRS_EXAM_X, (D-1.4.2) STUD_CRS_X, : (D-1.4.3) STUD_PRG_X, : (D-1.4.4), STUD_CRS_TRAN_X (D-1.4.5) STUD_PRG_TRAN_X.

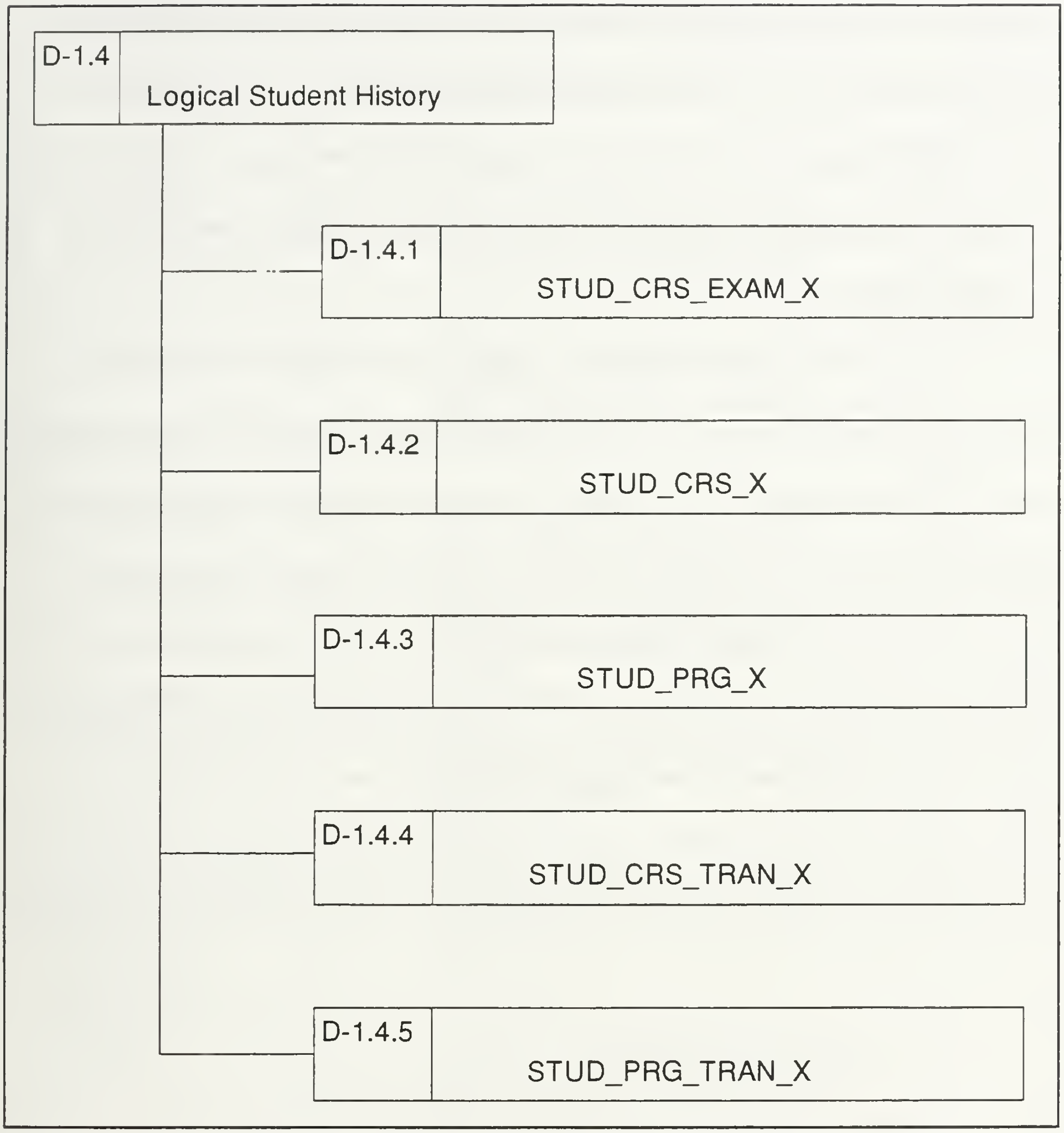

Figure 30. SSD System DFD: (D-1.4) Logical Student History Data Store Decomposition.

b. DFD Symbol Dictionary

The DFD decomposition diagrams are accompanied by the DFD symbol dictionary. Without the dictionary, it is difficult for a prototype developer to distinguish data table names with the precision necessary to code the prototype. For example, two data table names in the data model are ERR_CODES and ERR_LIST Although the be names may be distinctive to the data modeler, implementation coding and debugging may frustrating to the programmer because a data element may be coded to read from the incorrect data table.

The DFD symbol dictionary is arranged alphabetically and contains an entry for each of the 214 symbols that appear in the diagrams. Each page of the dictionary contains columnar headings for symbol name and hierarchical number (data flows are not assigned a number), type of symbol, description, and the DFD diagram number where the symbol appears. In addition to alphabetical appearance, font type and size is used as to further aid dictionary use. Processes are listed in all capital letters, and data flow are listed in ten pitch title case. Figure 31 is an excerpt from the dictionary. The entire dictionary may be viewed in NPS-SM-97-006: *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Final Report* (Kamel et al., 1997).

c. Process Specifications

Process specifications summarize the data input, output, and logic of each of the primitive processes. Only primitive level processes are included as parent processes are an aggregated collection of the children's inputs, outputs, and logic. A typical process specification for a primitive level process is shown in Figure 32. Process specifications for entire model may be viewed in NPS-SM-97-006: *Analysis, Design, and Prototype*

DFD Symbol Dictionary

Name	Symbol Type	Definition	DFD
CrsOnHandQty	Data Flow	Data element definitions can be found in the Attribute Definitions Report (Exhibit 5, Appendix A)	P-4 4P
Current Course Request	Data Flow	Course requested: that is current version	P-5 10.1P P-5 10.2P
Current Program Request	Data Flow	Program requested: that is current version	P-5.10.1P P-5.10.2P
CUST (D-1.5.1)	Data Store	CustSSn_ID + State + CustLastName + CustFirstName + CustMidInit + CustDSN + CustCommNo + CustAddr1 + CustAddr2 + CustCity + CustZip	D-1.5 P-4 1P P-4 2P
Customer Identity	Data Flow	Customer Instance	P-4 1P P-4 2P P-4 3P
Customer Information	Data Flow	Name, rank, SSN, grade, service component, address, and telephone number.	context P-0 P-4.2P
Customer Instance	Data Flow	CustSSn_ID + State + CustLastName + CustFirstName + CustMidInit + CustDSN + CustCommNo + CustAddr1 + CustAddr2 + CustCity + CustZip	P-4 1P P-4 2P
Customer Order Information	Data Flow	Customer Information + Material Request + Invoice Data	P-0
Customer Request		High level bundle of inquiries or other requests from a customer: status, information, transcript request, request for material, etc.	context
Customer SSN	Data Flow	SSN of customer	P-4 1P
DETERMINE IF STUDENT MEETS PREREQUISITES (P-5.10.3P)	Process	Compares the requested course or program prerequistes to the student's course history.	P-5.10
DETERMINE OF STUDENT IS IN DATA BASE (P-5.1P)	Process	Checks for SSN match to a student SSN in the MCI student data base.	P-5
DETERMINE PASS/FAIL (P-5.9.3P)	Process	Compares number student's exam correct answers to the minimum passing score for that exam.	P-5.9
Diploma	Data Flow	The certificate issued to the student for passing all of the course exams that make up a program. The diploma is accompanied by a letter indicating transript information for the program and summary of the included courses.	P-5.9 P-5.9.6P
DISENROLL STUDENT (P-5.6P)	Process	Disenrolls a student from a course he/she is enrolled in	P-5
Disenrolled	Data Flow	Data element definitions can be found in the Attribute Definitions Report (Exhibit 5, Appendix A)	P-5.6P

Data element definitions can be found in the Attribute Definitions Report (Exhibit 5, Appendix A)

SSD Process Model
Exhibit 28, Appendix B

3

Figure 31. Excerpt From DFD Symbol Dictionary.

Process Specification Form

Process Number: P-5.9.6P

Process Name: PRINT DIPLOMA

Input Data Flow:

Program Completion Information
Student Identity
AD Marine Student Address
Marine Reservist Address
NonMarine Student Address

Output Data Flow:

Diploma
Invoice Instance
PrgDiplssueDate
Tran_ID + SP_TransDate_ID

Module Logic:

```
For each program completion
GET    Student Identity
       appropriate address
UPDATE Student Program History
CREATE Invoice Instance
FORMAT & PRINT Diploma
```

Figure 32. Process Specification Form for (P-5.9.6P) Print Diploma.

Implementation of a Contemporary Information System for the Marine Corps Institute, Final Report (Kamel et al., 1997).

3. Application Mapping

A Process versus Data Entity (CRUD) Matrix was developed from the To-Be process model. The CRUD Matrix maps the process activities to the data base tables and is included as Figure C-38 of Appendix C. The CRUD Matrix validates: 1) that all of the data model entities have a purpose in the process model, and 2) that the data model contains only the entities required by the process model.

Clustering the CRUD Matrix results in the Clustered CR Matrix. Every "C', "U", and "D" was replaced with a "C" as described in Chapter III. BPWin® did not perform an automated clustering. A manual procedure was necessary. All of the BPWin entities representing transient data created in the process model were removed from the CRUD Matrix. All of the manual processes were also removed as well since there was not a data entity with which to associate. The remaining relationships were arranged to form groups.

Analysis of the groupings that result from the Clustered CR Matrix reveal four SSD applications: Student Servicing, Unit Servicing, Grading, and Registrar. A fifth application, Executive Summary Information, was identified to provide management with the adhoc query capability achievable with a relational database. The logical and physical distribution of the five applications throughout SSD is described in another team members thesis (Evers, Jr., 1997). The CR Matrix is included as Figure C-39, Appendix C. Table 5, details the capability of each of the applications.

Application	**Capability**
Student Servicing	On-line Course Catalog Access, Enrollment, Disenrollment, Course History Access, Order Materials
Unit Servicing	On-line Course Catalog Access, Enrollment, Disenrollment, Course History Access, Order Materials , UAR Generation
Grading	Grading, Course History, Student History
Registrar	On-line Course Catalog Access, Course History, Transcript Generation
Executive Summary Information	On-line Course Catalog Access, Predefined SQL Query Capability

Table 5. Recommended Application Capability.

VIII. SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

This chapter provides a summary of the thesis as well as recommendations and conclusions. First it addresses the research questions and objectives presented in Chapter 1. Next it summarizes the enterprise analysis methodology, process modeling, and a recommended reengineering plan for the Student Services Department at MCI. Additionally, it includes implementation recommendations and some anticipated obstacles. The chapter concludes with suggested topics for future study and conclusions.

A. ACHIEVEMENT OF RESEARCH OBJECTIVES AND QUESTIONS

This research is the result of a year long project commissioned by MCI to develop the architecture and supporting migration plan to transition from a closed, non-relational system to an open, client/server based relational database management system (DBMS). The research and development was conducted by a six member team at the Naval Postgraduate School. The objectives of this research project were achieved: enterprise analysis was conducted, business area analysis of the SSD was conducted, data and process models were developed, the process model was reengineered, an information system was designed and, a proof of concept prototype was produced. If implemented, the modernization plan will make the SSD more efficient and effective at providing service to their customers.

In the course of this project, the research questions posed in Chapter I were answered. These questions and their answers are outlined below.

- Can a process model be developed to reflect the current business process of the Student Services Department of the Marine Corps Institute (MCI)?

A detailed As-Is process model was created using IDEF0 modeling techniques for the Student Services Department of MCI. The model diagrams and the data dictionary are included in NPS Technical Report NPS-SM-97-006: *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Final Report* (Kamel et al., 1997). The model conforms to the DoD standard for process modeling and can serve as a baseline process model for future reengineering efforts.

- Can the business process of the Student Services Department of MCI be reengineered?

The SSD business process can only be reengineered to a limited extent due to the nature of MCI work flow as well as budgetary constraints. There are no tasks in the SSD process that can be eliminated because of the sequential nature of the SSD work flow. However, reengineering benefits can be gained from implementation of a shared relational database that eliminates redundant data entry, publication of the course catalog on the Internet, and development of on-line enrollment forms to further increase the efficiency and effectiveness of the Student Services Department.

- Can a process model be developed to reflect the reengineered business process of the Student Services Department of MCI?

A To-Be process model was created using IDEF0 modeling techniques for the Student Services Department of MCI. The model diagrams and the data dictionary are included in NPS Technical Report NPS-SM-97-006: *Analysis, Design, and Prototype Implementation of a Contemporary Information System for the Marine Corps Institute, Final Report* (Kamel et al., 1997). The model conforms to the DoD standard for process modeling and can serve MCI as an example and first iteration of an ongoing reengineering effort.

- What BPR methodology is most suitable for reengineering the Student Services Department of MCI?

Of the four BPR methodologies surveyed, Hammer and Champy's Business Process Reengineering, Thomas Davenport's Process Innovation, H. James Harrington's Business Process Improvement, and DoD's Functional Process Improvement (FPI), no one methodology was identified as a perfect fit for reengineering the SSD. Each methodology has strengths and weaknesses that effect its use in the MCI business environment. Elements of all four methodologies were applied with particular emphasis on the business process improvement methodology of H. J. Harrington.

- What CASE tool is most suitable for reengineering the Student Services Department of MCI?

Although BPwin® was the CASE tool selected and used for process modeling, System Architect/BPR Professional would have been a better choice because it offered one central repository for both data and process model metadata and a more versatile DFD graphics capability. Despite the advertised compatibility of BPwin® with its sibling data modeling tool ERwin®, initial metadata transfer between the two tools was less than perfect. During the course of the project, it was necessary to request a software patch from the vendor so that data model definitions could be imported into BPwin®.

- Can a CRUD diagram be developed to support the BPR of the Student Services Department of MCI?

A CRUD matrix for the SSD was generated and clustered. The CRUD matrix, containing 44 data entities and 113 functional activities was clustered manually because none of the reviewed CASE tools had that capability. BPwin® did have a CRUD matrix module that generated the CRUD matrix on a Microsoft Excel spreadsheet but needed to be refined and adjusted manually because of the model's large size.

B. SUMMARY OF PROCESS MODEL DEVELOPMENT

Process model development was conducted according to the first two stages of James Martin's information engineering methodology: enterprise level analysis and business area analysis. Within these two stages, information about the organization is gathered and analyzed with matrices and diagrams to produce an As-Is model. The As-Is model is then reengineered to produce the To-Be model. The DoD standard IDEF0 modeling technique is used for both process models. This process takes some time to complete but ensures sufficient detail for sound analysis.

C. IMPLEMENTATION RECOMMENDATIONS

The following recommendations are suggested for reengineering implementation at MCI.

- Examine the set of high level matrices developed in this study that show the relationship between entities. functions, organization units and locations. Use the information obtained from the matrices to review the mission, functions, goals, organization structure, and the information needed to run MCI business.

- View reengineering at MCI as an ongoing effort and supported by the information systems architectures, methodologies and tools.

- Establish a priority and schedule for developing, refining, and reengineering the business area process, beyond the student services functions, according to the business areas identified in this study.

- Utilize a single database to facilitate data sharing among MCI departments, streamline processes, facilitate automation, eliminate data redundancy, and improve customer service.

- Utilize Activity Based Costing (ABC) methodology to identify cost drivers in SSD. Like most DoD activities, capturing and distributing cost data is not a common practice.

- Facilitate further SSD reengineering with the development and collection of measures of effectiveness (MOE) and measures of performance (MOP). Properly chosen MOPs and MOEs are critical to the evaluation of process improvements and will help identify other candidate processes for improvement.

- Consider the development of a Training NCO Interface Application. This application would essentially manage the Training NCO's R-5 file on a local database and would reduce manual data input for the new system.

D. ANTICIPATED OBSTACLES

Organizational issues such as fiscal limitations, politics, cultural bias, and top-level leadership support must be considered. IS managers must be able to face these challenges effectively, or the technical issues discussed in this work will have little impact on the success of future system deployment. These issues are beyond the scope of this thesis.

E. FUTURE RESEARCH REQUIREMENTS

Many information technology solutions have reengineering applicability to the business areas at MCI. However, before they are blindly applied, a thorough business area analysis, similar to the one conducted in this thesis on the Student Services Department, must be conducted on each of the remaining business areas. The two business areas with the most interaction with SSD are the logistics and the program and course development departments.

F. CONCLUSIONS

To deploy and operate effectively and efficiently in the information age, DoD organizations must take a serious look at the way they conduct business and implement their processes. A detailed process analysis of a business area provides an opportunity for redesigning/reengineering to reduce costs, improve efficiency, and better meet the needs of customers. The development of an enterprise wide model and detailed data and process business area models are the necessary building blocks for developing and deploying information systems that support the mission and objectives of the organization.

Adopting a methodology based on the development of the three models (business/process, data and technology) is extremely important for successful redesign at both enterprise and business application area levels. The development of a detailed As-Is business process model is necessary to thoroughly understand the processes of the different departments of MCI and for successful reengineering. There are a variety of modeling techniques available, as well as numerous CASE tools which support these models. Managers face the dilemma of which tools and strategies to select when dealing with the migration from legacy systems to open, relational information systems. This research supports the use of an information engineering methodology coupled with IDEF modeling techniques and a suitable CASE tool which supports synchronization of process and data models. This approach will allow for successful migration to open, client/server information systems.

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APPENDIX A. BPR METHODOLOGIES

This appendix contains details of the business process reengineering methodologies discussed in Chapter III.

a. Hammer , Champy, and Stanton

For more information consult the following books:

Michael Hammer, James Champy, *Reengineering the Corporation : A Manifesto for Business Revolution,* HarperBusiness, New York: 1994.

Michael Hammer, Steven A. Stanton, *The Reengineering Revolution : A Handbook,* HarperBusiness, New York: 1995.

b. Thomas Davenport

From Thomas H. Davenport, *Process Innovation: Reengineering Work through Information Technology*, Harvard Business School Press, Boston: 1993.

<u>Davenport's Five Phases of Process Innovation</u>

PHASE I: IDENTIFY PROCESSES FOR INNOVATION

Key activities:
- -Enumerate major processes
- -Determine process boundaries
- -Assess strategic relevance of each process
- -Render high-level judgements of the "health" of each process
- -Qualify the culture and politics of each process

PHASE II: IDENTIFY CHANGE LEVERS

Key activities:
- -Identify potential technological and human opportunities for process change
- -Identify potentially constraining technological and human factors
- -Research opportunities in terms of application to specific processes
- -Determine which constraints will be accepted

PHASE III: DEVELOP PROCESS VISION

Key activities:
- -Assess existing business strategy for process directions
- -Consult with process customers for performance objectives
- -Benchmark for process performance targets and examples of innovation
- -Formulate process performance objectives
- -Develop specific process attributes

PHASE IV: UNDERSTAND EXISTING PROCESSES

Key activities:
- -Describe the current process flow
- -Measure the process in terms of the new process objectives
- -Assess the process in terms of the new process attributes
- -Identify problems with or shortcomings of the process
- -Identify short-term improvements in the process
- -Assess current information technology and organization

PHASE V: DESIGN AND PROTOTYPE THE NEW PROCESS

Key activities:
- -Brainstorm design alternatives
- -Assess feasibility, risk, and benefit of design alternatives and select the preferred process design
- -Prototype the new process design
- -Develop a migration strategy
- -Implement new organizational structures and systems

c. H. James Harrington

From H. James Harrington, *Business Process Improvement: The Breakthrough Strategy for Total Quality, Productivity, and Competitiveness*, McGraw-Hill, Inc.: New York, 1991.

Harrington's Five Phases of Business Process Improvement (BPI)

PHASE I: ORGANIZING FOR IMPROVEMENT

Objective: To ensure success by building leadership, understanding, and commitment

Activities:
1. Establish Executive Improvement Team (EIT)
2. Appoint a business process improvement (BPI) champion
3. Provide executive training
4. Develop an improvement model
5. Communicate goals to employees
6. Review business strategy and customer requirements
7. Select the critical process
8. Appoint process owners
9. Select the process improvement team (PIT)

PHASE II: UNDERSTANDING THE PROCESS

Objective: To understand all the dimensions of the current business process

Activities:
1. Define the process scope and mission
2. Define process boundaries
3. Provide team training
4. Develop a process overview
5. Define customer and business measurements and expectations for the process
6. Flow diagram the process
7. Collect cost, time, and value data
8. Perform process walk-throughs
9. Resolve differences
10. Update process documentation

PHASE III: STREAMLINING

Objective: To improve the efficiency, effectiveness, and adaptability of the business process

Activities:
1. Provide team training
2. Identify improvement opportunities:

Errors and rework	High cost
Poor quality	Long time delays
Backlog	

3. Eliminate bureaucracy
4. Eliminate no-value-added activities
5. Simplify the process
6. Reduce process time
7. Error-proof the process
8. Upgrade equipment

9. Standardize
10. Automate
11. Document the process
12. Select the employees
13. Train the employees

PHASE IV: MEASUREMENT AND CONTROL

Objective: To implement a system to control the process for ongoing improvement

Activities:
1. Develop in-process measurements and targets
2. Establish a feedback system
3. Audit the process periodically
4. Establish a poor-quality cost system

PHASE V: CONTINUOUS IMPROVEMENT

Objective: implement a continuous improvement process

Activities:
1. Qualify the process
2. Perform periodic qualification reviews
3. Define and eliminate process problems
4. Evaluate the change impact on the business and on customers
5. Benchmark the process
6. Provide advanced team training

d. DoD Functional Process Improvement (FPI)

From DoDInst 8020.1M

A 25-step methodology has been developed that will take an FPI project team from developing a strategic plan to the development of a final functional economic analysis (FEA) or business case. It is important to note that an organization may have already completed some of the steps of the methodology through other means such as Total Quality Management (TQM) initiatives or an Information Systems Planning (ISP) effort. The information generated as a result of these efforts will greatly reduce the amount of time necessary to complete the FPI project.

Strategic Planning (Steps 1-4)

1. Secure Executive Commitment for Functional Process Improvement Project
    - Conduct executive briefings
        - Concepts and principles of FPI
        - DoD policy and requirements
        - Functional management process (DoD 8020.1-M, Ch 2)
        - FPI Management Framework
        - Intended expected benefits
        - Project management considerations
    - Arrange site visits to organizations committed to TQM/FPI
    - Develop Charter defining scope and extent of project
    - Secure explicit commitment to launch project
2. Confirm/Define Functional Mission
    - identify higher authority mandates/constraints
        - Review DoD relevant policy
        - Review applicable DoD directives (8000 series)
        - Review DMRD requirements/constraints
    - Identify current resource availability

- Develop statement of values and beliefs
- Develop mission statement
- Test mission statement for consistency and efficacy
  - Mission statement is consistent with higher authority mandates/constraints
  - Mission statement can be accomplished with current resource availability
  - Mission statement embodies stated values and beliefs

3. Develop Strategic Plan
- Identify functional Customers
  - External
  - Internal
- Establish critical customer requirements and needs
  - Analysis of current service levels
  - Customer surveys and interviews
  - Value-chain analysis (customer products and services)
  - Prioritized customer requirements and needs
- Identify/rank current and potential competitors (alternative sources)
- Test customer requirements and needs against mission statement
- Resolve mission/customer requirements and needs inconsistencies
- Develop prioritized list of customer requirements that will be met
- Develop functional goals for satisfying customer requirements
  - Develop vision statement (Guiding Principle(s))
  - Identify goals for key results areas
    - Customer satisfaction
    - Productivity
    - Innovation
    - Resource conservation
    - Management development and performance
    - Employee development and performance
    - Public responsibility
    - Develop critical success factors
- Test goals statements against mission, values and beliefs

4. Conduct Strategic/Customer Benchmarking and Best Practices Analysis
- Conduct Competitive analysis
- Examine available benchmarking databases
- Interview customers
- Interview functional area experts
- Research literature
- Validate goals statements against benchmarking best practices data
- Refine statement of goals

Business Planning (Steps 5-8)

5. Develop Business Plan
- Develop measurements for each stated goal
- Identify product and services features for each customer requirement
- Develop specific objectives for satisfying customer requirements
- Develop performance targets for each objective
- Resolve goals, objectives and product features anomalies
- Develop/refine quality matrices

6. Identify, Understand and Document Current Business Processes
- Conduct/validate business systems planning (BSP)/Information Systems Planning (ISP) data

-List business processes
-List current organization structures
-Develop process/organization matrix
-Develop product feature/process matrix
-Evaluate/analyze/prioritize relative process performance
-Select functional process for FPI action

7. Document the Functional Architecture
   -Document the mission of the functional area
   -Document the mission of the subordinate functional activity(s)
   -Relate functional area and activity(s) to Enterprise Architecture
   -Describe the business process(s) (of activity) subject to process improvement
   -Identify all organizational impacts for the business process(s)
   -Establish scope of effort for improving the business process(s)
   -Identify and charter the Functional Activity Program Manager
   -Restate/revise the parameters for process improvement
      - Process objectives
      - Performance measures and methods
      - Performance targets
      - Current performance variances to targets
   -Develop the Functional Management Strategy
   -Secure OSD Principle Staff Assistant approval to proceed

8. Initiate Functional Process Improvement Project
   -Develop project plan
      - Develop project scope
      - Develop work breakdown structure (WBS)
      - Develop organization breakdown structure (OBS)
      - Select process improvement action team (PAT)
      - Identify project resources and facilities
      - Develop resource assignment matrix (RAM)
      - Develop initial schedules
      - Develop initial cost estimates
   -Conduct initial training
   -Develop project execution management plan
   -Launch project

<u>Process Analysis [Problems/0pportunities] (Steps 9-1 3)</u>

9. Review, Revise or Develop AS-IS Activity Models for Selected Process
   -Model AS-IS process/activities
   -Model AS-IS activity process flow
   -Review process models
   -Update process models
   -Validate process models

10. Review, Revise or Develop AS-IS Data Models for Selected Process
   -Model AS-IS data models
   -Review data models
   -Update data models
   -Validate data models

11 . Perform Activity-Based Costing Study of AS-IS Process

- Review metrics, measures and methods
- Conduct activity-based costing
  - Analyze activities
  - Gather cost data
  - Trace costs to activities
  - Establish output measures
  - Analyze costs
- Conduct time-line analysis

12. Conduct Cost/Process Benchmarking and Best Practice Analysis with respect to AS-IS Models

- Develop benchmarking strategy
  - Identify features, functions and services
  - Identify operating, administrative and personnel cost categories
- Select and screen comparison companies
- Collect data
  - Proprietary information
  - Physical observation
  - Trade data
- Develop conclusions
- Refine performance targets

13. Perform Functional Process Improvement Analysis

- Review objectives and measures
  - Produce the "right" products and services
  - Consistency of performance
  - Timeliness and customer response
  - Appropriate cost (competitive)
  - Safety, morale, job satisfaction
  - Good citizenship (affect on other organizations)
  - Customer relationships (flexibility, accommodation)
- Perform techniques to discover problems and improvement opportunities
  - Pareto analysis
  - Histograms
  - Cause and effect diagrams
  - Scatter diagrams
  - Statistical process control
  - Process simulation
- Identify quick fixes
- Conduct what-if analysis
- Conduct scenario analysis
- Analyze cost drivers
  - Economies of scale
  - Learning curve effects
  - Capacity utilization
  - Linkages (value-chain analysis) (overhead)
  - Interrelationships (other business processes)
  - Integration (make us buy analysis)
  - Timing (just-in-time analysis)
  - Policy (constraints, mandates)
  - Location (geographical analysis)

- Institutional factors (environmental considerations)
- Analyze quality drivers
  - Inputs (data and materials)
  - People (process personnel)
  - Equipment (machines, computers, systems)
  - Methods (procedures, rules, regulations, training)
  - Materials (supplies, tools)

  - Environment (including location)
  - Outputs (data, products and services)
  - Administrative functions
  - External agencies and higher authority
  - Feedback (control systems, measurements)
- Prepare Improvement Opportunity Analysis Report
- Conduct in-progress review (IPR)
- Make IPR changes to AS-IS models and improvement report
- Publish AS-IS report

<u>Process Design/Justification (Steps 14-21)</u>

14. Develop Process Improvement Initiative Packages (four classes)
    - Class 1: Package quick fix improvement initiatives
    - Class 2: Package improvement initiatives that have little or no impact on existing information systems
    - Class 3: Package improvement initiatives that have major impacts on existing information systems
    - Class 4: Package improvement initiatives that will require new information systems (new technology)
  - Rank improvement initiatives within class

15. Develop Potential High-Level To-Be Activity and Data Models
  - Develop/revise the "vision" of the To-Be environment
  - Select To-Be concept
  - Select improvement packages for high-level modeling
  - Perform high-level modeling
    - Activity models
    - Data models
    - Process models

16. Revise Improvement Initiative Packages Based on To-Be Models
  - Develop clear statement of problem/opportunity
  - Revise improvement initiative packages based on high-level To-Be models
  - Develop assumptions and constraints
  - Determine implementation alternatives for each selected improvement initiative package

17. Select Initiative Package Based on Economic Analysis of Potential Alternatives
  - Perform economic analysis
    - Collect cost/benefit data for each alternative
    - Perform Risk Adjusted Discounted Cash Flow (RADCF) analysis
    - Perform sensitivity analysis
    - Document non-quantitative considerations

18. Develop Detailed To-Be Activity and Data Models Based on Selected Initiative Package
  - Develop detailed To-Be models
    - Activity models
    - Data models
    - Process models
  - Perform simulation
  - Perform functional level integration analysis
  - Document information systems support considerations

19. Develop Preliminary Functional Economic Analysis (FEA) Decision Package
  - Summarize functional strategic plan
  - Identify functional activity performance measures and targets
  - Document activity improvement program
  - Document economic analysis of proposed improvement initiatives

20. Develop Data Management and Technical Management Plans
  - Develop functional activity information systems strategy
  - Analyze data systems
  - Document recommended changes and redirection

21 . Develop Final Functional Economic Analysis (FEA) Decision Package
  - Document savings, benefits and risks of selected alternatives
  - Develop project white papers
  - Develop integrated financial plan
  - Update Planning, Programming and Budgeting System (PPBS)
  - Define approval requirements
  - Obtain policy approvals
  - Obtain FEA approval

<u>Improvement Execution Plan (Steps 22-25)</u>

22. Develop Project/Action/Transition Plans
  - Develop integrated implementation plan
  - Develop new goals and strategies
  - Establish new performance targets
  - Develop implementation schedule
  - Determine implementation resource requirements
  - Establish implementation team
  - Designate implementation steering committee
  - Design project implementation controls

23. Conduct Executive Presentations
  - Prepare executive briefing
  - Conduct executive briefing
  - Review recommended changes to the Project/Action/Transition Plans
  - Revise Project/Action/Transition Plans
  - Produce project implementation plan

24. Execute Approved FEA
  - Develop design specifications
  - Develop prototype/pilot
  - Manage change
  - Conduct IPR for steering committee

-Produce project execution report

25. Evaluate Results, Update Baseline Data and Document Lessons Learned
   - Monitor industry trends and developments
   - Evaluate results of improvement action
   - Establish criteria for future improvement projects
   - Document lessons learned
   - Update baseline models (convert To-Be to AS-IS)

APPENDIX B. AS-IS PROCESS MODEL

This appendix contains the components of the As-Is Process Model documentation. Table B-1 is a list of tables and figures as they appear in the appendix.

Number	Title
Table B-2	As-Is Process Model Decomposition Diagram
Figure B-1	As-Is Process Model Node Tree Diagram (SSD0): 3 Levels - Provide Student Services
Figure B-2	As-Is Process Model Node Tree Diagram (SSD1): 4 Levels - Obtain Customer Input
Figure B-3	As-Is Process Model Node Tree Diagram (SSD2): 4 Levels - Make Changes to Student's Course Activity Record
Figure B-4	As-Is Process Model Node Tree Diagram (SSD3): 4 Levels - Grade Student's Exams
Figure B-5	As-Is Process Model Node Tree Diagram (SSD4): 4 Levels - Process Unit Activity Reports
Figure B-6	As-Is Process Model Node Tree Diagram (SSD5): 4 Levels - Process Request for Material
Figure B-7	As-Is Process Model Node Tree Diagram (SSD6): 4 Levels - Process Requests for Registrar Action

Table B-1. List of To-Be Process Model Components.

Activity Number	Activity Name
SSD0	PROVIDE STUDENT SERVICES
SSD1	OBTAIN CUSTOMER INPUT
SSD1.1	PROCESS INCOMING PHONE CALLS
SSD1.1.1	PROCESS CONVERSANT CALLS
SSD1.1.1.1	PROVIDE CONVERSANT INSTRUCTIONS
SSD1.1.1.2	PROCESS CONVERSANT INQUIRY
SSD1.1.1.2.1	OBTAIN TOUCHTONE SSN
SSD1.1.1.2.2	OBTAIN TOUCHTONE COURSE NUMBER
SSD1.1.1.2.3	PROVIDE CONVERSANT COURSE STATUS
SSD1.1.1.3	EXIT CONVERSANT SYSTEM
SSD1.1.1.4	TRANSFER CALL TO MCI STAFF
SSD1.1.1.5	PROVIDE ADDITIONAL CONVERSANT INSTRUCTIONS
SSD1.1.2	PROCESS MCI OPERATOR- ASSISTED CALLS
SSD1.1.2.1	PROCESS PHONE REQUEST FOR STATUS/INFO
SSD1.1.2.1.1	INPUT PHONE CUSTOMER'S SSN
SSD1.1.2.1.2	PROVIDE PHONE CUSTOMER STATUS
SSD1.1.2.2	PROCESS PHONE CHANGE TO STUDENT'S INFORMATION
SSD1.1.2.2.1	PROCESS PHONE REQUEST FOR ENROLLMENT
SSD1.1.2.2.1.1	IDENTIFY PHONE ENROLLMENT CUSTOMER
SSD1.1.2.2.1.1.1	OBTAIN SSN OF PHONE ENROLLMENT CUSTOMER
SSD1.1.2.2.1.1.2	INPUT SSN OF PHONE ENROLLMENT CUSTOMER
SSD1.1.2.2.1.2	DETERMINE DESIRED COURSE OF PHONE ENROLLMENT CUSTOMER
SSD1.1.2.2.1.2.1	OBTAIN DESIRED COURSE NUMBER OF PHONE ENROLLMENT CUSTOMER
SSD1.1.2.2.1.2.2	INPUT DESIRED COURSE NUMBER OF PHONE ENROLLMENT CUSTOMER
SSD1.1.2.2.1.3	VERIFY PHONE ENROLLMENT CUSTOMER INFORMATION
SSD1.1.2.2.1.3.1	VALIDATE PHONE ENROLLMENT CUSTOMER INFORMATION
SSD1.1.2.2.1.3.2	INPUT MISSING PHONE ENROLLMENT CUSTOMER INFORMATION
SSD1.1.2.2.1.3.3	VALIDATE PHONE ENROLLMENT CUSTOMER MEETS COURSE PREREQUISITES
SSD1.1.2.2.1.4	ENTER TRANSACTION CODE FOR PHONE ENROLLMENT
SSD1.1.2.2.1.4.1	INPUT TC-A FOR PHONE ENROLLMENT

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD1.1.2.2.1.4.2	UPDATE ON-LINE TRANSACTION ENROLL FILE WITH PHONE ENROLLMENT
SSD1.1.2.2.2	PROCESS PHONE REQUEST TO CHANGE INFORMATION
SSD1.1.2.2.2.1	IDENTIFY CUSTOMER REQUESTING PHONE CHANGE
SSD1.1.2.2.2.1.1	OBTAIN SSN OF PHONE CHANGE CUSTOMER
SSD1.1.2.2.2.1.2	INPUT SSN OF PHONE CHANGE CUSTOMER
SSD1.1.2.2.2.2	DETERMINE INFORMATION TO CHANGE BY PHONE
SSD1.1.2.2.2.2.1	PROCESS PHONE CHANGE TO STUDENT'S NAME (NON-ACTIVE DUTY USMC)
SSD1.1.2.2.2.2.1.1	OBTAIN CHANGE TO STUDENT'S NAME BY PHONE (NON-ACTIVE DUTY USMC)
SSD1.1.2.2.2.2.1.2	INPUT CHANGE TO STUDENT'S NAME BY PHONE (NON-ACTIVE DUTY USMC)
SSD1.1.2.2.2.2.2	PROCESS PHONE CHANGE TO STUDENT'S ADDRESS (NON-ACTIVE DUTY USMC)
SSD1.1.2.2.2.2.2.1	OBTAIN CHANGE TO STUDENT'S ADDRESS BY PHONE (NON-ACTIVE DUTY USMC)
SSD1.1.2.2.2.2.2.2	INPUT CHANGE TO STUDENT'S ADDRESS BY PHONE (NON-ACTIVE DUTY USMC)
SSD1.1.2.2.2.2.3	PROCESS PHONE CHANGE TO STUDENT'S RANK (NON-ACTIVE DUTY USMC)
SSD1.1.2.2.2.2.3.1	OBTAIN PHONE CHANGE TO STUDENT'S RANK (NON-ACTIVE DUTY USMC)
SSD1.1.2.2.2.2.3.2	INPUT PHONE CHANGE TO STUDENT'S RANK (NON-ACTIVE DUTY USMC)
SSD1.1.2.2.2.3	ENTER TRANSACTION CODE FOR PHONE CHANGE
SSD1.1.2.2.2.3.1	INPUT TC-D FOR CHANGE BY PHONE
SSD1.1.2.2.2.3.2	UPDATE ON-LINE TRANSACTION R-6 FILE WITH PHONE CHANGE
SSD1.1.2.2.3	PROCESS PHONE REQUEST FOR EXTENTION
SSD1.1.2.2.3.1	IDENTIFY PHONE EXTENTION CUSTOMER
SSD1.1.2.2.3.1.1	OBTAIN SSN OF PHONE EXTENTION CUSTOMER
SSD1.1.2.2.3.1.2	INPUT SSN OF PHONE EXTENTION CUSTOMER
SSD1.1.2.2.3.2	DETERMINE DESIRED COURSE OF PHONE EXTENTION CUSTOMER
SSD1.1.2.2.3.2.1	OBTAIN DESIRED COURSE NUMBER OF PHONE EXTENTION CUSTOMER
SSD1.1.2.2.3.2.2	INPUT DESIRED COURSE NUMBER OF PHONE

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
	EXTENTION CUSTOMER
SSD1.1.2.2.3.3	VERIFY PHONE EXTENTION CUSTOMER INFORMATION
SSD1.1.2.2.3.3.1	VALIDATE PHONE EXTENTION CUSTOMER INFORMATION
SSD1.1.2.2.3.3.2	INPUT MISSING PHONE EXTENTION CUSTOMER INFORMATION
SSD1.1.2.2.3.3.3	VALIDATE PHONE EXTENTION CUSTOMER MEETS COURESE PREREQUISITES
SSD1.1.2.2.3.4	ENTER TRANSACTION CODE FOR PHONE EXTENTION CUSTOMER
SSD1.1.2.2.3.4.1	INPUT TC-E FOR PHONE EXTENTION
SSD1.1.2.2.3.4.2	UPDATE ON-LINE TRANSACTION R-6 FILE WITH PHONE EXTENTION
SSD1.1.2.2.4	PROCESS PHONE REQUEST FOR DISENROLLMENT
SSD1.1.2.2.4.1	IDENTIFY PHONE DISENROLLMENT CUSTOMER
SSD1.1.2.2.4.1.1	OBTAIN SSN OF PHONE DISENROLLMENT CUSTOMER
SSD1.1.2.2.4.1.2	INPUT SSN OF PHONE DISENROLLMENT CUSTOMER
SSD1.1.2.2.4.2	DETERMINE DESIRED COURSE OF PHONE DISENROLLMENT CUSTOMER
SSD1.1.2.2.4.2.1	OBTAIN DESIRED COURSE NUMBER OF PHONE DISENROLLMENT CUSTOMER
SSD1.1.2.2.4.2.2	INPUT DESIRED COURSE NUMBER OF PHONE DISENROLLMENT CUSTOMER
SSD1.1.2.2.4.3	VERIFY PHONE DISENROLLMENT CUSTOMER INFORMATION
SSD1.1.2.2.4.3.1	VALIDATE PHONE DISENROLLMENT CUSTOMER INFORMATION
SSD1.1.2.2.4.3.2	INPUT MISSING PHONE DISENROLLMENT CUSTOMER INFORMATION
SSD1.1.2.2.4.3.3	VALIDATE PHONE DISENROLLMENT CUSTOMER MEETS COURSE PREREQUISITES
SSD1.1.2.2.4.4	ENTER TRANSACTION CODE FOR PHONE DISENROLLMENT
SSD1.1.2.2.4.4.1	INPUT TC-H FOR PHONE DISENROLLMENT
SSD1.1.2.2.4.4.2	UPDATE ON-LINE TRANSACTION R-6 FILE WITH PHONE DISENROLLMENT
SSD1.1.2.2.5	PROCESS PHONE REQUEST FOR RE-ENROLLMENT

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD1.1.2.2.5.1	IDENTIFY PHONE RE-ENROLLMENT CUSTOMER
SSD1.1.2.2.5.1.1	OBTAIN SSN OF PHONE RE-ENROLLMENT CUSTOMER
SSD1.1.2.2.5.1.2	INPUT SSN OF PHONE RE-ENROLLMENT CUSTOMER
SSD1.1.2.2.5.2	DETERMINE DESIRED COURSE OF PHONE RE-ENROLLMENT CUSTOMER
SSD1.1.2.2.5.2.1	OBTAIN DESIRED COURSE NUMBER OF PHONE RE-ENROLLMENT CUSTOMER
SSD1.1.2.2.5.2.2	INPUT DESIRED COURSE NUMBER OF PHONE RE-ENROLLMENT CUSTOMER
SSD1.1.2.2.5.3	VERIFY PHONE RE-ENROLLMENT CUSTOMER INFORMATION
SSD1.1.2.2.5.3.1	VALIDATE PHONE RE-ENROLLMENT CUSTOMER INFORMATION
SSD1.1.2.2.5.3.2	INPUT MISSING PHONE RE-ENROLLMENT CUSTOMER INFORMATION
SSD1.1.2.2.5.3.3	VALIDATE PHONE RE-ENROLLMENT CUSTOMER MEETS COURSE PREREQUISITES
SSD1.1.2.2.5 4	ENTER TRANSACTION CODE FOR PHONE RE-ENROLLMENT
SSD1.1.2.2.5.4.1	INPUT TC-R FOR PHONE RE-ENROLLMENT CUSTOMER
SSD1.1.2.2 5.4.2	UPDATE ON-LINE TRANSACTION ENROLL FILE WITH PHONE RE-ENROLLMENT
SSD1.1.2.3	PROCESS PHONE REQUEST FOR MATERIAL
SSD1.1.2.3.1	DETERMINE MATERIAL PHONE CUSTOMER NEEDS
SSD1.1.2.3.1.1	VERIFY PHONE CUSTOMER'S INFORMATION
SSD1.1.2.3.1.2	VALIDATE PHONE CUSTOMER'S MATERIAL REQUEST
SSD1.1.2.3.2	PROCESS STANDARD REQUESTS FOR MATERIAL FOR PHONE CUSTOMER
SSD1.1.2.3.2.1	VALIDATE PHONE CUSTOMER'S REQUEST
SSD1.1.2.3.2.2	VERIFY AVAILABILITY OF MATERIAL REQUESTED BY PHONE
SSD1.1.2.3.2.3	ENTER TRANSACTION CODE FOR MATERIAL REQUESTED BY PHONE
SSD1.1.2.3.2.3.1	ENTER TC-I FOR PHONE REQUEST FOR DUPLICATE EXAM
SSD1.1.2.3 2.3.2	ENTER TC-P FOR PHONE REQUEST FOR DUPLICATE COURSE/PROGRAM

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD1.1.2.3.2.3.3	ENTER TC-T FOR PHONE REQUEST FOR INDIVIDUAL GENERIC DP-37
SSD1.1.2.3.2.3.4	ENTER TC-Y FOR PHONE REQUEST FOR DUPLICATE DIPLOMA/COMPLETION CERTIFICATE
SSD1.1.2.3.3	PREPARE "REQUEST FOR MATERIAL" FORM FOR PHONE CUSTOMER
SSD1.1.2.3.3.1	OBTAIN BLANK "REQUEST FOR MATERIAL" FORM
SSD1.1.2.3.3.2	WRITE PHONE CUSTOMER'S NAME ON "REQUEST FOR MATERIAL" FORM
SSD1.1.2.3.3.3	WRITE PHONE CUSTOMER'S SSN ON "REQUEST FOR MATERIAL" FORM
SSD1.1.2.3.3.4	WRITE PHONE CUSTOMER'S ADDRESS ON "REQUEST FOR MATERIAL" FORM
SSD1.1.2.3.3.5	WRITE PHONE CUSTOMER'S DESIRED ITEM NAME ON "REQUEST FOR MATERIAL" FORM
SSD1.1.2.3.3.6	WRITE PHONE CUSTOMER'S DESIRED QUANTITY ON "REQUEST FOR MATERIAL" FORM
SSD1.1.2.3.4	PREPARE "OFF-LINE REQUEST" FORM FOR PHONE CUSTOMER
SSD1.1.2.3.4.1	OBTAIN BLANK "OFF-LINE REQUEST" FORM
SSD1.1.2.3.4.2	WRITE PHONE CUSTOMER'S NAME ON "OFF-LINE REQUEST" FORM
SSD1.1.2.3.4.3	WRITE PHONE CUSTOMER'S SSN ON "OFF-LINE REQUEST" FORM
SSD1.1.2.3.4.4	WRITE PHONE CUSTOMER'S ADDRESS ON "OFF-LINE REQUEST" FORM
SSD1.1.2.3.4.5	WRITE PHONE CUSTOMER'S ITEM NAME ON "OFF-LINE REQUEST" FORM
SSD1.1.2.3.4.6	WRITE PHONE CUSTOMER'S DESIRED QUANTITY ON "OFF-LINE REQUEST" FORM
SSD1.2	SORT INCOMING U.S. MAIL
SSD1.2.1	SEGREGATE STUDENT COURSE INPUT
SSD1.2.1.1	SEGREGATE FEEDBACK FORMS
SSD1.2.1.2	SEGREGATE GENERIC DP-37s
SSD1.2.1.3	SEGREGATE PRE-SLUGGED DP-37s
SSD1.2.1.4	SEGREGATE ESSAY EXAM/LESSONS
SSD1.2.2	SEGREGATE UNIT INPUT
SSD1.2.2.1	SEGREGATE UNIT ACTIVITY REPORTS
SSD1.2.2.2	SEGREGATE ENROLLMENTS
SSD1.2.3	SEGREGATE MAILED CUSTOMER INQUIRIES

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD1.2.3.1	SEGREGATE WRITTEN REQUEST FOR STATUS
SSD1.2.3.2	SEGREGATE WRITTEN REQUEST FOR CHANGE TO CUSTOMER STATUS
SSD1.2.3.3	SEGREGATE WRITTEN CHANGE TO CUSTOMER INFORMATION
SSD1.2.3.4	SEGREGATE WRITTEN REQUEST FOR MATERIAL
SSD1.3	SORT INCOMING E-MAIL
SSD1.3.1	PRINT E-MAIL MESSAGES
SSD1.3.2	SEGREGATE E-MAIL REQUEST FOR STATUS / INFO
SSD1.3.3	SEGREGATE E-MAIL REQUEST FOR CHANGE TO CUSTOMER STATUS
SSD1.3.4	SEGREGATE E-MAIL REQUEST FOR MATERIAL
SSD1.3.5	SEGREGATE E-MAIL UAR RESPONSE
SSD1.3.6	PROCESS INDIVIDUAL E-MAIL RECEIVED
SSD1.4	PROCESS WALK-IN CUSTOMERS
SSD1.4.1	PROCESS WALK-IN REQUEST FOR STATUS
SSD1.4.1.1	INPUT SSN OF WALK-IN CUSTOMER
SSD1.4.1.2	PROVIDE WALK-IN CUSTOMER STATUS
SSD1.4.2	PROCESS WALK-IN REQUEST FOR CHANGE TO CUSTOMER STATUS / INFORMATION
SSD1.4.3	PROCESS WALK-IN REQUEST FOR MATERIAL
SSD2	MAKE CHANGES TO STUDENT'S COURSE ACTIVITY RECORD
SSD2.1	PROCESS REQUEST FOR ENROLLMENT
SSD2.1.1	IDENTIFY ENROLLMENT CUSTOMER
SSD2.1.1.1	OBTAIN SSN OF ENROLLMENT CUSTOMER
SSD2.1.1.2	INPUT SSN OF ENROLLMENT CUSTOMER
SSD2.1.2	DETERMINE TYPE OF ENROLLMENT
SSD2.1.2.1	PROCESS REQUEST FOR REGULAR ENROLLMENT
SSD2.1.2.1.1	VERIFY INFORMATION OF REGULAR ENROLLMENT CUSTOMER
SSD2.1.2.1.1 1	VALIDATE INFORMATION OF REGULAR ENROLLMENT CUSTOMER
SSD2.1.2.1.1.2	INPUT MISSING INFORMATION OF REGULAR ENROLLMENT CUSTOMER
SSD2.1.2.1.1.3	VALIDATE REGULAR ENROLLMENT CUSTOMER MEETS COURSE PREREQUISITES
SSD2.1.2.1.2	DETERMINE COURSE OF REGULAR ENROLLMENT CUSTOMER

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD2.1.2.1.2.1	OBTAIN COURSE OF REGULAR ENROLLMENT CUSTOMER
SSD2.1.2.1.2.2	INPUT COURSE CODE OF REGULAR ENROLLMENT CUSTOMER
SSD2.1.2.2	PROCESS REQUEST FOR BULK ENROLLMENT
SSD2.1.2.2.1	VERIFY INFORMATION OF BULK ENROLLMENT CUSTOMER
SSD2.1.2.2.1.1	VALIDATE INFORMATION OF BULK ENROLLMENT CUSTOMER
SSD2.1.2.2.1.2	INPUT MISSING INFORMATION OF BULK ENROLLMENT CUSTOMER
SSD2.1.2.2.1.3	VALIDATE BULK ENROLLMENT CUSTOMER MEETS COURSE PREREQUISITES
SSD2.1.2.2.2	DETERMINE COURSE OF BULK ENROLLMENT CUSTOMER
SSD2.1.2.2.2.1	OBTAIN COURSE OF BULK ENROLLMENT CUSTOMER
SSD2.1.2.2.2.2	INPUT COURSE OF BULK ENROLLMENT CUSTOMER
SSD2.1.2.3	PROCESS REQUEST FOR ADMINISTRATIVE ENROLLMENT
SSD2.1.2.3.1	VERIFY INFORMATION OF ADMINISTRATIVE ENROLLMENT CUSTOMER
SSD2.1.2.3.1.1	VALIDATE INFORMATION OF ADMINISTRATIVE ENROLLMENT CUSTOMER
SSD2.1.2.3.1.2	INPUT MISSING INFORMATION OF ADMINISTRATIVE ENROLLMENT CUSTOMER
SSD2.1.2.3.1.3	VALIDATE ADMINISTRATIVE ENROLLMENT CUSTOMER MEETS COURSE PREREQUISITES
SSD2.1.2.3.2	DETERMINE COURSE OF ADMINISTRATIVE ENROLLMENT CUSTOMER
SSD2.1.2.3.2.1	OBTAIN COURSE OF ADMINISTRATIVE ENROLLMENT CUSTOMER
SSD2.1.2.3.2.2	INPUT COURSE CODE OF ADMINISTRATIVE ENROLLMENT CUSTOMER
SSD2.1.2.4	PROCESS REQUEST FOR RE-ENROLLMENT
SSD2.1.2.4.1	VERIFY INFORMATION OF RE-ENROLLMENT CUSTOMER
SSD2.1.2.4.1.1	VALIDATE INFORMATION OF RE-ENROLLMENT CUSTOMER
SSD2.1.2.4.1.2	INPUT MISSING INFORMATION OF RE-ENROLLMENT CUSTOMER

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD2.1.2.4.1.3	VALIDATE RE-ENROLLMENT CUSTOMER MEETS COURSE PREREQUISITES
SSD2.1.2.4.2	DETERMINE COURSE OF RE-ENROLLMENT CUSTOMER
SSD2.1.2.4.2.1	OBTAIN COURSE OF RE-ENROLLMENT CUSTOMER
SSD2.1.2.4.2.2	INPUT COURSE OF RE-ENROLLMENT CUSTOMER
SSD2.1.2.5	PROCESS REQUEST FOR SPECIAL RE-ENROLLMENT
SSD2.1.2.5.1	VERIFY INFORMATION OF SPECIAL RE-ENROLLMENT CUSTOMER
SSD2.1.2.5.1.1	VALIDATE INFORMATION OF SPECIAL RE-ENROLLMENT CUSTOMER
SSD2.1.2.5.1.2	INPUT MISSING INFORMATION OF SPECIAL RE-ENROLLMENT CUSTOMER
SSD2.1.2.5.1.3	VALIDATE SPECIAL RE-ENROLLMENT CUSTOMER MEETS COURSE PREREQUISITES
SSD2.1.2.5.2	DETERMINE COURSE OF SPECIAL RE-ENROLLMENT CUSTOMER
SSD2.1.2.5.2.1	OBTAIN COURSE OF SPECIAL RE-ENROLLMENT CUSTOMER
SSD2.1.2.5.2.2	INPUT COURSE OF SPECIAL RE-ENROLLMENT CUSTOMER
SSD2.1.3	ENTER TRANSACTION CODE FOR ENROLLMENT
SSD2.1.3.1	INPUT TC-A FOR REGULAR ENROLLMENT
SSD2.1.3.2	INPUT TC-B FOR BULK ENROLLMENT
SSD2.1.3.3	INPUT TC-N FOR ADMINISTRATIVE ENROLLMENT
SSD2.1.3.4	INPUT TC-R FOR RE-ENROLLMENT
SSD2.1.3.5	INPUT TC-S FOR SPECIAL RE-ENROLLMENT
SSD2.1.3.6	UPDATE ON-LINE TRANSACTION ENROLL FILE WITH ENROLLMENT
SSD2.2	PROCESS CHANGE TO STUDENT INFORMATION
SSD2.2.1	IDENTIFY STUDENT REQUESTING CHANGE TO INFORMATION
SSD2.2.1.1	OBTAIN SSN OF STUDENT REQUESTING CHANGE
SSD2.2.1.2	INPUT SSN OF STUDENT REQUESTING CHANGE
SSD2.2.2	DETERMINE INFORMATION TO CHANGE
SSD2.2.2.1	PROCESS CHANGE TO STUDENT'S NAME
SSD2.2.2.1.1	OBTAIN CHANGE TO STUDENT'S NAME
SSD2.2.2.1.2	INPUT CHANGE TO STUDENT'S NAME
SSD2.2.2.2	PROCESS CHANGE TO STUDENT'S RANK

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD2.2.2.2.1	OBTAIN CHANGE TO STUDENT'S RANK
SSD2.2.2.2.2	INPUT CHANGE TO STUDENT'S RANK
SSD2.2.2.3	PROCESS CHANGE TO SERVICE COMPONENT
SSD2.2.2.3.1	OBTAIN CHANGE TO STUDENT'S SERVICE COMPONENT
SSD2.2.2.3.2	INPUT CHANGE TO STUDENT'S SERVICE COMPONENT
SSD2.2.2.4	PROCESS CHANGE TO SERVICE STATUS
SSD2.2.2.4.1	OBTAIN CHANGE TO STUDENT'S SERVICE STATUS
SSD2.2.2.4.2	INPUT CHANGE TO STUDENT'S SERVICE STATUS
SSD2.2.2.5	PROCESS CHANGE TO STUDENT'S ADDRESS
SSD2.2.2.5.1	OBTAIN CHANGE TO STUDENT'S ADDRESS
SSD2.2.2.5.2	INPUT CHANGE TO STUDENT'S ADDRESS
SSD2.2.3	ENTER TRANSACTION CODE FOR CHANGE
SSD2.2.3.1	INPUT TC-D FOR CHANGE TO STUDENT'S DATA
SSD2.2.3.2	UPDATE ON-LINE TRANSACTION R-6 FILE WITH CHANGE
SSD2.3	PROCESS REQUEST FOR ADMINISTRATIVE ACTION
SSD2.3.1	PROCESS REQUEST FOR EXTENSION
SSD2.3.1.1	IDENTIFY EXTENSION STUDENT
SSD2.3.1.1.1	OBTAIN SSN OF EXTENSION STUDENT
SSD2.3.1.1.2	INPUT SSN OF EXTENSION STUDENT
SSD2.3.1.1.3	OBTAIN NAME OF EXTENSION STUDENT
SSD2.3.1.1.4	INPUT NAME OF EXTENSION STUDENT
SSD2.3.1.2	VERIFY INFORMATION OF EXTENSION STUDENT
SSD2.3.1.2.1	VALIDATE INFORMATION OF EXTENSION STUDENT
SSD2.3.1.2.2	INPUT MISSING INFORMATION FOR EXTENSION STUDENT
SSD2.3.1.2.3	VALIDATE EXTENSION STUDENT MEETS PREREQUISITES
SSD2.3.1.3	DETERMINE COURSE OF EXTENSION STUDENT
SSD2.3.1.3.1	OBTAIN COURSE OF EXTENSION STUDENT
SSD2.3.1.3.2	INPUT COURSE CODE OF EXTENSION STUDENT
SSD2.3.1.4	ENTER TRANSACTION CODE FOR EXTENSION
SSD2.3.1.4.1	INPUT TC-E FOR EXTENSION
SSD2.3.1.4.2	UPDATE ON-LINE TRANSACTION R-6 FILE WITH EXTENSION

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD2.3.2	PROCESS REQUEST FOR DISENROLLMENT
SSD2.3.2.1	IDENTIFY DISENROLLMENT STUDENT
SSD2.3.2.1.1	OBTAIN SSN OF DISENROLLMENT STUDENT
SSD2.3.2.1.2	INPUT SSN OF DISENROLLMENT STUDENT
SSD2.3.2.2	DETERMINE COURSE OF DISENROLLMENT STUDENT
SSD2.3.2.2.1	OBTAIN COURSE OF DISENROLLMENT STUDENT
SSD2.3.2.2.2	INPUT COURSE OF DISENROLLMENT STUDENT
SSD2.3.2.3	VERIFY INFORMATION OF DISENROLLMENT STUDENT
SSD2.3.2.3.1	VALIDATE INFORMATION ABOUT DISENROLLMENT CUSTOMER
SSD2.3.2.3.2	INPUT MISSING INFORMATION ABOUT DISENROLLMENT CUSTOMER
SSD2.3.2.3.3	VALIDATE DISENROLLMENT CUSTOMER MEETS PREREQUISITES
SSD2.3.2.4	ENTER TRANSACTION CODE FOR DISENROLLMENT
SSD2.3.2.4.1	INPUT TC-H FOR DISENROLLMENT
SSD2.3.2.4.2	UPDATE ON-LINE TRANSACTION R-6 FILE WITH DISENROLLMENT
SSD2.3.3	PROCESS EXAM ISSUE
SSD2.3.3.1	IDENTIFY STUDENT FOR EXAM ISSUE
SSD2.3.3.1.1	OBTAIN SSN OF STUDENT FOR EXAM ISSUE
SSD2.3.3.1.2	INPUT SSN OF STUDENT FOR EXAM ISSUE
SSD2.3.3.1.3	OBTAIN NAME OF STUDENT FOR EXAM ISSUE
SSD2.3.3.1.4	INPUT NAME OF STUDENT FOR EXAM ISSUE
SSD2.3.3.2	IDENTIFY COURSE FOR EXAM ISSUE
SSD2.3.3.2.1	OBTAIN COURSE FOR EXAM ISSUE
SSD2.3.3.2.2	INPUT COURSE CODE FOR EXAM ISSUE
SSD2.3.3.3	VERIFY STUDENT INFORMATION FOR EXAM ISSUE
SSD2.3.3.3.1	VALIDATE INFORMATION OF STUDENT FOR EXAM ISSUE
SSD2.3.3.3.2	INPUT MISSING INFORMATION OF STUDENT FOR EXAM ISSUE
SSD2.3.3.3.3	VALIDATE STUDENT MEETS PREREQUISITES FOR EXAM ISSUE
SSD2.3.3.4	ENTER TRANSACTION CODE FOR EXAM ISSUE
SSD2.3.3.4.1	INPUT TC-I FOR EXAM ISSUE
SSD2.3.3.4.2	UPDATE ON-LINE TRANSACTION R-6 FILE FOR

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
	EXAM ISSUE
SSD2.3.4	PROCESS ADMIN CREDIT FOR PME
SSD2.3.4.1	IDENTIFY CUSTOMER FOR PME ADMIN CREDIT
SSD2.3.4.1.1	OBTAIN SSN OF CUSTOMER FOR PME ADMIN CREDIT
SSD2.3.4.1.2	INPUT SSN OF CUSTOMER FOR PME ADMIN CREDIT
SSD2.3.4.2	DETERMINE COURSE FOR PME ADMIN CREDIT
SSD2.3.4.2.1	OBTAIN COURSE FOR PME ADMIN CREDIT
SSD2.3.4.2.2	INPUT COURSE FOR PME ADMIN CREDIT
SSD2.3.4.3	VERIFY CUSTOMER INFORMATION FOR PME ADMIN CREDIT
SSD2.3.4.3.1	VALIDATE INFORMATION ABOUT CUSTOMER FOR PME ADMIN CREDIT
SSD2.3.4.3.2	INPUT MISSING INFORMATION ABOUT CUSTOMER FOR PME ADMIN CREDIT
SSD2.3.4.3.3	VALIDATE CUSTOMER FOR PME ADMIN CREDIT MEETS PREREQUISITES
SSD2.3.4.4	ENTER TRANSACTION CODE FOR ADMIN CREDIT FOR PME
SSD2.3.4.4.1	INPUT TC-O FOR PME ADMIN CREDIT
SSD2.3.4.4.2	UPDATE ON-LINE TRANSACTION R-6 FILE FOR PME ADMIN CREDIT
SSD2.4	PROCESS STANDARD REQUEST FOR MATERIAL
SSD2.4.1	IDENTIFY STUDENT REQUESTING MATERIAL
SSD2.4.1.1	OBTAIN SSN OF STUDENT REQUESTING STANDARD MATERIAL
SSD2.4.1.2	INPUT SSN OF STUDENT REQUESTING STANDARD MATERIAL
SSD2.4.2	DETERMINE STANDARD MATERIAL REQUESTED
SSD2.4.2.1	DETERMINE LESSON FOR LESSON ANSWER SHEET ISSUE
SSD2.4.2.2	DETERMINE COURSE FOR DUPLICATE DIPLOMA/ COMPLETION CERTIFICATE ISSUE
SSD2.4.2.3	DETERMINE COURSE FOR INDIVIDUAL DP-37 ISSUE
SSD2.4.2.4	DETERMINE COURSE OF DUPLICATE COURSE MATERIAL ISSUE
SSD2.4.3	INPUT TRANSACTION CODE FOR STANDARD MATERIAL ISSUE
SSD2.4.3.1	INPUT TC-L FOR LESSON ANSWER SHEET ISSUE
SSD2.4.3.2	INPUT TC-P FOR DUPLICATE COURSE

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
	MATERIALS ISSUE
SSD2.4.3.3	INPUT TC-T FOR INDIVIDUAL DP-37 ISSUE
SSD2.4.3.4	INPUT TC-Y FOR DUPLICATE DIPLOMA/ COMPLETION CERTIFICATE ISSUE
SSD2.4.3.5	UPDATE ON-LINE TRANSACTION R-6 FILE FOR STANDARD MATERIAL ISSUE
SSD3	GRADE STUDENTS' EXAMS
SSD3.1	PROCESS PRE-SLUGGED DP-37s
SSD3.1.1	RUN PRE-SLUGGED DP-37s THROUGH SCANTRON
SSD3.1.1.1	LOAD PRE-SLUGGED DP-37s INTO SCANTRON
SSD3.1.1.2	CREATE DISK WITH SCORES FOR GRADED PRE-SLUGGED DP-37s
SSD3.1.2	FILE SCANNED PRE-SLUGGED DP-37s
SSD3.1.3	FORWARD UNSCANNED PRE-SLUGGED DP-37s TO BE HAND GRADED
SSD3.2	PROCESS GENERIC DP-37s
SSD3.2.1	SCREEN GENERIC DP-37s
SSD3.2.2	RUN GENERIC DP-37s THROUGH SCANTRON
SSD3.2.2.1	LOAD GENERIC DP-37s INTO SCANTRON
SSD3.2.2.2	CREATE DISK WITH SCORES FOR GRADED GENERIC DP-37s
SSD3.2.3	FILE SCANNED GENERIC DP-37s
SSD3.2.4	FORWARD UNSCANNED GENERIC DP-37s TO BE HAND GRADED
SSD3.3	PROCESS OPSCAN ERROR LISTING REPORT
SSD3.4	PROCESS HAND GRADED EXAMS
SSD3.4.1	HANDGRADE NON-SCANNABLE DP-37S
SSD3.4.2	ENTER SCORES FOR HAND GRADED EXAMS
SSD3.4.3	ENTER SCORES FOR PME EXAMS
SSD4	PROCESS UNIT ACTIVITY REPORTS
SSD4.1	WORK RETURNED UARs
SSD4.1.1	MAKE DESIRED UPDATES FROM UAR
SSD4.1.1.1	PROCESS UAR REQUEST FOR ENROLLMENT
SSD4.1.1.1.1	IDENTIFY UAR ENROLLMENT CUSTOMER
SSD4.1.1.1.1.1	OBTAIN SSN OF UAR ENROLLMENT CUSTOMER
SSD4.1.1.1.1.2	INPUT SSN OF UAR ENROLLMENT CUSTOMER
SSD4.1.1.1.2	DETERMINE DESIRED COURSE OF UAR ENROLLMENT CUSTOMER
SSD4.1.1.1.2.1	OBTAIN DESIRED COURSE NUMBER OF UAR ENROLLMENT CUSTOMER

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD4.1.1.1.2.2	INPUT DESIRED COURSE NUMBER OF UAR ENROLLMENT CUSTOMER
SSD4.1.1.1.3	VERIFY UAR ENROLLMENT CUSTOMER INFORMATION
SSD4.1.1.1.3.1	VALIDATE UAR ENROLLMENT CUSTOMER INFORMATION
SSD4.1.1.1.3.2	INPUT MISSING UAR ENROLLMENT CUSTOMER INFORMATION
SSD4.1.1.1.3.3	VALIDATE UAR ENROLLMENT CUSTOMER MEETS COURSE PRE-REQUISITES
SSD4.1.1.1.4	ENTER TRANSACTION CODE FOR UAR ENROLLMENT
SSD4.1.1.1.4.1	INPUT TC-A FOR UAR ENROLLMENT
SSD4.1.1.1.4.2	UPDATE ON-LINE TRANSACTION ENROLL FILE WITH UAR ENROLLMENT
SSD4.1.1.2	PROCESS UAR REQUEST FOR DATA CHANGE
SSD4.1.1.2.1	IDENTIFY UAR CUSTOMER FOR DATA CHANGE
SSD4.1.1.2.1.1	OBTAIN SSN OF UAR CHANGE CUSTOMER
SSD4.1.1.2.1.2	INPUT SSN OF UAR CHANGE CUSTOMER
SSD4.1.1.2.2	DETERMINE INFORMATION TO CHANGE BY UAR
SSD4.1.1.2.2.1	PROCESS UAR CHANGE TO STUDENT'S NAME
SSD4.1.1.2.2.1.1	OBTAIN UAR CHANGE TO STUDENT'S NAME
SSD4.1.1.2.2.1.2	INPUT CHANGE TO STUDENT'S NAME BY UAR
SSD4.1.1.2.2.2	PROCESS UAR CHANGE TO STUDENT'S ADDRESS
SSD4.1.1.2.2.2.1	OBTAIN UAR CHANGE TO STUDENT'S ADDRESS
SSD4.1.1.2.2.2.2	INPUT UAR CHANGE TO STUDENT'S ADDRESS
SSD4.1.1.2.2.3	PROCESS UAR CHANGE TO STUDENT'S RANK
SSD4.1.1.2.2.3.1	OBTAIN UAR CHANGE TO STUDENT'S RANK
SSD4.1.1.2.2.3.2	INPUT UAR CHANGE TO STUDENT'S RANK
SSD4.1.1.2.3	ENTER TRANSACTION CODE FOR UAR CHANGE
SSD4.1.1.2.3.1	ENTER TC-D FOR DATA CHANGE BY UAR
SSD4.1.1.2.3.2	UPDATE ON-LINE TRANSACTION R-6 FILE WITH UAR CHANGE
SSD4.1.1.3	PROCESS UAR REQUEST FOR EXTENTION
SSD4.1.1.3.1	IDENTIFY UAR EXTENTION CUSTOMER
SSD4.1.1.3.1.1	OBTAIN SSN OF UAR EXTENTION CUSTOMER
SSD4.1.1.3.1.2	INPUT SSN OF UAR EXTENTION CUSTOMER
SSD4.1.1.3.2	DETERMINE DESIRED COURSE OF UAR EXTENTION CUSTOMER
SSD4.1.1.3.2.1	OBTAIN DESIRED COURSE NUMBER OF UAR

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
	EXTENTION CUSTOMER
SSD4.1.1.3.2.2	INPUT DESIRED COURSE NUMBER OF UAR EXTENTION CUSTOMER
SSD4.1.1.3.3	VERIFY UAR EXTENTION CUSTOMER INFORMATION
SSD4.1.1.3.3.1	VALIDATE UAR EXTENTION CUSTOMER INFORMATION
SSD4.1.1.3.3.2	INPUT MISSING UAR EXTENTION CUSTOMER INFORMATION
SSD4.1.1.3.3.3	VALIDATE UAR EXTENTION CUSTOMER MEETS COURSE PRE-REQUISITES
SSD4.1.1.3.4	ENTER TRANSACTION CODE FOR UAR EXTENTION CUSTOMER
SSD4.1.1.3.4.1	INPUT TC-E FOR UAR EXTENTION
SSD4.1.1.3.4.2	UPDATE ON-LINE TRANSACTION R-6 FILE WITH UAR EXTENTION
SSD4.1.1.4	PROCESS UAR REQUEST FOR DISENROLLMENT
SSD4.1.1.4.1	IDENTIFY UAR DISENROLLMENT CUSTOMER
SSD4.1.1.4.1.1	OBTAIN SSN OF UAR DISENROLLMENT CUSTOMER
SSD4.1.1.4.1.2	INPUT SSN OF UAR DISENROLLMENT CUSTOMER
SSD4.1.1.4.2	DETERMINE DESIRED COURSE OF UAR DISENROLLMENT CUSTOMER
SSD4.1.1.4.2.1	OBTAIN DESIRED COURSE NUMBER OF UAR DISENROLLMENT CUSTOMER
SSD4.1.1.4.2.2	INPUT DESIRED COURSE NUMBER OF UAR DISENROLLMENT CUSTOMER
SSD4.1.1.4.3	VERIFY UAR DISENROLLMENT CUSTOMER INFORMATION
SSD4.1.1.4.3.1	VALIDATE UAR DISENROLLMENT CUSTOMER INFORMATION
SSD4.1.1.4.3.2	INPUT MISSING UAR DISENROLLMENT CUSTOMER INFORMATION
SSD4.1.1.4.3.3	VALIDATE UAR DISENROLLMENT CUSTOMER MEETS PREREQUISITES
SSD4.1.1.4.4	ENTER TRANSACTION CODE FOR UAR DISENROLLMENT
SSD4.1.1.4.4.1	INPUT TC-H FOR UAR DISENROLLMENT
SSD4.1.1.4.4.2	UPDATE ON-LINE TRANSACTION R-6 FILE WITH UAR DISENROLLMENT
SSD4.1.1.5	PROCESS UAR REQUEST FOR DUPLICATE

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
	MATERIALS
SSD4.1.1.5.1	IDENTIFY UAR DUPLICATE MATERIALS CUSTOMER
SSD4.1.1.5.1.1	OBTAIN SSN OF UAR DUPLICATE MATERIALS CUSTOMER
SSD4.1.1.5.1.2	INPUT SSN OF UAR DUPLICATE MATERIALS CUSTOMER
SSD4.1.1.5.2	DETERMINE DESIRED MATERIALS FOR UAR DUPLICATE MATERIALS CUSTOMER
SSD4.1.1.5.2.1	OBTAIN DESIRED MATERIALS FOR UAR DUPLICATE MATERIALS CUSTOMER
SSD4.1.1.5.2.2	DETERMINE AVAILABILITY OF DESIRED MATERIALS FOR UAR DUPLICATE MATERIALS CUSTOMER
SSD4.1.1.5.3	VERIFY UAR DUPLICATE MATERIALS CUSTOMER INFORMATION
SSD4.1.1.5.3.1	VALIDATE UAR DUPLICATE MATERIALS CUSTOMER INFORMATION
SSD4.1.1.5.3.2	INPUT MISSING UAR DUPLICATE MATERIALS CUSTOMER INFORMATION
SSD4.1.1.5.3.3	VALIDATE UAR DUPLICATE MATERIALS CUSTOMER MEETS PRE-REQUISITES
SSD4.1.1.5.4	ENTER TRANSACTION CODE FOR UAR DUPLICATE MATERIALS CUSTOMER
SSD4.1.1.5.4.1	INPUT TC-I FOR DUPLICATE EXAM BY UAR CUSTOMER
SSD4.1.1.5.4.2	INPUT TC-P FOR DUPLICATE COURSE/ PROGRAM BY UAR CUSTOMER
SSD4.1.1.5.4.3	INPUT TC-T FOR REPLACEMENT DP-37 BY UAR CUSTOMER
SSD4.1.1.5.4.4	INPUT TC-Y FOR DUPLICATE DIPLOMA/ COMPLETION CERTIFICATE BY UAR CUSTOMER
SSD4.1.1.5.4.5	UPDATE ON-LINE TRANSACTION BATCH FILE WITH UAR DUPLICATE MATERIALS ORDER
SSD4.1.1.6	PROCESS UAR REQUEST FOR RE-ENROLLMENT
SSD4.1.1.6.1	IDENTIFY UAR RE-ENROLLMENT CUSTOMER
SSD4.1.1.6.1.1	OBTAIN SSN OF UAR RE-ENROLLMENT CUSTOMER
SSD4.1.1.6.1.2	INPUT SSN OF UAR RE-ENROLLMENT CUSTOMER
SSD4.1.1.6.2	DETERMINE DESIRED COURSE OF UAR RE-ENROLLMENT CUSTOMER

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD4.1.1.6.2.1	OBTAIN DESIRED COURSE OF UAR RE-ENROLLMENT CUSTOMER
SSD4.1.1.6.2.2	INPUT DESIRED COURSE OF UAR RE-ENROLLMENT CUSTOMER
SSD4.1.1.6.3	VERIFY UAR RE-ENROLLMENT CUSTOMER INFORMATION
SSD4.1.1.6.3.1	VALIDATE UAR RE-ENROLLMENT CUSTOMER INFORMATION
SSD4.1.1.6.3.2	INPUT MISSING UAR RE-ENROLLMENT CUSTOMER INFORMATION
SSD4.1.1.6.3.3	VALIDATE UAR RE-ENROLLMENT CUSTOMER MEETS PREREQUISITES
SSD4.1.1.6.4	ENTER TRANSACTION CODE FOR UAR RE-ENROLLMENT
SSD4.1.1.6.4.1	INPUT TC-R FOR UAR RE-ENROLLMENT
SSD4.1.1.6.4.2	UPDATE ON-LINE TRANSACTION ENROLL FILE WITH UAR RE-ENROLLMENT
SSD4.1.2	PREPARE MATERIAL REQUEST FORMS FROM UAR
SSD4.1.2.1	PREPARE "REQUEST FOR MATERIAL" FORMS FROM UAR
SSD4.1.2.1.1	WRITE STUDENT'S NAME ON "REQUEST FOR MATERIAL" FORMS FROM UAR
SSD4.1.2.1.2	WRITE STUDENT'S SSN ON "REQUEST FOR MATERIAL" FORMS FROM UAR
SSD4.1.2.1.3	WRITE STUDENT'S ADDRESS ON "REQUEST FOR MATERIAL" FORMS FROM UAR
SSD4.1.2.1.4	WRITE DATE ON "REQUEST FOR MATERIAL" FORMS FROM UAR
SSD4.1.2.1.5	WRITE UAR CLERK'S NAME "REQUEST FOR MATERIAL" FORMS FROM UAR
SSD4.1.2.1.6	WRITE ITEM NAME ON "REQUEST FOR MATERIAL" FORMS FROM UAR
SSD4.1.2.1.7	WRITE QUANTITY ON "REQUEST FOR MATERIAL" FORMS FROM UAR
SSD4.1.2.2	PREPARE "OFF-LINE REQUEST" FORMS FROM UAR
SSD4.1.2.2.1	WRITE STUDENT'S NAME ON "OFF-LINE REQUEST" FORMS FROM UAR
SSD4.1.2.2.2	WRITE STUDENT'S SSN ON "OFF-LINE REQUEST" FORMS FROM UAR
SSD4.1.2.2.3	WRITE STUDENT'S ADDRESS ON "OFF-LINE

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
	REQUEST" FORMS FROM UAR
SSD4.1.2.2.4	WRITE DATE ON "OFF-LINE REQUEST" FORMS FROM UAR
SSD4.1.2.2.5	WRITE UAR CLERK'S NAME ON "OFF-LINE REQUEST" FORMS FROM UAR
SSD4.1.2.2.6	WRITE ITEM NAME ON "OFF-LINE REQUEST" FORMS FROM UAR
SSD4.1.2.2.7	WRITE QUANTITY ON "OFF-LINE REQUEST" FORMS FROM UAR
SSD4.1.3	FILE WORKED UAR
SSD4.2	PROCESS OUTGOING UARs BY U.S. MAIL
SSD4.2.1	OBTAIN OUTGOING PRINTED UARs
SSD4.2.2	PACKAGE OUTGOING UARs BY U.S. MAIL
SSD4.2.2.1	SEPARATE PRINTED UARs FOR MAILING
SSD4.2.2.2	PLACE UARs IN ENVELOPES
SSD4.2.2.3	FORWARD PACKAGED UARs TO LOGISTICS
SSD5	PROCESS REQUEST FOR MATERIAL
SSD5.1	SEGREGATE REQUEST FOR REGISTRAR ACTION
SSD5.2	SEGREGATE STANDARD REQUESTS FOR MATERIAL
SSD5.2.1	VALIDATE STUDENT'S REQUEST
SSD5.2.2	VERIFY AVAILABILITY OF REQUESTED MATERIAL
SSD5.2.3	ENTER TRANSACTION CODE FOR REQUESTED MATERIAL
SSD5.2.3.1	ENTER TC-I FOR REQUEST FOR DUPLICATE EXAM
SSD5.2.3.2	ENTER TC-P FOR REQUEST FOR DUPLICATE COURSE / PROGRAM
SSD5.2.3.3	ENTER TC-T FOR REQUEST FOR INDIVIDUAL GENERIC DP-37
SSD5.2.3.4	ENTER TC-Y TO REQUEST FOR DUPLICATE DIPLOMA/COMPLETION CERTIFICATE
SSD5.3	PROCESS "REQUEST FOR MATERIAL" FORMS
SSD5.3.1	VALIDATE INFORMATION ON "REQUEST FOR MATERIAL" FORM
SSD5.3.1.1	VALIDATE NAME ON "REQUEST FOR MATERIAL" FORM
SSD5.3.1.2	VALIDATE SSN ON "REQUEST FOR MATERIAL" FORM
SSD5.3.1.3	VALIDATE ADDRESS ON "REQUEST FOR

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
	MATERIAL" FORM
SSD5.3.1.4	VALIDATE QUANTITY ON "REQUEST FOR MATERIAL" FORM
SSD5.3.2	PREPARE MATERIAL REQUESTED ON "REQUEST FOR MATERIAL" FORM
SSD5.3.2.1	TYPE "REQUEST FOR MATERIAL" MAILING LABELS
SSD5.3.2.2	OBTAIN MATERIAL REQUESTED ON "REQUEST FOR MATERIAL" FORM
SSD5.3.3	PREPARE PACKAGE OF "REQUEST FOR MATERIAL" FORM
SSD5.3.3.1	PLACE "REQUEST FOR MATERIAL" MAILING LABELS ON ENVELOPE
SSD5.3.3.2	INSERT MATERIAL REQUESTED ON "REQUEST FOR MATERIAL" FORM INTO ENVELOPE
SSD5.3.3.3	FORWARD "REQUEST FOR MATERIAL" PACKAGE TO LOGISTICS MAILROOM
SSD5.4	SEGREGATE "OFF-LINE REQUEST" FORMS
SSD5.4.1	COMPLETE "OFF-LINE REQUEST" FORM
SSD5.4.2	VALIDATE INFORMATION ON "OFF-LINE REQUEST" FORM
SSD5.4.3	FORWARD "OFF-LINE REQUEST" FORM TO LOGISTICS
SSD5.4.4	FORWARD "OFF-LINE REQUEST" FORM TO OPERATIONS
SSD6	PROCESS REQUESTS FOR REGISTRAR ACTION
SSD6.1	ISSUE (RE-ISSUE) DIPLOMA
SSD6.1.1	OBTAIN DIPLOMA MAILING LABELS
SSD6.1.2	PRINT DIPLOMAS
SSD6.1.2.1	LOAD DIPLOMA PRINT FILE
SSD6.1.2.2	EXECUTE DIPLOMA PRINT PROGRAM
SSD6.1.3	PACKAGE DIPLOMA FOR MAILING
SSD6.1.3.1	PLACE DIPLOMA MAILING LABEL ON ENVELOPE
SSD6.1.3.2	INSERT DIPLOMA INTO ENVELOPE
SSD6.1.3.3	FORWARD PACKAGED DIPLOMA TO LOGISTICS MAILROOM
SSD6.2	PROCESS TRANSCRIPT REQUEST
SSD6.2.1	OBTAIN CUSTOMER TRANSCRIPT INFORMATION
SSD6.2.1.1	VERIFY TRANSCRIPT CUSTOMER'S PERSONAL INFORMATION
SSD6.2.1.1.1	VERIFY TRANSCRIPT CUSTOMER'S NAME

Table B-2. As-Is Process Model Decomposition Diagram.

Activity Number	Activity Name
SSD6.2.1.1.2	VERIFY TRANSCRIPT CUSTOMER'S SSN
SSD6.2.1.1.3	VERIFY TRANSCRIPT CUSTOMER'S ADDRESS
SSD6.2.1.1.4	VERIFY TRANSCRIPT CUSTOMER'S DATES OF SERVICE
SSD6.2.1.2	PERFORM RESEARCH FOR STUDENT COURSE INFORMATION
SSD6.2.1.2.1	SEARCH ON-LINE DATA FOR STUDENT COURSE INFORMATION
SSD6.2.1.2.1.1	SEARCH ACTIVE FILES FOR TRANSCRIPT INFORMATION
SSD6.2.1.2.1.2	SEARCH ARCHIVE FILES FOR TRANSCRIPT INFORMATION
SSD6.2.1.2.2	SEARCH MICROFICHE DATA FOR STUDENT COURSE INFORMATION
SSD6.2.1.2.3	REFER CUSTOMER TO HQMC FOR COURSES PRIOR TO JAN 79
SSD6.2.1.3	OBTAIN STUDENT COURSE INFORMATION
SSD6.2.1.3.1	OBTAIN STUDY HOURS
SSD6.2.1.3.2	OBTAIN ENROLLMENT DATE
SSD6.2.1.3.3	OBTAIN COMPLETION DATE
SSD6.2.1.3.4	OBTAIN GRADE PERCENT
SSD6.2.1.3.5	OBTAIN COURSE NUMBER
SSD6.2.1.3.6	OBTAIN COURSE TITLE
SSD6.2.2	PREPARE TRANSCRIPT
SSD6.2.2.1	COMPLETE TRANSCRIPT FORM ON SCREEN
SSD6.2.2.2	PRINT TRANSCRIPT
SSD6.2.2.3	PRINT TRANSCRIPT LETTER
SSD6.2.2.4	TYPE TRANSCRIPT MAILING LABEL
SSD6.2.3	PACKAGE TRANSCRIPT FOR MAILING
SSD6.2.3.1	INSERT TRANSCRIPT INTO ENVELOPE
SSD6.2.3.2	INSERT TRANSCRIPT LETTER INTO ENVELOP
SSD6.2.3.3	PLACE TRANSCRIPT MAILING LABEL ON TRANSCRIPT ENVELOPE
SSD6.2.3.4	FORWARD TRANSCRIPT PACKAGE TO LOGISTICS

Table B-2. As-Is Process Model Decomposition Diagram.

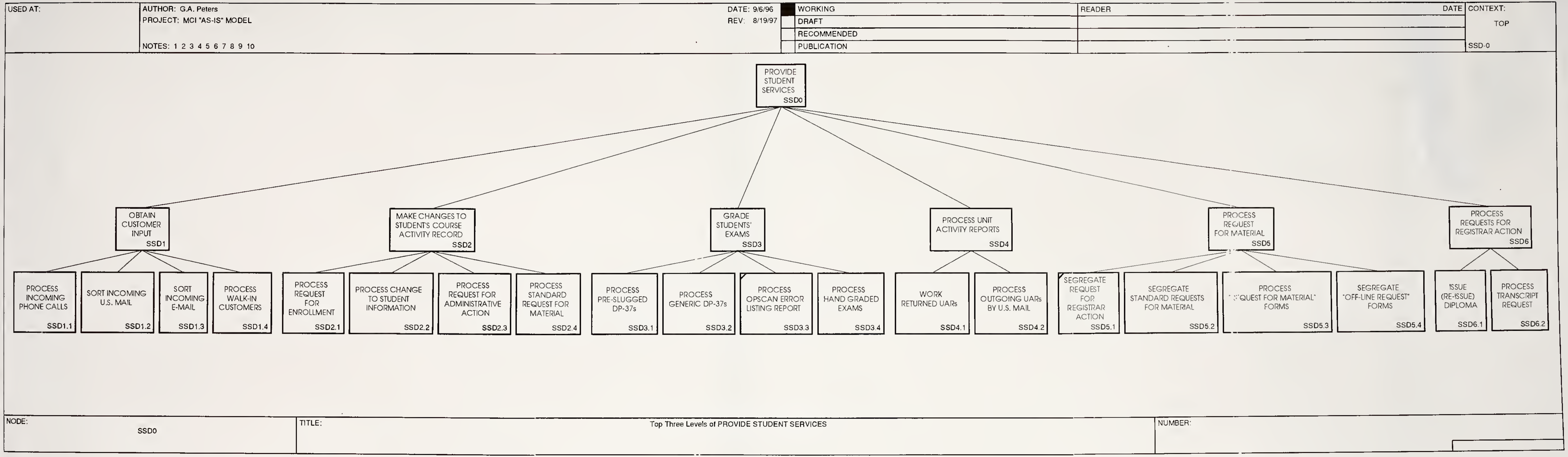


Figure B-1. As-Is Process Model Node Tree Diagram (SSD0).

Figure B-2. As-Is Process Model Node Tree Diagram (SSD1).

Figure B-3. As-Is Process Model Node Tree Diagram (SSD2).

DATE 8/18/97
REV 8/18/97
WORKING
DRAFT
RECOMMENDED
PUBLICATION
READER
DATE
CONTEXT
TOP
SSD0
MAKE CHANGES TO STUDENTS COURSE ACTIVITY RECORD SSD2
PROCESS REQUEST FOR ADMINISTRATIVE ACTION SSD2.3
PROCESS STANDARD REQUEST FOR MATERIAL SSD2.4
ENTER TRANSACTION CODE FOR CHANGE SSD2.2.3
PROCESS REQUEST FOR EXTENSION SSD2.3.1
PROCESS REQUEST FOR DISENROLLMENT SSD2.3.2
PROCESS EXAM ISSUE SSD2.3.3
PROCESS ADMIN CREDIT FOR PME SSD2.3.4
IDENTIFY STUDENT REQUESTING MATERIAL SSD2.4.1
DETERMINE STANDARD MATERIAL REQUESTED SSD2.4.2
INPUT TRANSACTION CODE FOR STANDARD MATERIAL ISSUE SSD2.4.3
SS CHANGE TO NTS ADDRESS SSD2.2.2.5
INPUT TC-D FOR CHANGE TO STUDENT'S DATA SSD2.2.3.1
UPDATE ON-LINE TRANSACTION R-6 FILE WITH CHANGE SSD2.2.3.2
IDENTIFY EXTENSION STUDENT SSD2.3.1.1
VERIFY INFORMATION OF EXTENSION STUDENT SSD2.3.1.2
DETERMINE COURSE OF EXTENSION STUDENT SSD2.3.1.3
ENTER TRANSACTION CODE FOR EXTENSION SSD2.3.1.4
IDENTIFY DISENROLLMENT STUDENT SSD2.3.2.1
DETERMINE COURSE OF DISENROLLMENT STUDENT SSD2.3.2.2
VERIFY INFORMATION OF DISENROLLMENT STUDENT SSD2.3.2.3
ENTER TRANSACTION CODE FOR DISENROLLMENT SSD2.3.2.4
IDENTIFY STUDENT FOR EXAM ISSUE SSD2.3.3.1
IDENTIFY COURSE FOR EXAM ISSUE SSD2.3.3.2
VERIFY STUDENT INFORMATION FOR EXAM ISSUE SSD2.3.3.3
ENTER TRANSACTION CODE FOR EXAM ISSUE SSD2.3.3.4
IDENTIFY CUSTOMER FOR PME ADMIN CREDIT SSD2.3.4.1
DETERMINE COURSE FOR PME ADMIN CREDIT SSD2.3.4.2
VERIFY CUSTOMER INFORMATION FOR PME ADMIT CREDIT SSD2.3.4.3
ENTER TRANSACTION CODE FOR ADMIN CREDIT FOR PME SSD2.3.4.4
OBTAIN SSN OF STUDENT REQUESTING STANDARD MATERIAL SSD2.4.1.1
INPUT SSN OF STUDENT REQUESTING STANDARD MATERIAL SSD2.4.1.2
DETERMINE LESSON FOR LESSON ANSWER SHEET ISSUE SSD2.4.2.1
DETERMINE COURSE FOR DUPLICATE DIPLOMA/ COMPLETION CERTIFICATE ISSUE SSD2.4.2.2
DETERMINE COURSE FOR INDIVIDUAL DP-37 ISSUE SSD2.4.2.3
DETERMINE COURSE OF DUPLICATE COURSE MATERIAL ISSUE SSD2.4.2.4
INPUT TC-L FOR LESSON ANSWER SHEET ISSUE SSD2.4.3.1
INPUT TC-P FOR DUPLICATE COURSE MATERIALS ISSUE SSD2.4.3.2
INPUT TC-T FOR INDIVIDUAL DP-37 ISSUE SSD2.4.3.3
INPUT TC-Y FOR DUPLICATE DIPLOMA/ COMPLETION CERTIFICATE ISSUE SSD2.4.3.4
UPDATE ON-LINE TRANSACTION R-6 FILE FOR STANDARD MATERIAL ISSUE SSD2.4.3.5
Top Four Levels of Make Changes to Student Activity Record
NUMBER

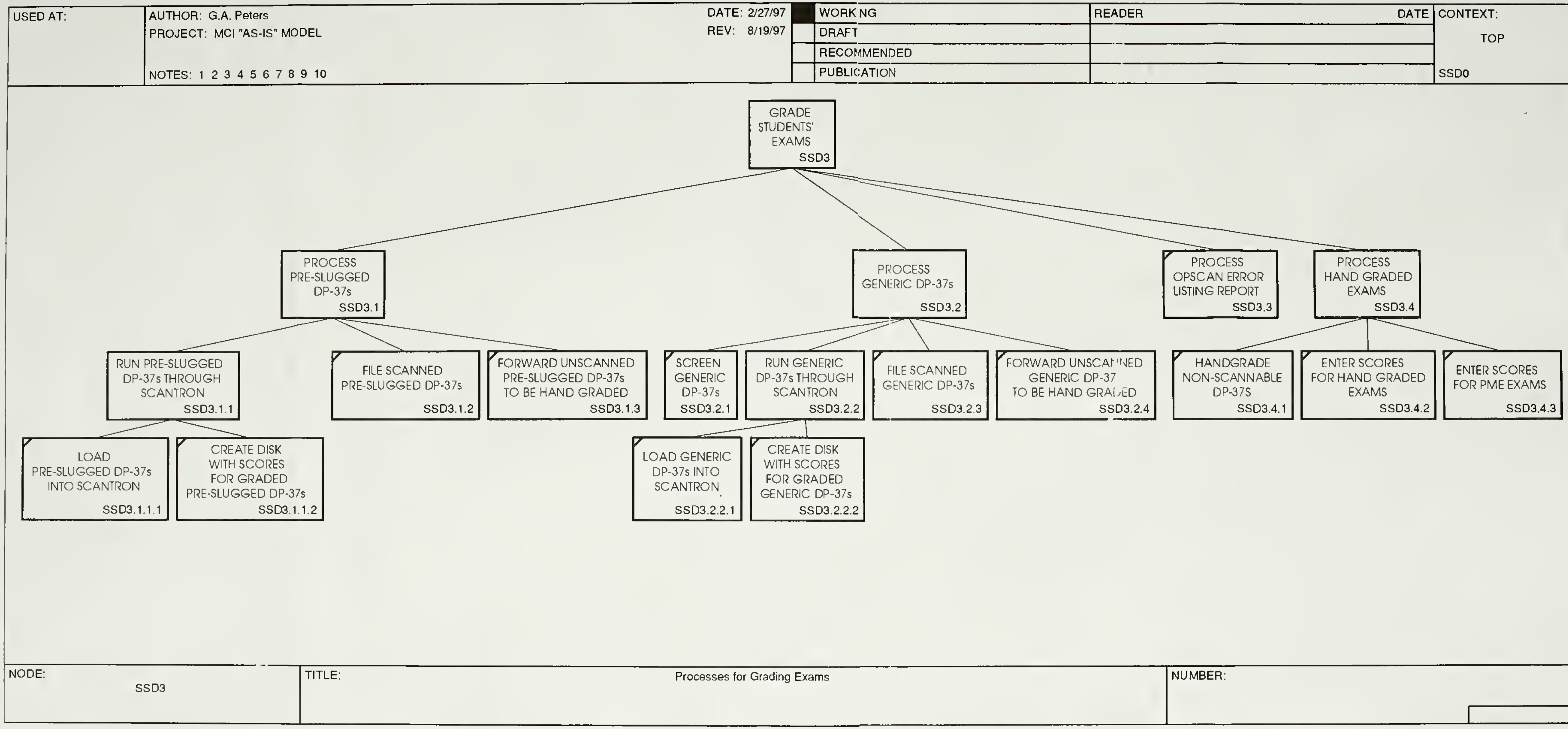


Figure B-4. As-Is Process Model Node Tree Diagram (SSD3).

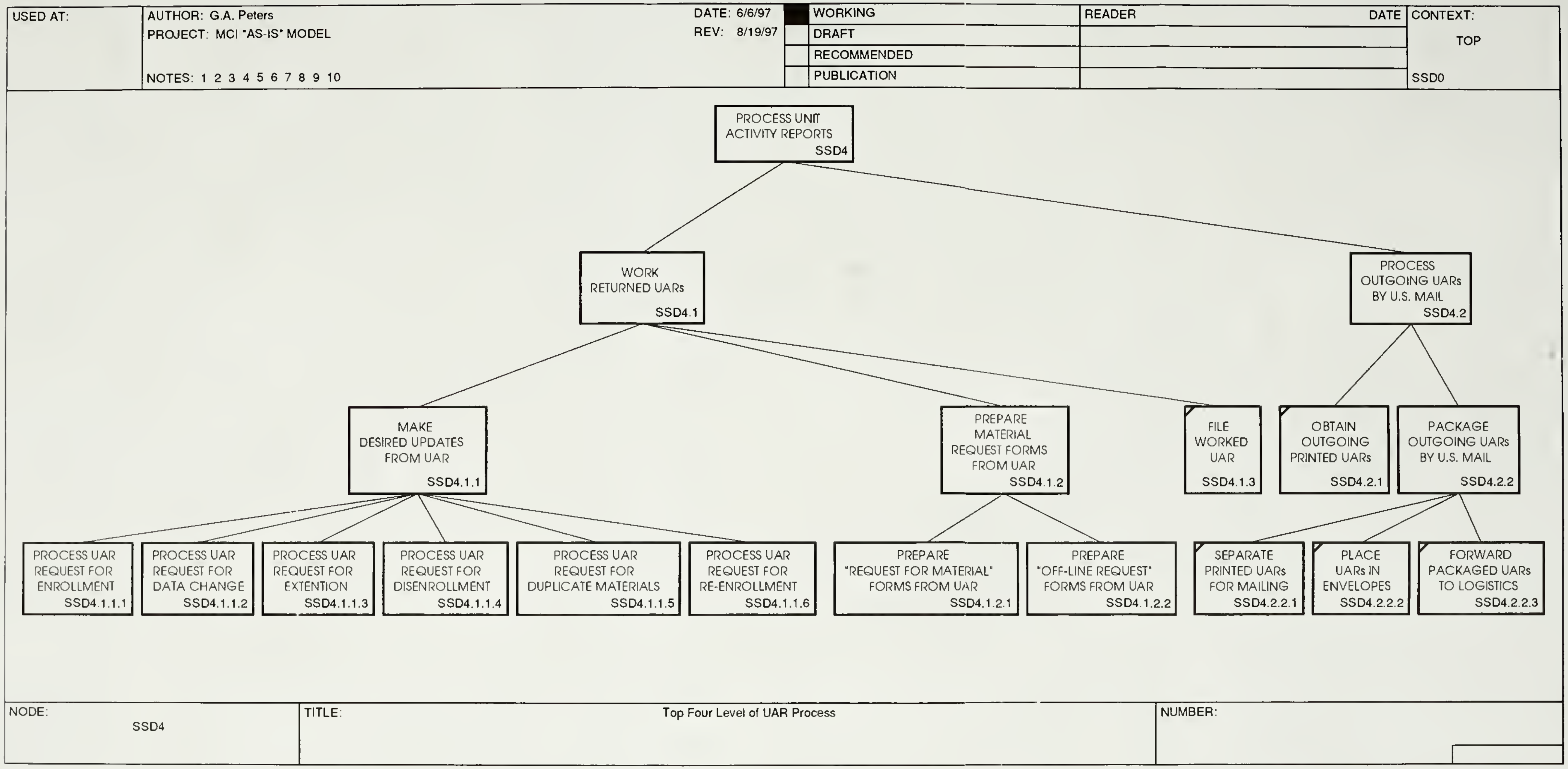


Figure B-5. As-Is Process Model Node Tree Diagram (SSD4).

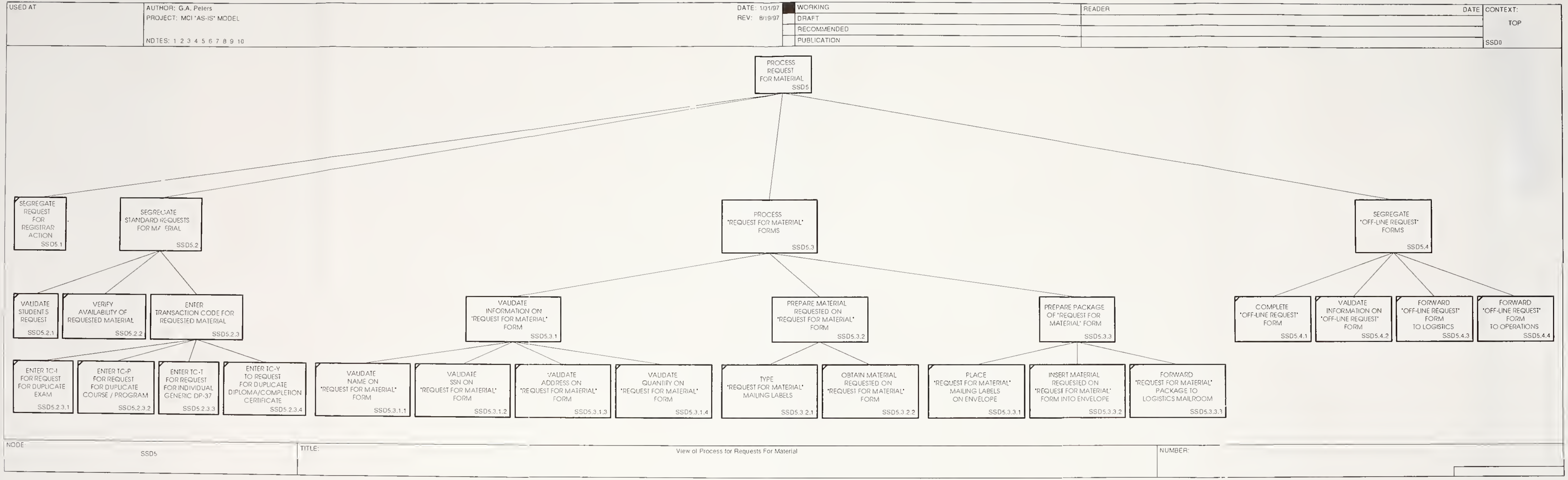


Figure B-6. As-Is Process Model Node Tree Diagram (SSD5).

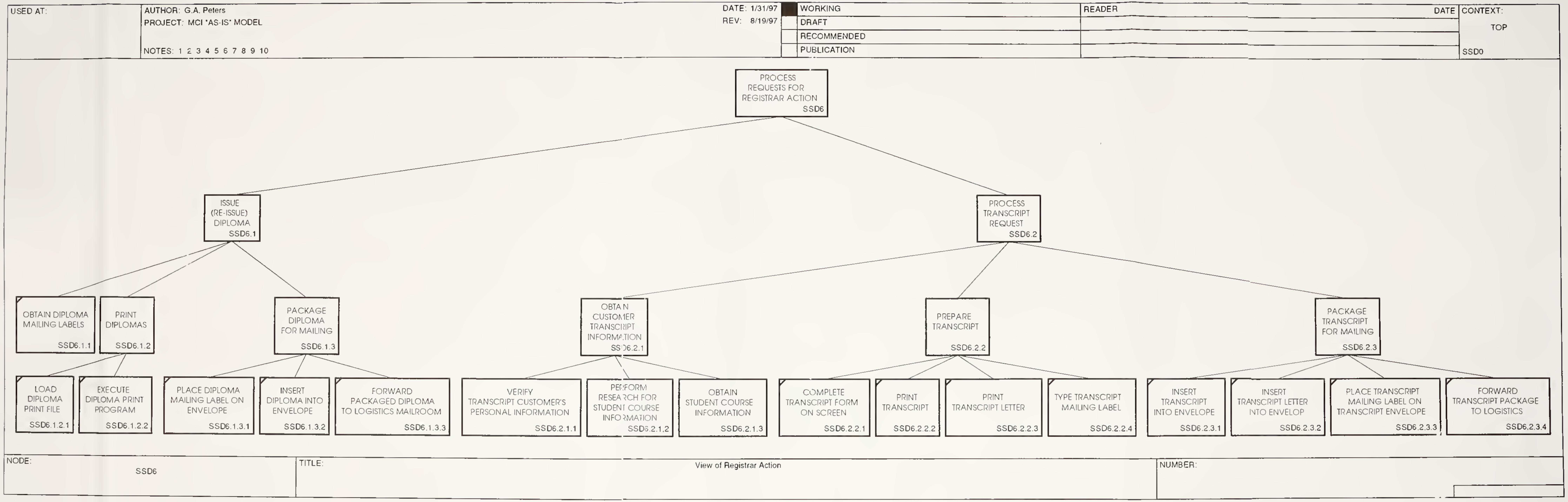


Figure B-7. As-Is Process Model Node Tree Diagram (SSD6).

APPENDIX C. TO-BE PROCESS MODEL

This appendix contains the components of the To-Be Process Model documentation. Table C-1 is a list of tables and figures as they appear in the appendix.

Number	Title
Table C-2	To-Be Process Model Decomposition Diagram
Table C-3	To-Be Activity Dictionary
Table C-4	To-Be Arrow Dictionary
Figure C-1	To-Be Process Model Node Tree Diagram (T0) All Levels - Student Service Support
Figure C-2	To-Be Process Model Context Diagram (T-0)
Figure C-3 - C-37	To-Be Process Model IDEF0 Diagrams
Figure C-38	To-Be Process Model CRUD Matrix
Figure C-39	To-Be Process Model Clustered CR Matrix

Table C-1. List of To-Be Process Model Components.

Activity Number	Activity Name
T0	STUDENT SERVICING
T1	CUSTOMER SERVICING
T1.1	OBTAIN CUSTOMER INPUT
T1.1.1	PROCESS INCOMING PHONE CALLS
T1.1.2	PROCESS WALK-IN CUSTOMERS
T1.1.3	SORT INCOMING U.S. MAIL
T1.1.3.1	SEGREGATE STUDENT COURSE INPUT
T1.1.3.1.1	SEGREGATE FEEDBACK FORMS
T1.1.3.1.2	SEGREGATE GENERIC DP-37s
T1.1.3.1.3	SEGREGATE PRE-SLUGGED DP-37s
T1.1.3.1.4	SEGREGATE ESSAY EXAMS
T1.1.3.2	SEGREGATE MAILED INQUIRIES
T1.1.3.3	SEGREGATE UNIT INPUT
T1.1.4	SORT INCOMING E-MAIL
T1.1.4.1	SEGREGATE E-MAIL STATUS REQUEST
T1.1.4.2	SEGREGATE E-MAIL STATUS CHANGES
T1.1.4.3	SEGREGATE E-MAIL MATERIAL REQUESTS
T1.1.4.4	SEGREGATE E-MAIL UAR RESPONSE
T1.1.4.5	SEGREGATE PERSONAL E-MAIL
T1.2	PROVIDE UNIT ACTIVITY SERVICES
T1.2.1	PREPARE UARs
T1.2.2	WORK RETURNED UARs
T2	STUDENT ACTIVITY SERVICING
T2.1	PROCESS ENROLLMENT
T2.1.1	DETERMINE TYPE OF ENROLLMENT
T2.1.2	VALIDATE ENROLLMENT REQUIREMENTS
T2.1.2.1	EVALUATE SERVICE COMPONENT
T2.1.2.2	EVALUATE GRADE
T2.1.2.3	EVALUATE COURSE/PROGRAM HISTORY
T2.2	PROCESS STATUS REQUEST
T2.2.1	PROCESS COURSE STATUS REQUEST
T2.2.1.1	DETERMINE ENROLLMENT STATUS
T2.2.1.2	DETERMINE COURSE STATUS
T2.2.1.3	DETERMINE EXAMINATION STATUS
T2.2.1.4	DETERMINE CERTIFICATION STATUS
T2.2.2	PROCESS TRANSCRIPT STATUS REQUEST
T2.2.2.1	DETERMINE PROGRESS OF RESEARCH
T2.2.2.2	DETERMINE TRANSCRIPT SHIP DATE
T2.2.3	PROCESS MATERIAL STATUS REQUEST
T2.2.3.1	DETERMINE COURSE MATERIAL STATUS

Table C-2. To-Be Process Model Decomposition Diagram.

Activity Number	Activity Name
T2.2.3.2	DETERMINE COMPONENT SHIP STATUS
T2.2.3.3	DETERMINE JOB AID SHIP STATUS
T2.2.3.4	DETERMINE CERTIFICATION SHIP STATUS
T2.2.3.5	DETERMINE UNIT MATERIAL SHIP STATUS
T2.3	CHANGE STUDENT INFORMATION
T2.3.1	PROCESS NAME CHANGE
T2.3.2	PROCESS SSN CHANGE
T2.3.3	PROCESS GRADE CHANGE
T2.3.4	PROCESS SERVICE COMPONENT CHANGE
T2.3.5	PROCESS SERVICE STATUS CHANGE
T2.3.6	PROCESS ADDRESS CHANGE
T2.4	PROCESS ADMINISTRATIVE ACTION
T2.4.1	DETERMINE TYPE OF ADMIN ACTION
T2.4.2	VALIDATE ADMIN ACTION
T2.4.2.1	EVALUATE ENROLLMENT STATUS
T2.4.2.2	EVALUATE EXAM ISSUE STATUS
T2.4.2.3	EVALUATE COURSE HISTORY
T2.4.2.4	EVALUATE OTHER COURSE CREDIT
T2.5	PROCESS REQUEST FOR MATERIAL
T2.5.1	DETERMINE MATERIAL AVAILABILITY
T2.5.2	VALIDATE MATERIAL REQUIREMENTS
T2.5.2.1	EVALUATE STUDENT STATUS
T2.5.2.2	EVALUATE MILITARY/ DOD STATUS
T2.5.2.3	EVALUATE UNIT REP STATUS
T2.5.2.4	EVALUATE FOREIGN MILITARY STATUS
T3	GRADING
T3.1	PROCESS DP-37s
T3.1.1	PROCESS PRE-SLUGGED DP-37s
T3.1.1.1	SCAN PRE-SLUGGED DP-37s
T3.1.1.2	FILE SCANNED PRE-SLUGGED DP-37s
T3.1.1.3	FORWARD UNSCANNED PS DP-37s
T3.1.2	PROCESS GENERIC DP-37s
T3.1.2.1	SCAN GENERIC DP-37s
T3.1.2.2	FILE SCANNED GENERIC DP-37s
T3.1.2.3	FORWARD UNSCANNED GEN DP-37s
T3.2	PROCESS HAND GRADED EXAMS
T3.2.1	HAND GRADE NON-SCANNABLE DP-37s
T3.2.2	ENTER HAND GRADED EXAMS SCORES
T3.2.3	ENTER SCORES FOR PME EXAMS
T3.3	RUN GRADING PROGRAM

Table C-2. To-Be Process Model Decomposition Diagram.

Activity Number	Activity Name
T3.3.1	EDIT DP-37 DATA
T3.3.1.1	EDIT PRE-SLUGGED DP-37 DATA
T3.3.1.2	EDIT GENERIC DP-37 DATA
T3.3.2	ANALYZE DP-37 DATA
T3.3.2.1	EVALUATE EXAM
T3.3.2.2	COMPARE STUDENT RECORD HISTORY
T3.4	PROCESS OPSCAN ERRORS
T3.4.1	PRODUCE OPSCAN ERROR REPORT
T3.4.2	CORRECT ERRONEOUS DP-37
T3.4.3	FIND ERRONEOUS DP-37
T4	REGISTRAR SERVICING
T4.1	ISSUE DIPLOMA
T4.1.1	PRINT DIPLOMAS
T4.1.2	PACKAGE DIPLOMA FOR MAILING
T4.2	ISSUE TRANSCRIPT
T4.2.1	VERIFY REQUESTOR INFORMATION
T4.2.1.1	INPUT REQUESTOR'S SSN
T4.2.1.2	INPUT REQUESTOR'S NAME
T4.2.1.3	INPUT REQUESTOR'S ADDRESS
T4.2.1.4	INPUT REQUESTOR'S DATES OF SERVICE
T4.2.2	RESEARCH TRANSCRIPT INFORMATION
T4.2.2.1	SEARCH ON-LINE DATA
T4.2.2.1.1	SEARCH ACTIVE FILES
T4.2.2.1.2	SEARCH ARCHIVE FILES
T4.2.2.2	SEARCH MICROFICHE
T4.2.2.2.1	INPUT COURSE NUMBER
T4.2.2.2.2	INPUT COURSE TITLE
T4.2.2.2.3	INPUT COMPLETION DATE
T4.2.2.2.4	INPUT ENROLLMENT DATE
T4.2.2.2.5	INPUT GRADE PERCENT
T4.2.2.2.6	INPUT STUDY HOURS
T4.2.2.3	REFER CUSTOMER TO HQMC
T4.2.3	PRINT TRANSCRIPT
T4.2.4	PACKAGE TRANSCRIPT FOR MAILING

Table C-2. To-Be Process Model Decomposition Diagram.

Activity Name	Activity Definition
ANALYZE DP-37 DATA	This activity represents the process of retrieving the DP-37 data and grading it to determine if the examination passed.
CHANGE STUDENT INFORMATION	This activity represents the processes that enable the MCI clerk to change student information. Information that can be changed includes name, rank, SSN, address, service status and service component.
COMPARE STUDENT RECORD HISTORY	If the student passes the exam, the student course record is updated on the database to reflect a completed course. If the completed course is a PME course, the students records are read to see if the student has completed all of the sub-courses for that PME. If all of the sub-courses are complete, the PME record is updated to reflect a completed Program. The record is moved to the history file and a completion certificate and diploma will be generated.
CORRECT ERRONEOUS DP-37	This activity represents the process of correcting the file containing all the errors generated when editing and grading the DP-37s. This should be done on-screen with direct access to student and course information.
CUSTOMER SERVICING	This business function represents the processes required to provide direct support to customers by receiving the input, distributing it for processing, and responding to the customer, when applicable.
DETERMINE CERTIFICATION SHIP STATUS	This activity identifies the shipping status of specified material in response to a request for completion certificate shipping status.
DETERMINE CERTIFICATION STATUS	Given the requestor is enrolled in a course or program, this activity determines if a completion certificate has been generated and issued to the student. The status of the student's completion certification is returned, i.e. issue date and mailed date when capable.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
DETERMINE COMPONENT SHIP STATUS	This activity identifies the shipping status of specified material in response to a request for component materials shipping status.
DETERMINE COURSE MATERIAL STATUS	This activity identifies the shipping status of specified material in response to a request for course or program materials status.
DETERMINE COURSE STATUS	Given the requestor is enrolled in a course or program, this activity determines the status of the student's progress in that course or program, i.e. the number of lessons completed (if required to be submitted).
DETERMINE ENROLLMENT STATUS	This activity determines if the requestor is enrolled in the course identified and determines the status of that enrollment.
DETERMINE EXAMINATION STATUS	Given the requestor is enrolled in a course or program, this activity determines if the exam has been issued, graded, or being processed from the Error Listing. The status of the student's progress or status on the exam is produced.
DETERMINE JOB AID SHIP STATUS	This activity identifies the shipping status of specified material in response to a request for job aid materials shipping status.
DETERMINE MATERIAL AVAILABILITY	This activity identifies the on hand availability of material for delivery given the type of material requested.
DETERMINE PROGRESS OF RESEARCH	This activity provides the status of progress researching information for a requestor's transcript.
DETERMINE TRANSCRIPT SHIP DATE	This activity provides the shipping status of a produced transcript in response to a transcript request.
DETERMINE TYPE OF ADMIN ACTION	This activity distinguishes what type of administrative action is requested, i.e. disenrollment or administrative credit for PME.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
DETERMINE TYPE OF ENROLLMENT	This activity represents the process of determining the type of enrollment which applies to the requestor for the specific enrollment. An enrollment can be either regular or administrative. An administrative enrollment will not issue materials but registers the requestor into the database as a student.
DETERMINE UNIT MATERIAL SHIP STATUS	This activity identifies the shipping status of specified material in response to a request for unit materials shipping status.
EDIT DP-37 DATA	This activity represents the processes for loading and editing the DP-37 data.
EDIT GENERIC DP-37 DATA	This activity represents the process of editing the file with data from the generic DP-37s. It will convert any numeric data from answers to alpha-numeric data and ensure the required data was scanned properly. It will also draw student and course information from the MCIAIS database. This is where proctoring rules for courses 3520 and 3521 are enforced. All good records build a file to be graded. All failed records build a file for the Error Listing.
EDIT PRE-SLUGGED DP-37 DATA	This activity represents the process of editing the file with data from the pre-slugged DP-37s. It will convert any numeric data from answers to alpha-numeric data and ensure the required data was scanned properly. All good records build a file to be graded. All failed records build a file for the Error Listing.
ENTER HAND GRADED EXAMS SCORES	This activity represents the process of entering the scores from hand graded exams into a file for evaluation.
ENTER SCORES FOR PME EXAMS	This activity represents the process of entering the scores from PME exams into a file for evaluation.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
EVALUATE COURSE HISTORY	This activity evaluates the student's course history to determine if previous MCI products completed are sufficient to provide the requested PME administrative credit. For example, if the student had been enrolled and completed several courses in a previous version of the Command and Staff Program, the student may be eligible for credit in part of the current Command and Staff Program.
EVALUATE COURSE/PROGRAM HISTORY	Process used to determine if the customer meets Course or Program pre-requisites based on prior completion of other MCI course, MCI Programs, or Resident Programs attended.
EVALUATE ENROLLMENT STATUS	This activity evaluates the enrollment status of the student to determine if student can be disenrolled or to provide credit to a course the student is enrolled in.
EVALUATE EXAM	This activity determines the student's exam score and whether that score was sufficient to pass the course.
EVALUATE EXAM ISSUE STATUS	This activity evaluates if the student's record contains an examination which has been received and graded. Administrative credit would not be necessary if the student had completed the course. A course completion would be issued instead of disenrollment if the student passed the exam.
EVALUATE FOREIGN MILITARY STATUS	This activity represents the processes required to validate the requestor's eligibility to be issued requested materials based on the status as a member of a foreign military service.
EVALUATE GRADE	Process used to determine if the requestor meets Course or Program pre-requisites based on grade.
EVALUATE MILITARY/ DOD STATUS	This activity represents the processes required to validate the requestor's eligibility to be issued requested materials based on the status as a military or DoD employee.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
EVALUATE OTHER COURSE CREDIT	This activity evaluates course work completed from other similar non-MCI courses or programs like might provide similar areas of study credit, i.e. War College, Armed Forces Staff College, etc.
EVALUATE SERVICE COMPONENT	Process used to determine if the requestor meets Course or Program pre-requisites based on service component.
EVALUATE STUDENT STATUS	This activity represents the processes required to validate the requestor's eligibility to be issued requested materials based on the status as a student.
EVALUATE UNIT REP STATUS	This activity represents the processes required to validate the requestor's eligibility to be issued requested materials based on the status as a unit training representative.
FILE SCANNED GENERIC DP-37s	This activity represents the manual process of filing the scanned DP-37s into a file after successful scanning until the OpScan Error Listing is processed.
FILE SCANNED PRE-SLUGGED DP-37s	This activity represents the manual process of filing the scanned DP-37s into a file after successful scanning until the OpScan Error Listing is processed.
FIND ERRONEOUS DP-37	This activity represents the process of correcting the file containing all the remaining errors, after on-line processing, generated when editing and grading the DP-37s. This requires viewing the original DP-37 submitted.
FORWARD UNSCANNED GEN DP-37s	This activity represents the manual process of forwarding the unscannable DP-37s to the grading section for hand-grading.
FORWARD UNSCANNED PS DP-37s	This activity represents the manual process of forwarding the unscannable DP-37s to the grading section for hand-grading.
GRADING	This business function represents the processes required to grade and record student examinations in the database.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
HAND GRADE NON-SCANNABLE DP-37s	Process of hand grading DP-37s either rejected by the Scantron or received as unscannable (photo copy or mutilated). Involves locating course number and exam version number in binder and extracting key for hand grading exam, then manually checking for passing score and entering pass/fail information in MCIAIS.
INPUT COMPLETION DATE	Enter the requestor's Course completion date from research.
INPUT COURSE NUMBER	Enter the requestor's Course number from research.
INPUT COURSE TITLE	Enter the requestor's Course title from research.
INPUT ENROLLMENT DATE	Enter the requestor's Course enrollment date from research.
INPUT GRADE PERCENT	Enter the requestor's grade received for completing Course from research.
INPUT REQUESTOR'S ADDRESS	Enter the requestor's address.
INPUT REQUESTOR'S DATES OF SERVICE	Enter the requestor's dates of service.
INPUT REQUESTOR'S NAME	Enter the requestor's name.
INPUT REQUESTOR'S SSN	Enter the requestor's SSN.
INPUT STUDY HOURS	Enter the requestor's number of study hours for completing Course from research.
ISSUE DIPLOMA	This activity represents the processes required to produce and issue diplomas to student's completing the required Courses for MCI Programs. This activity also applies to requests for duplicate diplomas.
ISSUE TRANSCRIPT	This activity represents the process of preparing a transcript and the form letter reply in response to a transcript request.
OBTAIN CUSTOMER INPUT	This activity represents the processes of receiving input from customers and the subsequent distribution of the input for processing. Input can be received by phone, walk-in, U.S. Mail, or electronic mail (also considered as naval message).
PACKAGE DIPLOMA FOR MAILING	This activity represents the process of packaging the diploma into an envelope for mailing.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
PACKAGE TRANSCRIPT FOR MAILING	This activity represents the processes required to package and deliver a student's transcript in response to a transcript request.
PREPARE UARs	This activity represents the generation of a Unit Activity Report used to reconcile student activity with a Marine Corp Unit and the unit commander with unit MCI participation summary information.
PRINT DIPLOMAS	This activity represents the process of printing diplomas to be issued or re-issued.
PRINT TRANSCRIPT	This activity represents the process of preparing a transcript and the form letter reply in response to a transcript request.
PROCESS GENERIC DP-37s	This activity represents the processes required to build input files with data from the student exams that have not been pre-slugged with student and course information for evaluation.
PROCESS ADDRESS CHANGE	This activity represents the process of changing a student's address.
PROCESS ADMINISTRATIVE ACTION	This activity represents the processes of completing administrative actions such as, disenrollment and administrative credit for Professional Military Education Courses.
PROCESS COURSE STATUS REQUEST	This activity represents the processes required to provide a student the status on the courses and/or programs in which currently enrolled.
PROCESS DP-37s	This activity represents the processes required to build files with data from the student exams (DP-37) for evaluation.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
PROCESS ENROLLMENT	This activity refers to the enrollment of a requestor into an MCI Course or MCI Program. The processes require identifying the requestor, the requested course/program, and determining eligibility for enrollment based on course/program pre-requisites. Once enrolled, a requestor is considered a Student. There are two types of enrollments; Regular and Administrative. The enrollment action generates the necessary flags to initiate delivery of course or program materials.
PROCESS GRADE CHANGE	This activity represents the process of changing a student's rank.
PROCESS HAND GRADED EXAMS	This activity represents the process of manually hand grading examinations (DP-37s) which could not be scanned, entering the scores for those exams, and entering the scores for PME examinations/essays.
PROCESS INCOMING PHONE CALLS	This activity represents the processing of incoming phone calls by an MCI Immediate Assist Clerk. This includes such activities as processing an enrollment, providing status and general information about MCI Products (Job Aids, Courses and Programs), changing student information, administrative action (disenrollment and PME credit), and issuing material in response to a request.
PROCESS MATERIAL STATUS REQUEST	This activity identifies the shipping status of specified material in response to a shipping status request for component, job aid, course, program, or unit material.
PROCESS NAME CHANGE	This activity represents the process of changing a student's name.
PROCESS OPSCAN ERRORS	This activity represents the processes performed to generate the Opscan Error Report file and correcting the errors on the file, both on-screen and using the original DP-37 if necessary.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
PROCESS PRE-SLUGGED DP-37s	This activity represents the processes required to build files with data from the student exams that have been pre-slugged with student and course information for evaluation.
PROCESS REQUEST FOR MATERIAL	This activity represents the processes for filling customer requests for material such as, courses, programs, components of courses or programs, job aids and Training NCO material.
PROCESS SERVICE COMPONENT CHANGE	This activity represents the process of changing a student's service component.
PROCESS SERVICE STATUS CHANGE	This activity represents the process of changing a student's service status.
PROCESS SSN CHANGE	This activity represents the process of changing a student's SSN.
PROCESS STATUS REQUEST	This activity represents the processes performed to provide student's with status for their requests. Information is provided on a student's status within a Course or Program, status on transcript preparation, and status on material requests.
PROCESS TRANSCRIPT STATUS REQUEST	This activity provides the status of progress researching information for a requestor's transcript and the shipping status of a produced transcript in response to a transcript request.
PROCESS WALK-IN CUSTOMERS	This activity represents the processing of a walk-in customer by an MCI Immediate Assist Clerk. This includes such activities as processing an enrollment, providing status and general information about MCI Products (Job Aids, Courses and Programs), changing student information, administrative action (disenrollment and PME credit), and issuing material in response to a request.
PRODUCE OPSCAN ERROR REPORT	This activity represents the activities required to generate the file containing all the errors generated when editing and grading the DP-37s.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
PROVIDE UNIT ACTIVITY SERVICES	This activity represents the processes of receiving input from Unit Activity customers (Training NCOs) and the subsequent processes to facilitate reconciliation with the Unit as a customer. Input can be received by phone, walk-in, U.S. Mail, or electronic mail (also considered as naval message). Reconciliation is initiated with a periodic Unit Activity Report.
REFER CUSTOMER TO HQMC	This activity represents the referral of transcript customer to HQMC for transcript information prior to Jan 1979.
REGISTRAR SERVICING	This business function represents the processes required to issue diplomas and research, produce and deliver transcripts.
RESEARCH TRANSCRIPT INFORMATION	This activity represents the processes performed to research and input information required to produce a transcript.
RUN GRADING PROGRAM	This activity represents the process of grading the input files containing the scanned data from the student examinations.
SCAN GENERIC DP-37s	This activity represents the processes of loading the OpScanner with Generic DP-37s to get the student's exam data and format that data into a file for the grading program.
SCAN PRE-SLUGGED DP-37s	This activity represents the processes of loading the OpScanner with Pre-Slugged DP-37s to get the student's exam data and format that data into a file for the grading program.
SEARCH ACTIVE FILES	This activity represents the process of searching the active records of MCIAIS for transcript customer's course completion history.
SEARCH ARCHIVE FILES	This activity represents the process of searching the archived records of MCIAIS for transcript customer's course completion history.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
SEARCH MICROFICHE	This activity searches archive records on microfiche for transcript customer's course completion history.
SEARCH ON-LINE DATA	This activity searches MCIAIS active and archive records for transcript customer's course completion history.
SEGREGATE E-MAIL MATERIAL REQUESTS	This activity represents the redistribution of electronic mail requesting material to the Processing Section mail-box for material requests.
SEGREGATE E-MAIL STATUS CHANGES	This activity represents the redistribution of electronic mail requesting a change to a requestor's status to the Processing Section mail-box for status change requests. Changing status includes enrolling, changing personal information, disenrolling, or completion of a course or part of a program with administrative credit.
SEGREGATE E-MAIL STATUS REQUEST	This activity represents the redistribution of electronic mail requesting status to the Processing Section mail-box for status requests.
SEGREGATE E-MAIL UAR RESPONSE	This activity represents the redistribution of electronic mail Unit Activity Reports to the Unit Activity Report Section mail-box.
SEGREGATE ESSAY EXAMS	This activity represents the process of separating PME essay exams and forwards them to PMED for grading.
SEGREGATE FEEDBACK FORMS	The process removes PMED and OSD feed back forms from the student course input received and forwards them to PMED or OSD for processing.
SEGREGATE GENERIC DP-37s	This manual process segregates exams and lessons which have not been pre-formatted with user information for the specific course or program (generic DP-37s) and forwards them to be graded.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
SEGREGATE MAILED INQUIRIES	This process receives Mailed Customer Inquiries and forwards the Input to subsequent activities for processing. The Mailed Customer Inquiries consist of requests for enrollment, requests for missing course materials, missing diplomas/completion certificates, requests for transcripts, requests for disenrollment, requests for status of student progress, requests for course catalogs, requests for information about courses in general, change address information on individual, from either a student or a unit representative. The requests for Transcripts are forwarded to the Registrar Section; the requests for Completion Certificates, Diplomas, replacement materials, enrollment, disenrollment, and changes to information are forwarded to the Processing Section.
SEGREGATE PERSONAL E-MAIL	This activity represents the redistribution of electronic mail to a specific individual's mail-box for processing.
SEGREGATE PRE-SLUGGED DP-37s	This manual process segregates exams and lessons which have been pre-formatted with user information peculiar to the specific course or program (Pre-Slugged DP-37s) and forwards them to be graded.
SEGREGATE STUDENT COURSE INPUT	This activity processes Student Course Input and forwarded to subsequent activities. The Student Course Input should include a completed lesson or course examination (DP-37), or a copy of a completed DP-37, and a feedback sheet. The feedback sheet is forwarded to either PMED or OSD according to the course/lesson completed. The DP-37s are segregated by type (Generic or Pre-Slugged) and forwarded to the grading section.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
SEGREGATE UNIT INPUT	This activity represents the process of receiving Unit Input and forwarding the Input to the UAR section for processing. The Unit Input should include a Unit Activity Report (UAR) or request for Unit support material. UAR input includes requests for, and submission of, information on behalf of a Student.
SORT INCOMING E-MAIL	This activity represents the processes performed with incoming electronic mail. This includes distribution for processing within SSD and forwarding correspondence to other personnel, divisions, and departments within MCI.
SORT INCOMING U.S. MAIL	This activity represents the processes performed with incoming mail. This includes segregation and distribution for processing within SSD and forwarding correspondence to other departments within MCI.
STUDENT ACTIVITY SERVICING	This business function represents the processes required to maintain a student's course activity record in the database. It includes the enrollment, maintenance activities, providing status, and issuing material.
STUDENT SERVICING	This functional area represents the business processes required to run a successful Student Services Department. It includes the entire cycle of servicing a student from enrollment in a Course or Program until completion certification. It also includes the processes to service customers obtaining other MCI Products such as Job Aids, Course/Program components and materials, and Unit MCI Materials without enrolling in a Course or Program.
VALIDATE ADMIN ACTION	This activity represents the process of ensuring the student meets the requirements necessary to effect the requested administrative action for the specified Course or Program.

Table C-3. Activity Dictionary.

Activity Name	Activity Definition
VALIDATE ENROLLMENT REQUIREMENTS	This activity represents the processes validating the requestor's eligibility with the pre-requisites of the Course or Program the requestor intends to enroll.
VALIDATE MATERIAL REQUIREMENTS	This activity represents the processes required to validate the requestor's eligibility to be issued requested materials.
VERIFY REQUESTOR INFORMATION	This activity verifies there is sufficient information available on student's request to begin research of transcript information. Information verified includes: Name, SSN, Address, and Dates of Service,
WORK RETURNED UARs	This activity represents the processes of reconciling student activity records based on input from unit Training NCOs and updating MCI records with the consolidated input.

Table C-3. Activity Dictionary.

Arrow Name	Arrow Definition
Activity Transactions/T2	This action calls the process for Customer Activity Transactions.
Admin Action/T2.4	Calls activity to process requests for administrative action.
Admin Credit Transaction	Transaction occurrence triggers an update to the Student's record giving administrative credit for Course on system date.
Admin Req Info	Transient information collected from student and input by clerk.
Admin Requests	This is the requester's information that requests the administrative credit and is entered in at the PC.
Approved	Requester meets requirements for intended administrative action.
Archived Student and Course Data	Student Master File containing history of all students enrolled in MCI courses during the period Jan 1979 - Jan 1989. History includes: Course Number; SSN; Last Name; Initials; Rank; MOS; RUC; Enrollment date; Re-enrollment date; Completion date; Extension (Y/N); Last Transaction code/date; Exams - Date/form/score for primary and alternate if applicable; Parent Group Type/Number.
Automated Equipment	All mechanical equipment maintained in SSD to provide support to SSD Operations: PC, Microfiche reader, Scantron, printer, PBX Telephone, etc.
AVRS	This represents the Conversant Automated Voice Response System (AVRS) which interacts with the database to provide a student's course status.
Banyan E-Mail	Mechanism that enables personnel to receive and send electronic correspondence.
Change Info/T2.3	Calls activity to process changes to a student's personal information.
Corrected DP-37s	DP-37s that had information that failed to scan properly or that contained data that did not pass the editing and were corrected.
Course Completion Data	This is the information necessary to register course completion in the database and initiate generation of course completion certificates.
Course Program Requirements	Course or Program requirements that determine the requester's eligibility to enroll/disenroll/admin credit into the course or program.
Course/Program Status Request	Inquiry from a requester for status on a course or program.

Table C-4. Arrow Dictionary.

Arrow Name	Arrow Definition
Customer Input	Customer contact with MCI in any media form: Phone, e-mail (includes DMS and DISN), written correspondence by U.S. Mail (or similar), or by walk-in. Customer input can be by the customer or by the unit representative calling on behalf of the student or by returning Unit Activity Reports.
Customer Requests	General bundle category of inquiries or other requests from a customer: status, information, transcript request, request for material, etc.
Diploma and Letter	Physical representation of a Diploma and a form letter of congratulation issued after completing all the courses in a program.
Diploma Package	Package consisting of a diploma and a form letter in an envelope addressed for distribution.
Diploma Print Date	Updates MCIAIS with date diploma is (re-)printed.
Disapproved	Requestor fails to meet requirements for intended administrative action.
Disenrollment Transaction	Transaction occurrence triggers an update disenrollment date of Students record.
Documentation	Bundled arrow representing the myriad of documentation that is distributed to the customer.
DP-37s	A bubble sheet exam form that contains student and course information as well as the student's answers to the examination.
Eligible	Requestor passes restriction for receiving requested materials.
Enroll/T2.1	Calls activity to process enrollment.
Enrollment Info	Transient data representing the information required to enroll a student.
Enrollment Request	This is information provided by the requester that will be keyed in to initiate an enrollment transaction.
Enrollment Transaction	This represents a validated enrollment creating the flags necessary to generate shipping documentation when called.
Erroneous DP-37s	DP-37 information on the error listing.
Error Codes	Represents the information in the error code table.
Error Listing File	File, created from DP-37 data that do not pass editing, is the basis of OpScan error report.
Exam Answer Key	This arrow represents the information contained in an answer key.
Exam Evaluation	Evaluation of hand-graded exam provides a score for the exam to be entered into the system.

Table C-4. Arrow Dictionary.

Arrow Name	Arrow Definition
Failed Exam Data	The data that represents a student's failing score for a hand-graded exam, a PME exam, or an exam score that was obtained from the grading program with applicable information.
Gen DP-37 File	Data obtained from Student's exam (Gen DP-37) formatted into a file for editing and input into the Grading Program.
Gen TOBESCAN File	File, created from formatted data obtained from Student's exam (Gen DP-37) that passed editing, is the basis of the student's exam input file for the Grading Program.
Generic DP-37s	This is the exam form (DP-37) that has not been pre-formatted with any student, course and exam identification information but completed with the student's answers to the exam.
Goodscan File	Bundled Arrow: a File, created from formatted data obtained from Student's exam (Gen DP-37 and Pre-Slugged) that passed editing, is the student's exam input file for the Grading Program.
Grading Data	MCIAIS data used to evaluate the student's exam in the Grading Program.
Hand-Graded DP-37s	DP-37s that were rejected by the OpScanner but hand graded and scores entered into MCIAIS.
Ineligible	Requester does not pass restriction for receiving requested materials.
Info Change Requests	This is any request to change personal information on a student. Could be name, rank, SSN, address, component, etc.
Information Changes	This is any request to change information on a student. Could be an enrollment, disenrollment, or other admin action to change personal information or PME credit.
Invalid Enrollment	Enrollment request did not satisfy the requirement for enrollment.
Invoice Data	Data necessary to build an invoice for mailing course or program components, courses or program materials, Job Aids or Training NCO materials.
Laser Jet Printer	Laser Jet printer used for printing Diplomas and Transcripts.
Manual Exam Scores	Source data that is input form hand grading exams.
Marine Manual Resources	Mechanism: Indicates where labor and manual processes occur.

Table C-4. Arrow Dictionary.

Arrow Name	Arrow Definition
Material Data	Data necessary to distinguish material that is issued as an MCI product. Job Aids, Exams, Course/Program components, and Unit Training NCO Material.
Material Info	Transient data that represents the MCI product material requested: Job Aids, Exams, Course/Program components, and Unit Training NCO Material.
Material Requests	Customer requests for material. Could be components of a course, program or job aid; complete (re-issue) job aid, course or program; or re-issue of completion certificate or diploma.
Material Shipment Data	Data concerning material shipments.
Material Status Request	Customer's request for status on material shipment.
MCI Information	Information about the course, programs and Job aids distributed by MCI. This covers the Course Catalog and MCI Procedures Manual (eventually).
MCI Procedures Manual	MCI's Procedures Manual which provides guidance, to student's and Training NCOs on the mission, functions, processes and protocols of conducting business with MCI.
MCI SOP	Procedures documented by each division to document standard operating procedures.
MCIAIS	The entire MCI database.
Microfiche Reader	Microfiche reader used to research Student and Course Information archived for period Jan 1979 - Jan 1989.
New Address	Updated information, from customer or source, used to make student data current.
New Component	Updated information, from customer or source, used to make student data current.
New Name	Updated information, from customer or source, used to make student data current.
New Rank	Updated information, from customer or source, used to make student data current.
New Service Status	Updated information, from customer or source, used to make student data current.
OPSCAN Error List	Formatted data consisting of data from: failed exams, exams that did not pass editing, control numbers for identification, and error codes or descriptors to indicate reason for failure.
OpScanner	OPSCAN 7 optical mark reader.
OSD/PMED Feedback	Evaluations of courses and programs often returned with exam sheets following a student's completion of an examination.

Table C-4. Arrow Dictionary.

Arrow Name	Arrow Definition
Passing Exam Data	The data that represents a student's passing score for a hand-graded exam, a PME exam, or an exam score that was obtained from the grading program with applicable information.
PBX Phone System	AT&T Merlin telephone/voice-mail system used to answer phone calls to the 1-800-MCI-USMC telephone number.
PC	Personal Computer to input data and read information.
Personal E-Mail	Electronic mail intended to be addressed to an individual employee or division of MCI.
PME Essay Evaluation	Evaluation of hand-graded PME essay exam.
PME Essays	
Postal Delivery	Mechanism: represents the method of delivery of input to SSD.
Pre-Slugged DP-37s	This is the exam form (DP-37) that has been pre-formatted with student, course and exam identification information and completed with the student's answers to the exam.
Process Hand Graded Exams/T3.2	Call: Calls activity to process hand grade exams.
Process Material Request/T2.5	Call: calls activity to process requests for material.
Process Status Request/T2.2	Call: Calls activity to process status requests.
Program Completion Data	This is the information necessary to register program completion in the database and initiate generation of course completion certificates.
PS DP-37 File	Data obtained from Student's (Pre-Slugged DP-37) exam formatted into a file for input into the Grading Program.
PS TOBESCAN File	File, created from formatted data obtained from Student's exam (Pre-Slugged DP-37) that passed editing, is the basis of the student's exam input file for the Grading Program.
Registrar Data	MCIAIS data required to execute registrar processes: create, research and issue transcripts, create and issue diplomas, and accompanied form letter.
Rejected DP-37s	This represents the Pre-Slugged and Generic DP-37s that were not successfully scanned.
Rejected Gen DP-37s	This represents the Generic DP-37s that were not successfully scanned.
Rejected PS DP-37s	This represents the Pre-Slugged DP-37s that were not successfully scanned.

Table C-4. Arrow Dictionary.

Arrow Name	Arrow Definition
Reply to Customer	A reply to the customer is in response to a request and usually will be replied to in the same media the request was submitted: enrollment not accepted, course status, rejected admin action request, not qualified to receive requested materials. There are instances when the reply may be implied, i.e. issuing a diploma in response to an exam or issuing material following enrollment are categories not represented by this arrow.
Returned UARs	Unit Activity Reports returned by a supported unit that has been reviewed and annotated with Training NCO feedback on student status and information.
Scannable Gen DP-37s	This represents the DP-37s that can be scanned based on physical condition.
Scannable PS DP-37s	This represents the DP-37s that can be scanned based on physical condition.
Scanned DP-37s	This represents the Pre-Slugged and Generic DP-37s that were successfully scanned.
Scanned Gen DP-37s	This represents the Generic DP-37s that were successfully scanned.
Scanned PS DP-37s	This represents the Pre-Slugged DP-37s that were successfully scanned.
SSN Change	Updated information, from customer or source, used to make student data current.
Status Data	MCIAIS data required to provide status.
Status Request	The customer's request for status. Status can be provided on a student's course, program, material shipment, transcript.
Status Request on Comp Transcript	The customer's request for status on a transcript.
Student & Customer Info	Information resident on database about students and customers. This includes name, rank, SSN, and address.
Student & Unit Data	Course and Program information regarding a student's status compiled by Marine Unit (RUC).
Student and Address Data	This arrow provides the activity with student and address data necessary to mail the diploma to the student completing the program.
Student and Course Data	The existing Student and Course Data on the database.
Student Data	Information resident on database about students. This includes name, grade, service component, and SSN.
Student's Course and Program Data	The existing Student, Course and Program Data on a specific instance.
Student's Program Data	Program information for student's in the database.

Table C-4. Arrow Dictionary.

Arrow Name	Arrow Definition
Student, Course & Exam Data	The existing MCIAIS Student, Course and Exam Data.
Transcript and Letter	This is the transcript and the accompanying form letter produce in response to a transcript request.
Transcript Course History	Course completion history of student with accreditation data.
Transcript Package	This is the transcript and the accompanying form letter produced in response to a transcript request and packaged for mailing.
Transcript Print Date	System date provided when transcript is completed to update MCIAIS for future status requests.
Transcript Request	Customer's request for a transcript or SSD clerk's input for same.
Transcript Request Information	This is the Transcript Customer's information required to research and produce a transcript: Name, SSN, Address, Dates of Service.
Transcript Status Request	Customer's request for status in response to a transcript request or S SD clerk's input for same.
UAR	Unit Activity Report sent to Marine units for student record reconciliation.
UAR Request	Customer's request for a Unit Activity Report or SSD clerk's input for same. Request can be for a single UAR or group of UARs.
Uncorrectable DP-37s	DP-37s that could not be corrected due to lack of available information provided on the bubble sheet submitted.
Unscannable Gen DP-37s	This represents the DP-37s that can not be scanned based on physical condition or OpScanner rejection.
Unscannable PS DP-37s	This represents the DP-37s that can not be scanned based on physical condition or OpScanner rejection.
Updated Student Info	Student information updated by phone call, walk-in, e-mail, UAR, or U.S. mail. This can be the result of any of the student activity transactions include an enrollment, disenrollment, student's information that is changed like name, rank, service, component, status, etc., or course completion, but is directed at updating personal information which should be verified prior to executing the transaction.
Valid Enrollment	Transient Enrollment data that passed evaluation against course/program requirements.

Table C-4. Arrow Dictionary.

Arrow Name	Arrow Definition
Work Returned UARs/T1.2.2	Call: Calls activity to process student activity servicing to update student records based on input provided with returned UAR.
Worked UAR	A Unit Activity Report that has been reconciled by the using unit and UAR processing clerk has updated the student records based on the reconciliation. To File.

Table C-4. Arrow Dictionary.

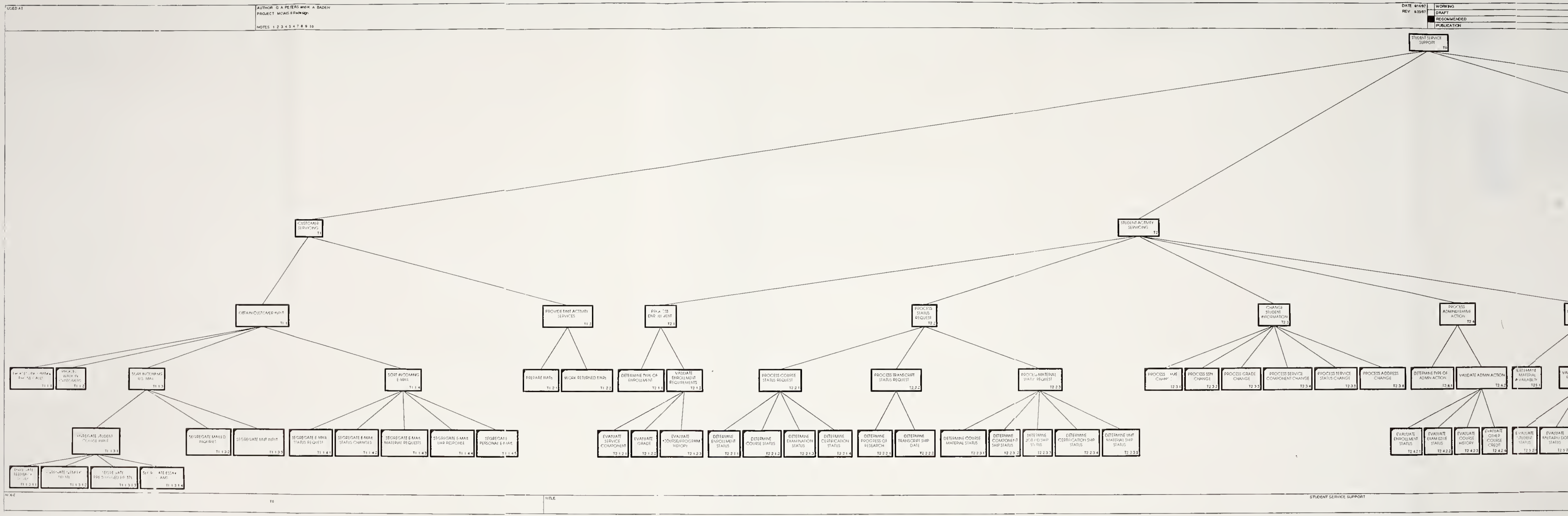
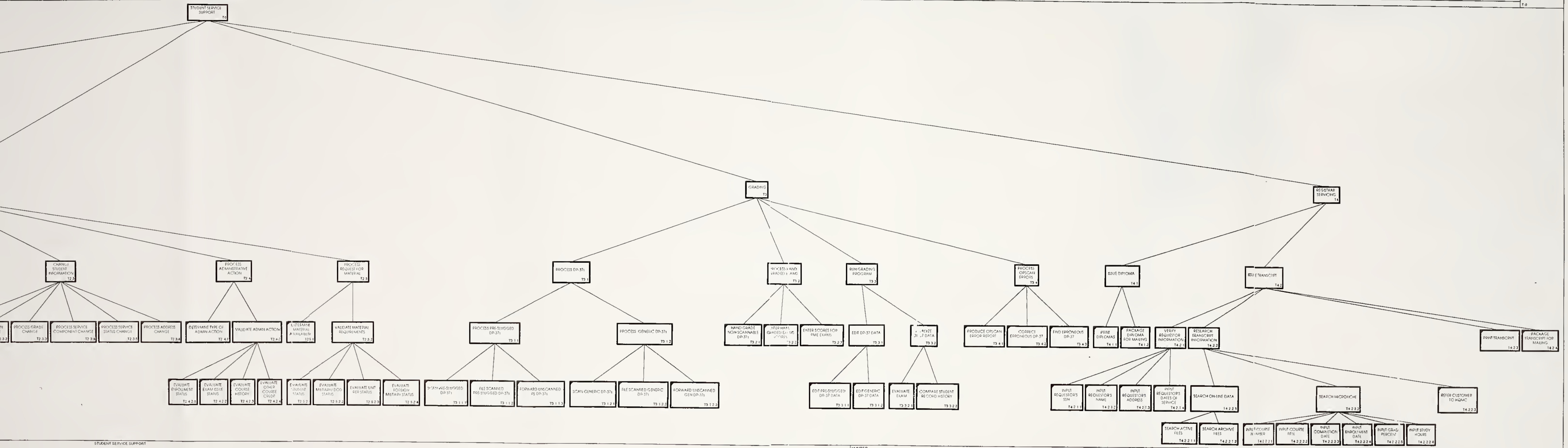


Figure C-1. To Be Process Model Node Tree Diagram (T0).

DATE 4/16/97 | WORKING | READER | DATE | CONTEXT
REV 6/23/97 | DRAFT
RECOMMENDED
PUBLICATION

TOP

T-0



STUDENT SERVICE SUPPORT | NUMBER

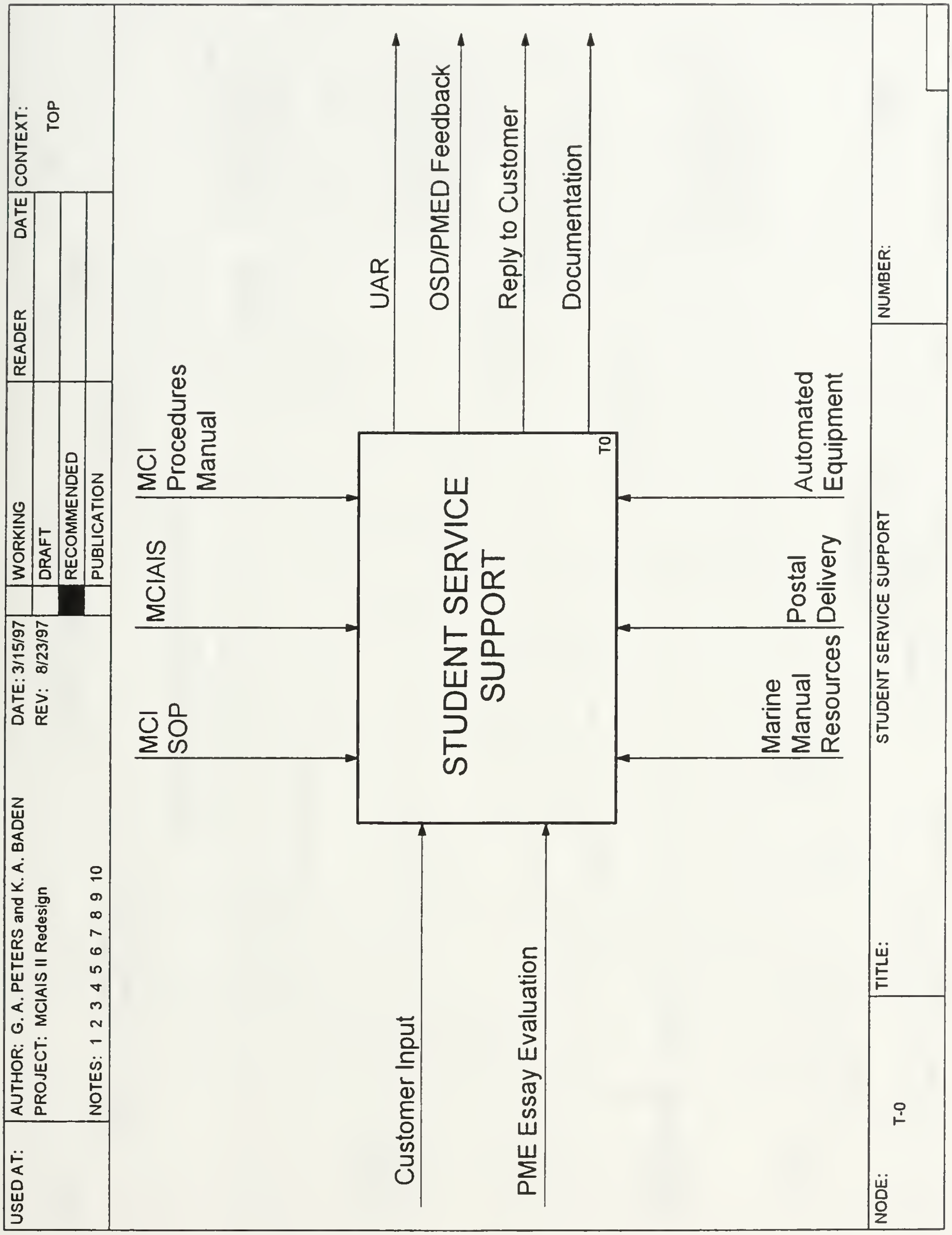


Figure C-2. To-Be Process Model Context Diagram (T-0).

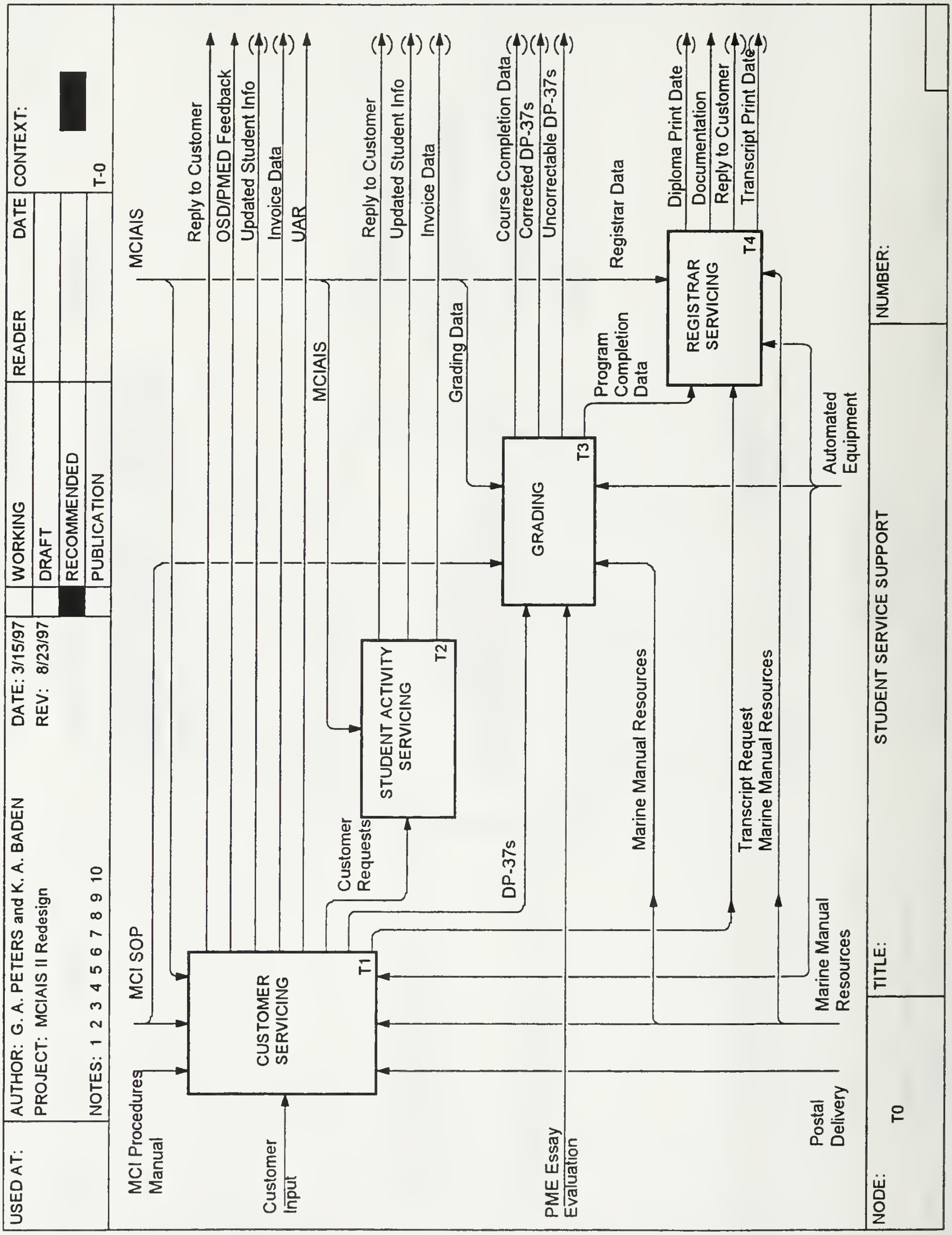


Figure C-3. To-Be Process Model IDEF0 Diagram (T0).

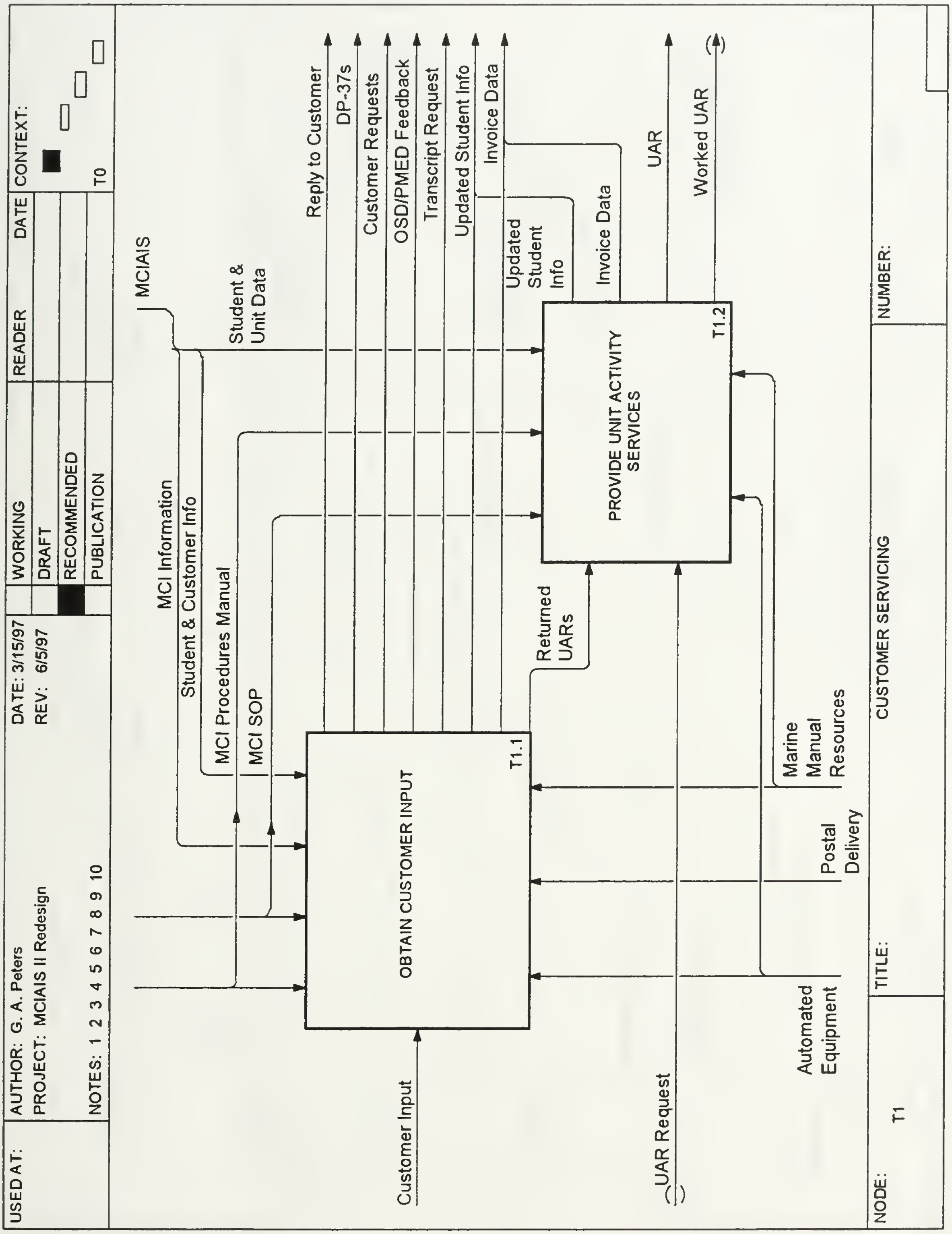


Figure C-4. To-Be Process Model IDEF0 Diagram (T1).

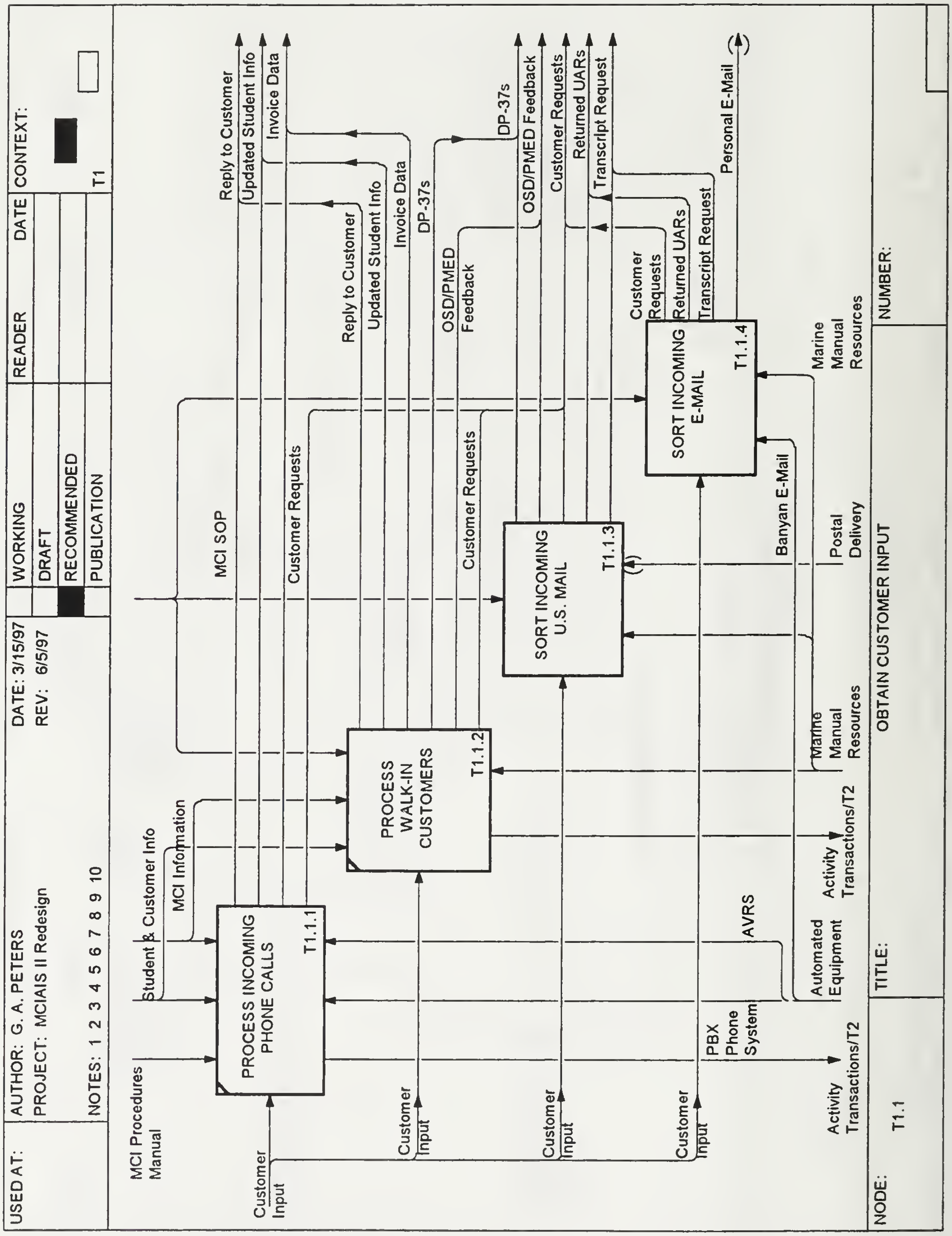


Figure C-5. To-Be Process Model IDEF0 Diagram (T1.1).

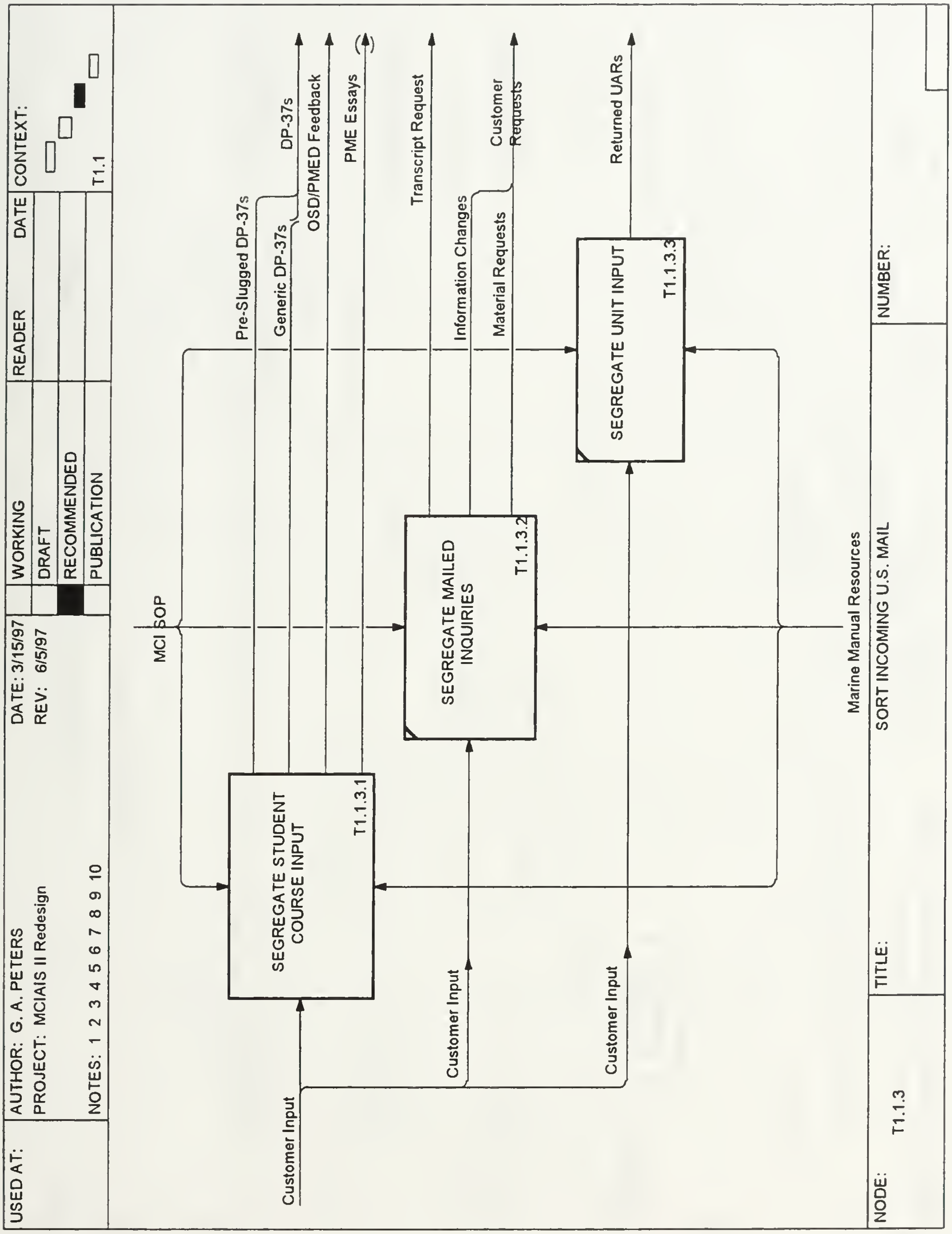


Figure C-6. To-Be Process Model IDEF0 Diagram (T1.1.3).

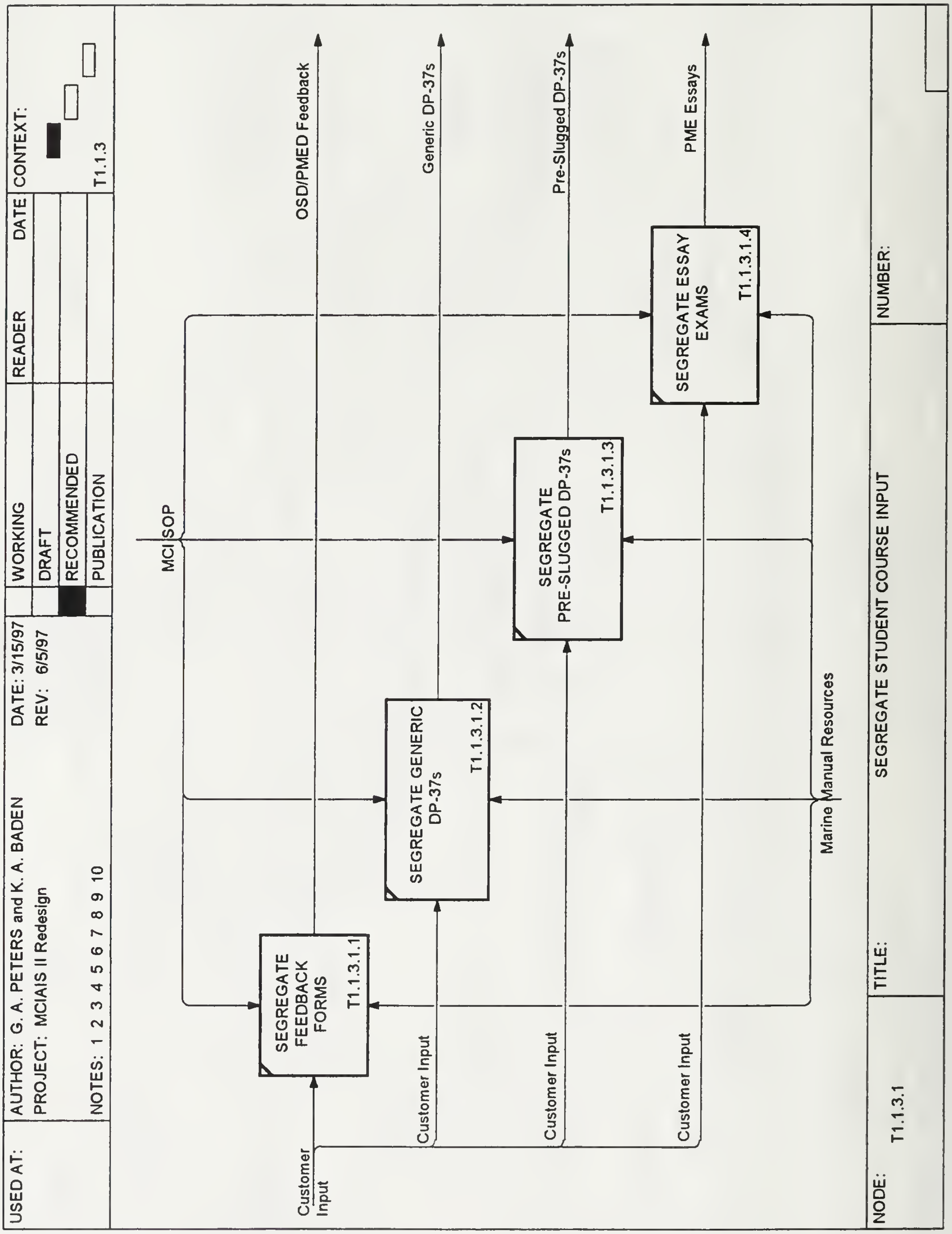


Figure C-7. To-Be Process Model IDEF0 Diagram (T1.1.3.1).

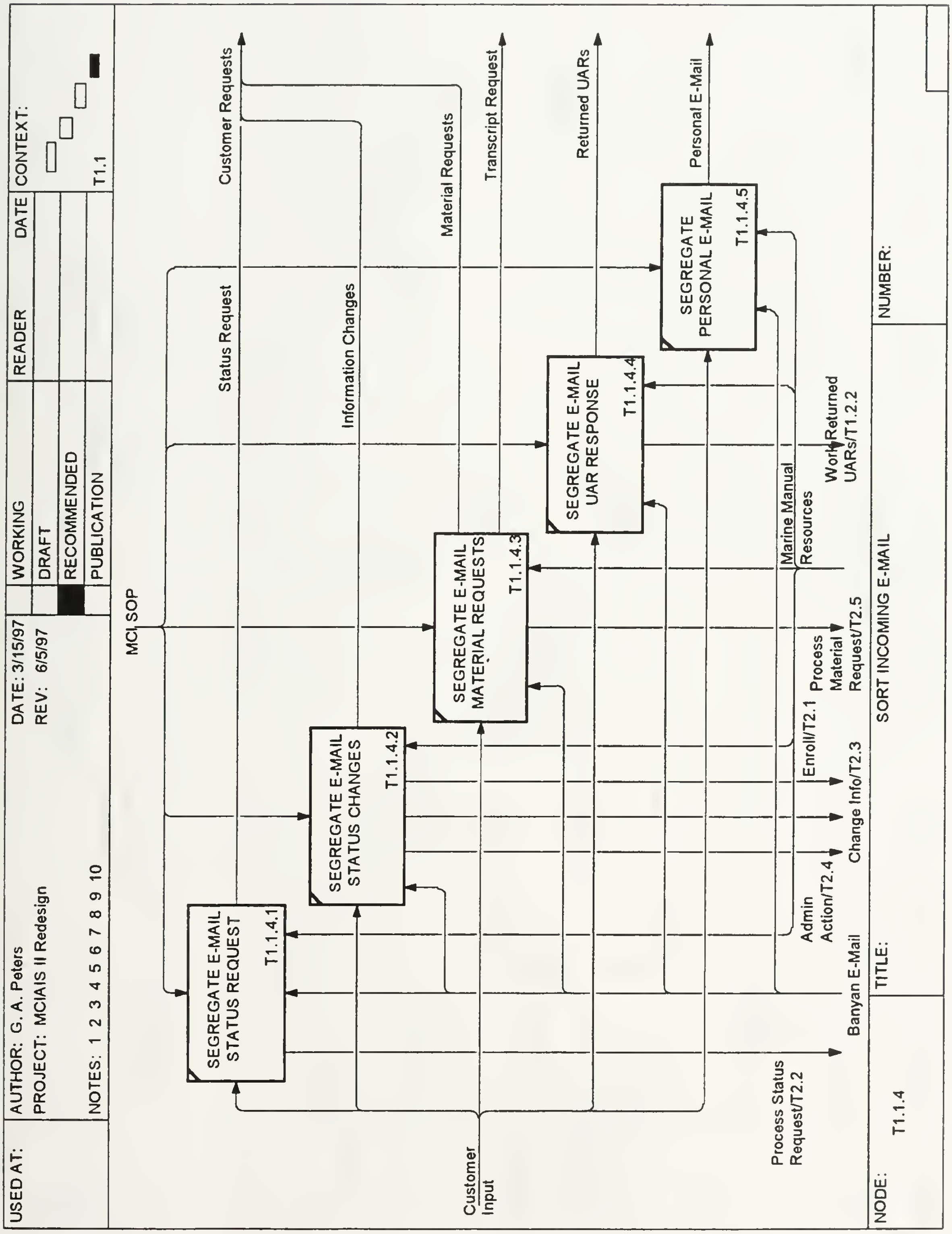


Figure C-8. To-Be Process Model IDEF0 Diagram (T1.1.4).

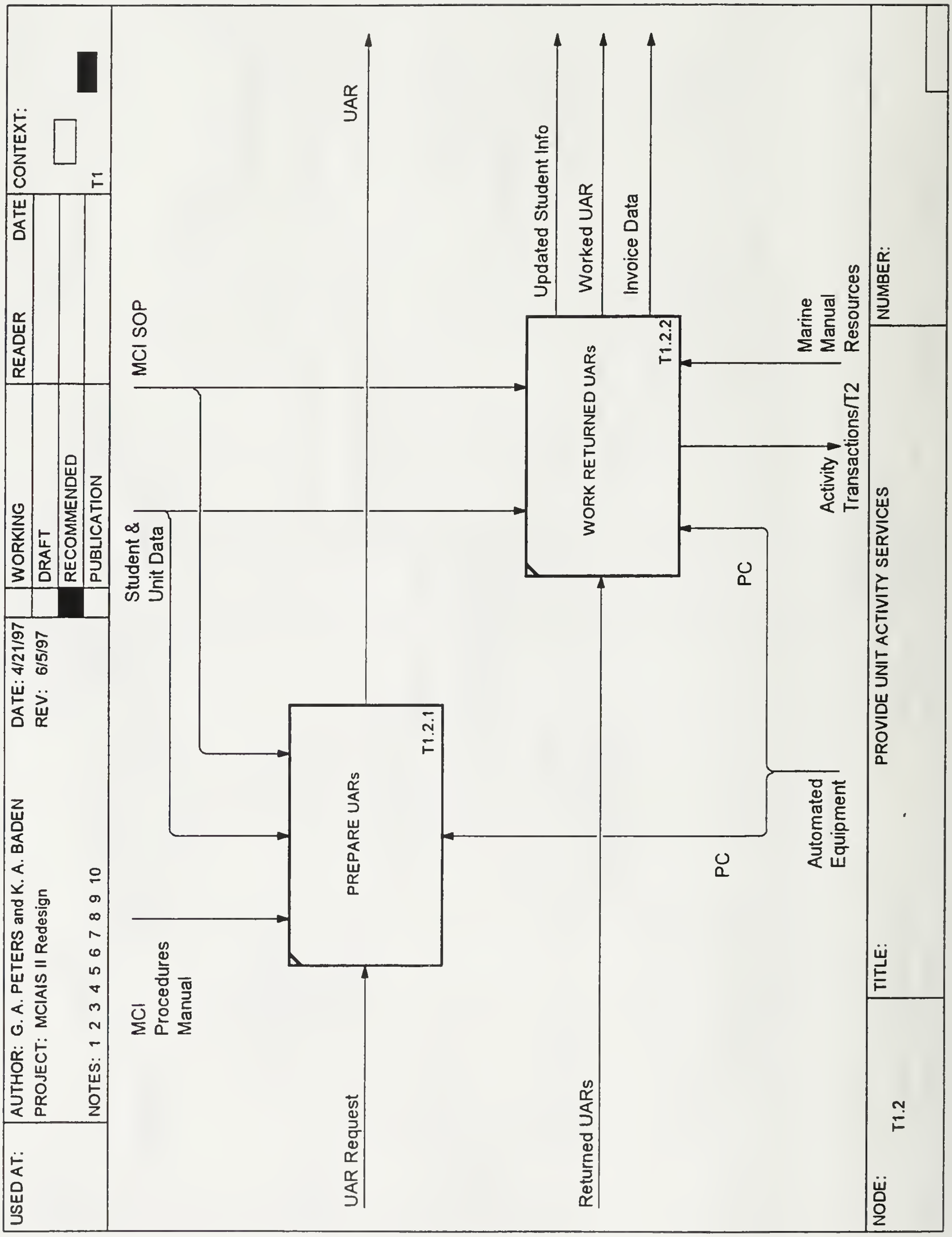


Figure C-9. To-Be Process Model IDEF0 Diagram (T1.2).

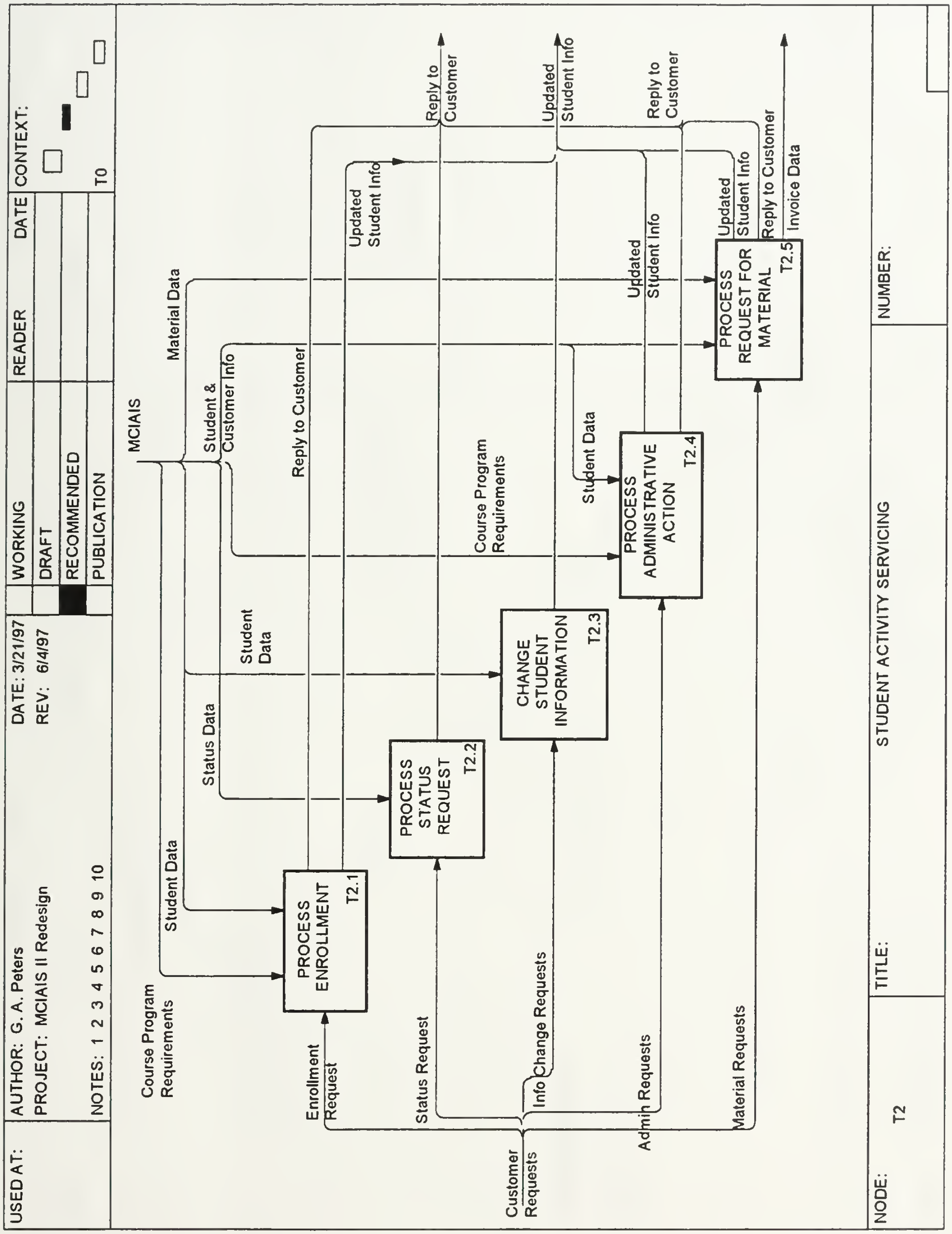


Figure C-10. To-Be Process Model IDEF0 Diagram (T2).

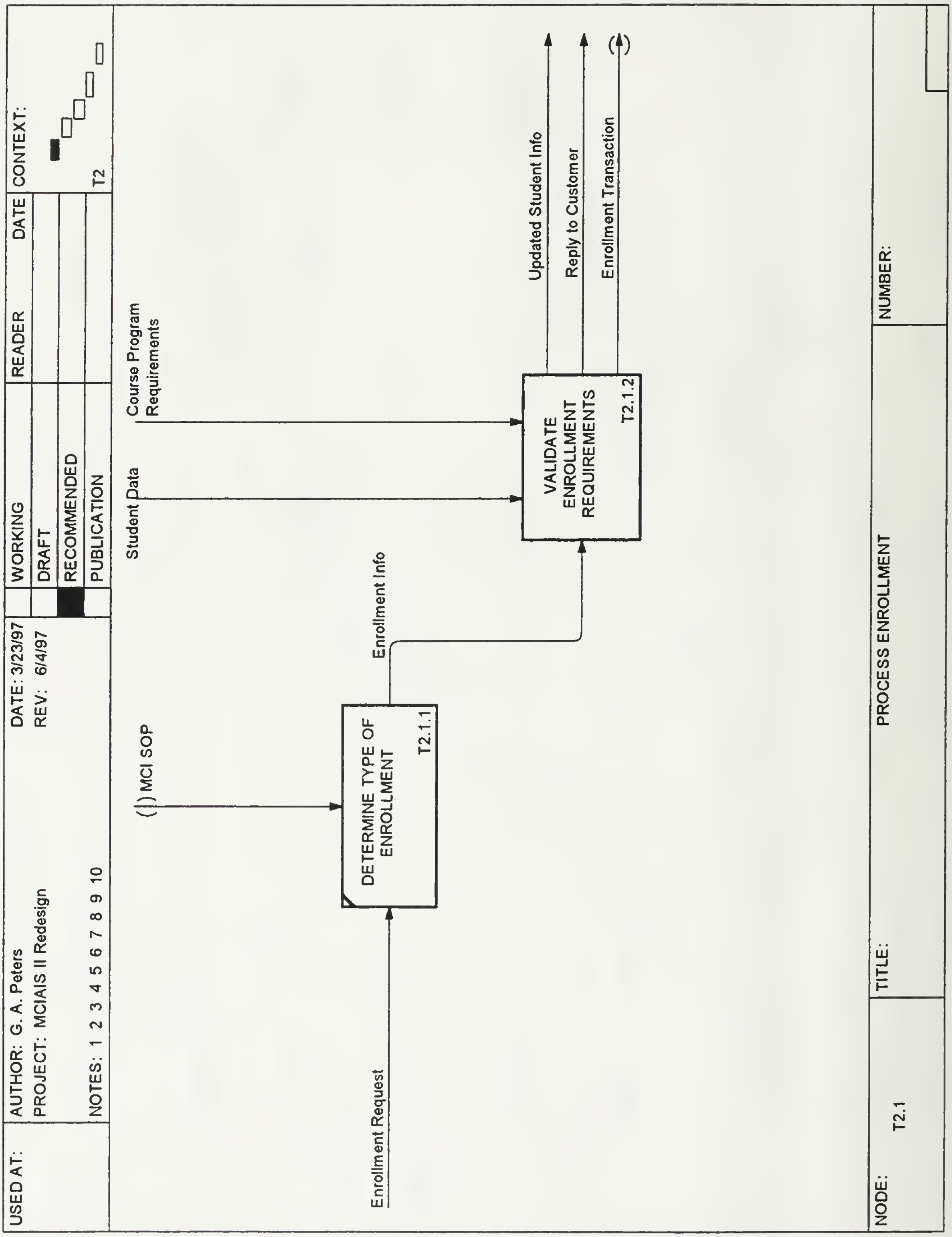


Figure C-11. To-Be Process Model IDEF0 Diagram (T2.1).

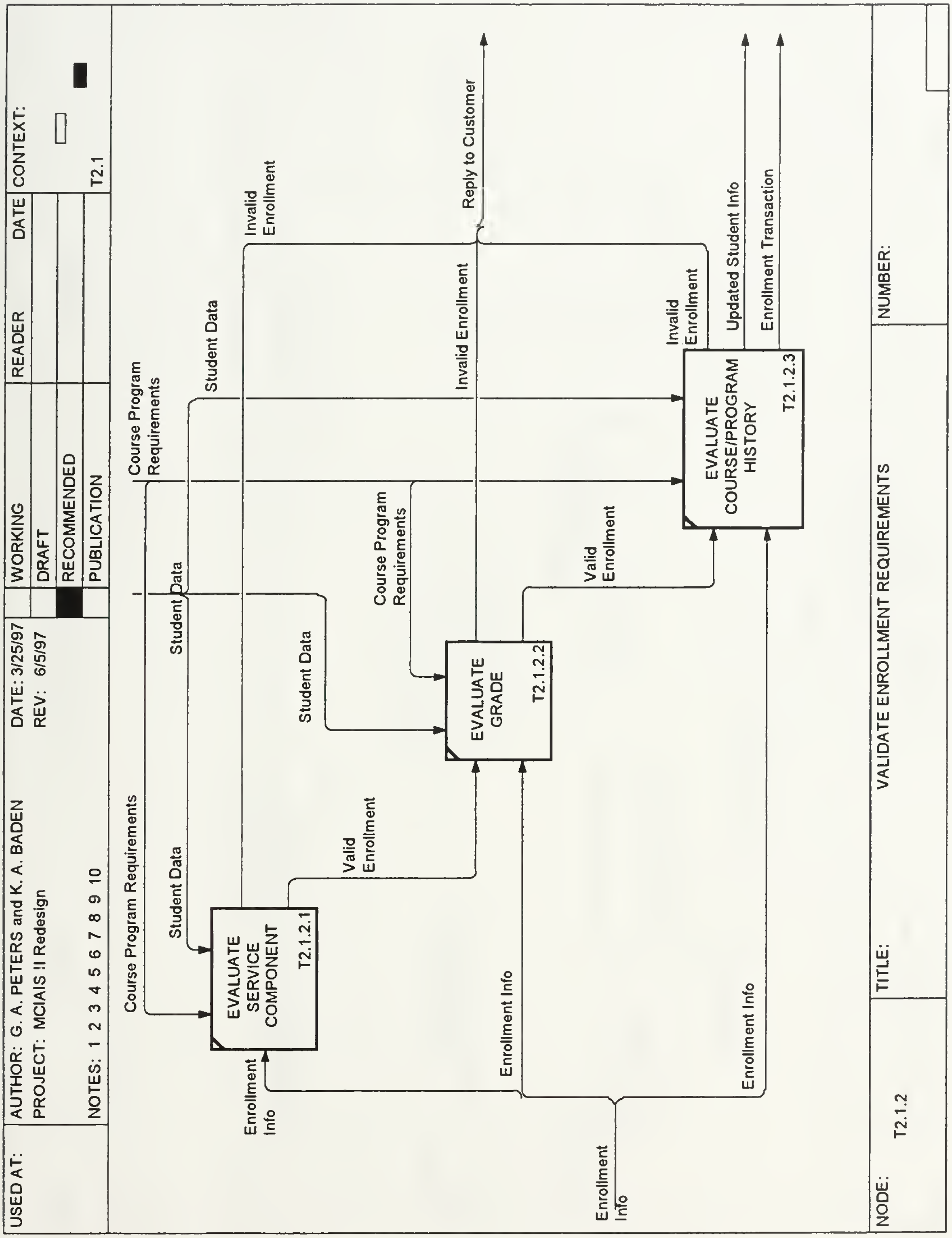


Figure C-12. To-Be Process Model IDEF0 Diagram (T2.1.2).

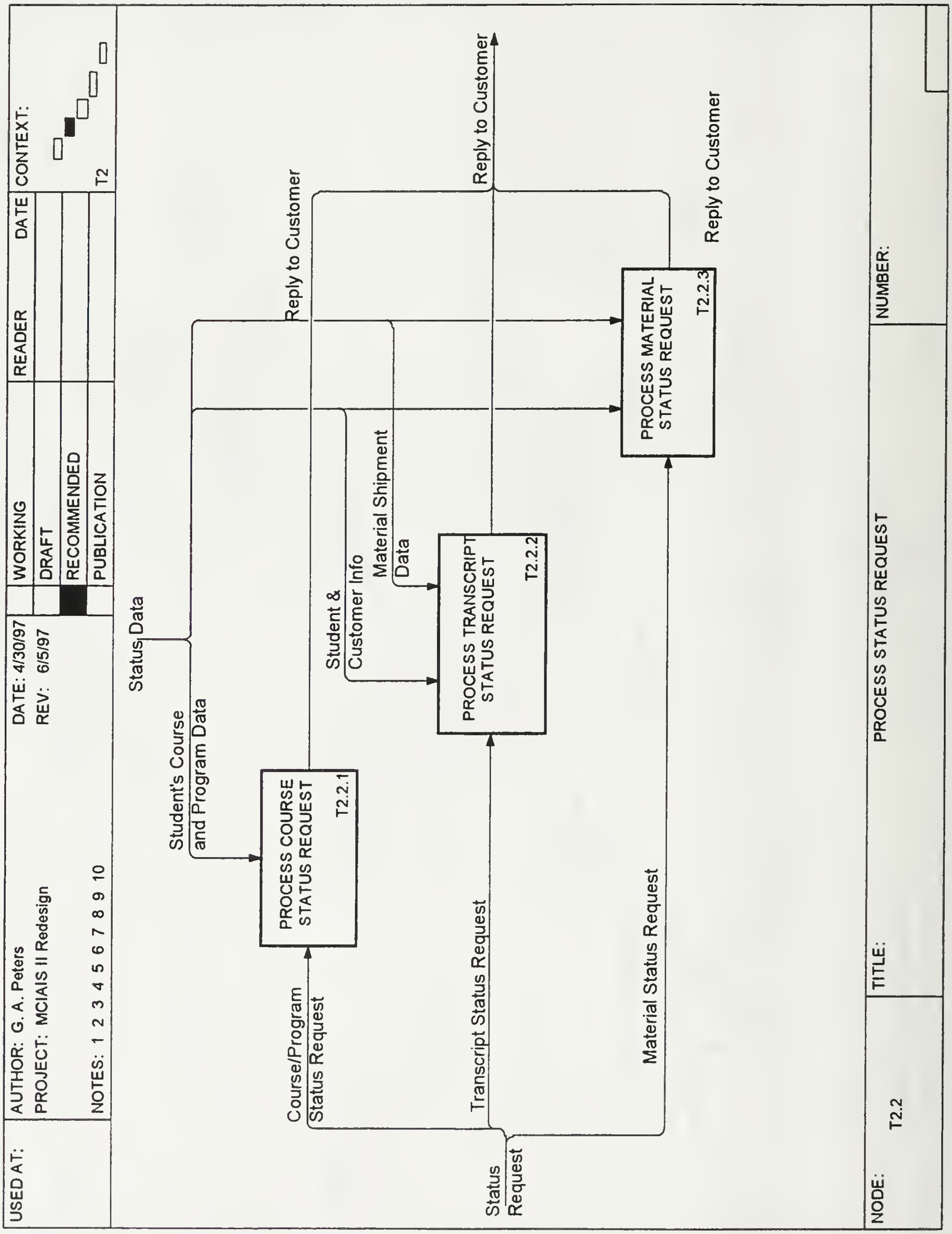


Figure C-13. To-Be Process Model IDEF0 Diagram (T2.2).

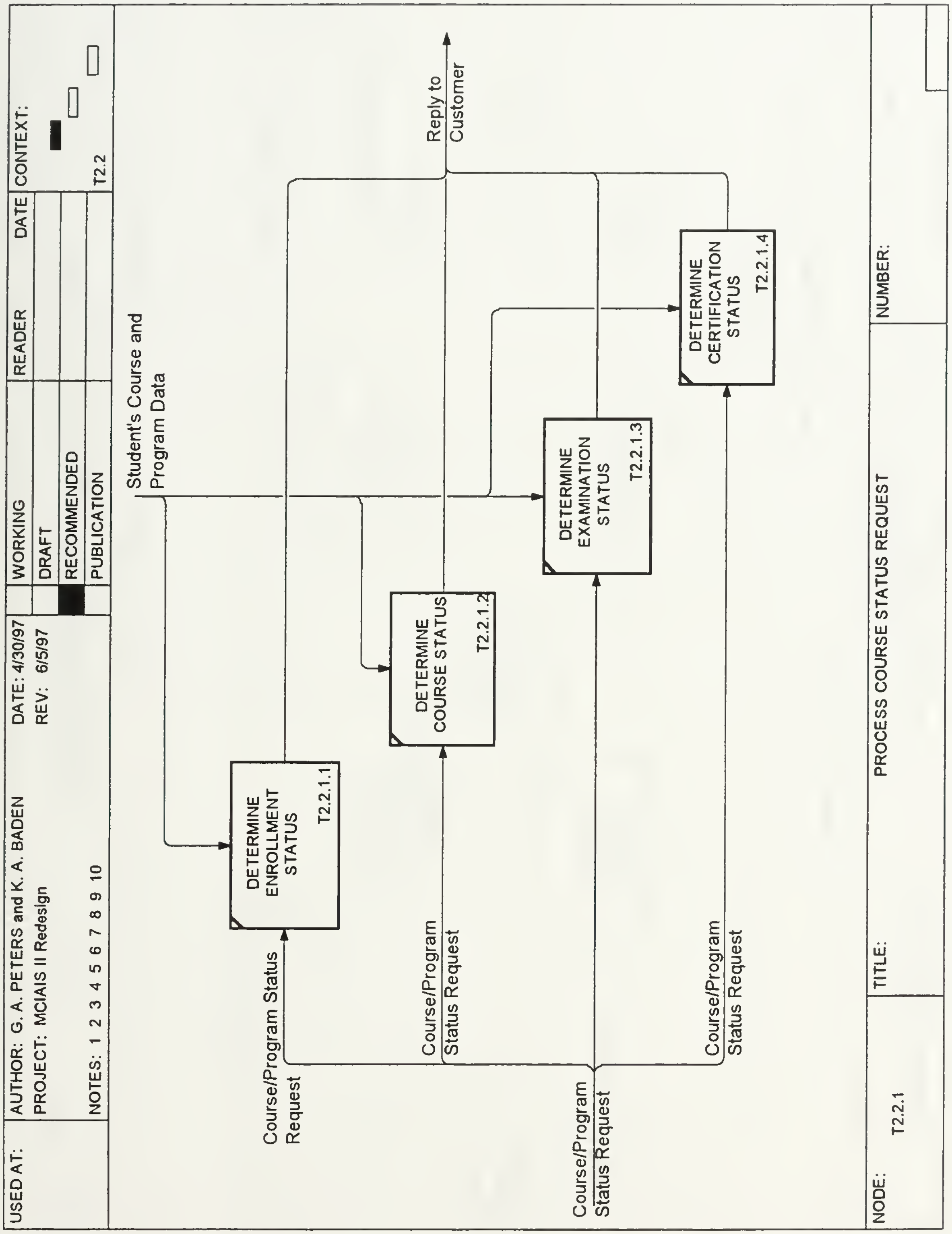


Figure C-14. To-Be Process Model IDEF0 Diagram (T2.2.1).

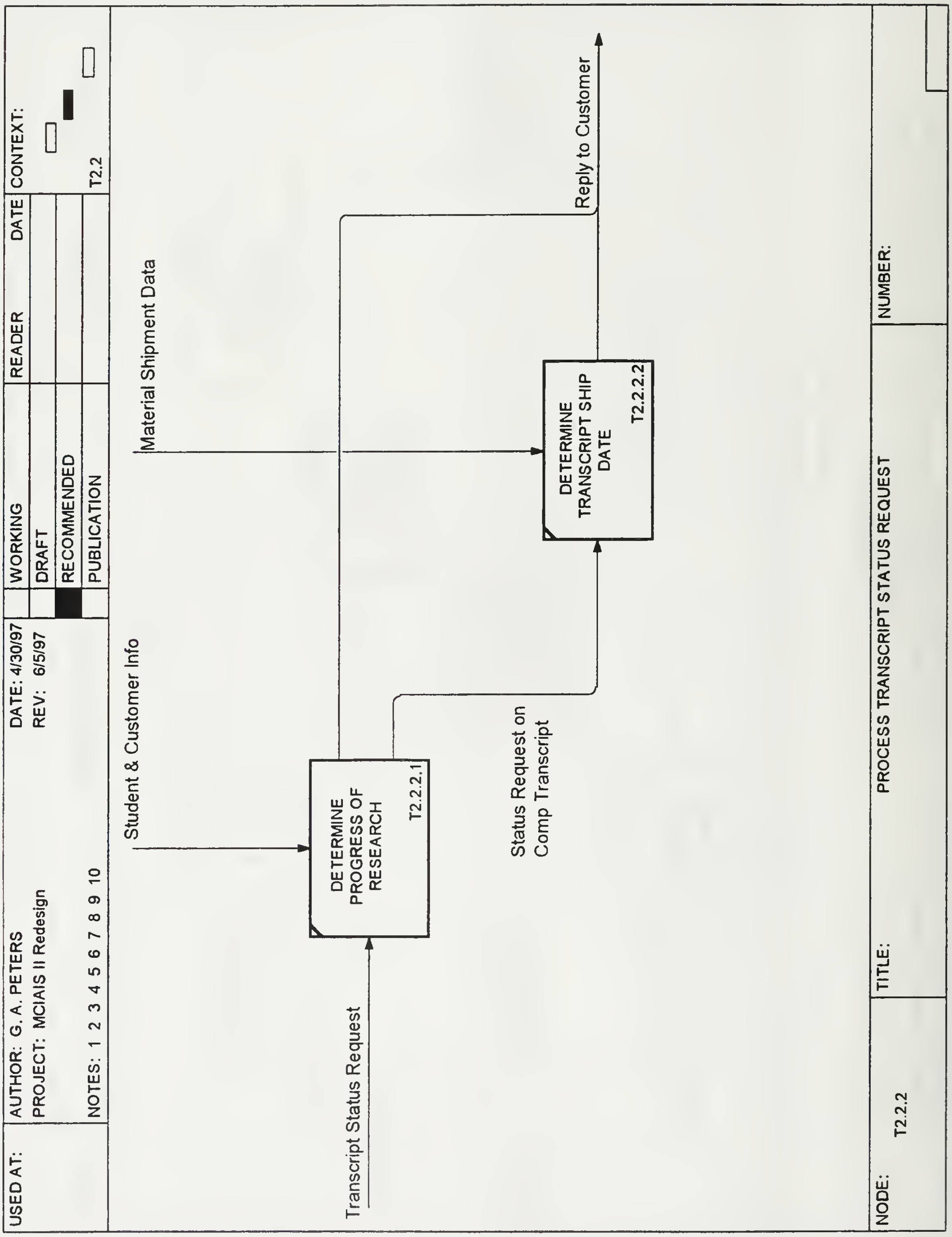


Figure C-15. To-Be Process Model IDEF0 Diagram (T2.2.2).

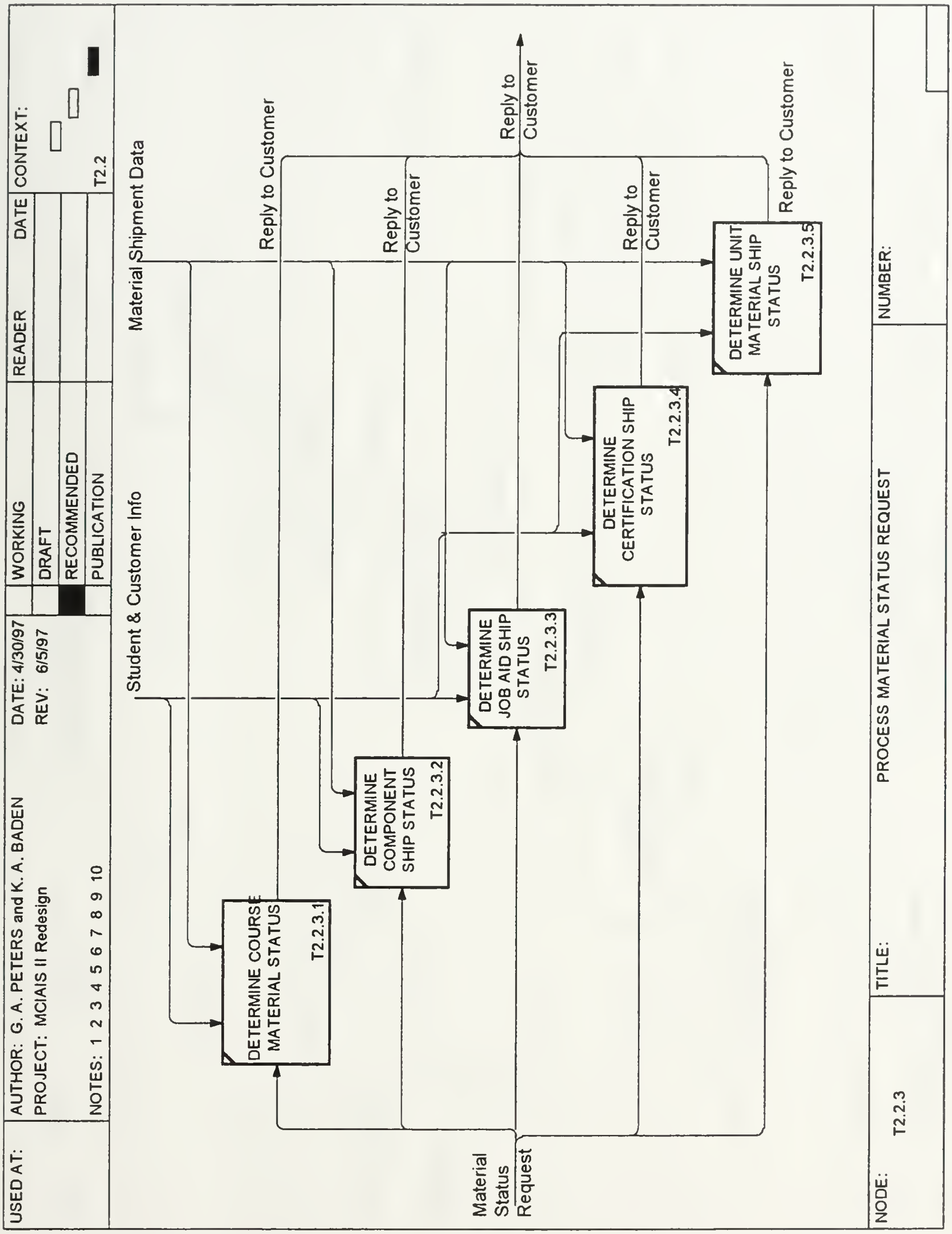


Figure C-16. To-Be Process Model IDEF0 Diagram (T2.2.3).

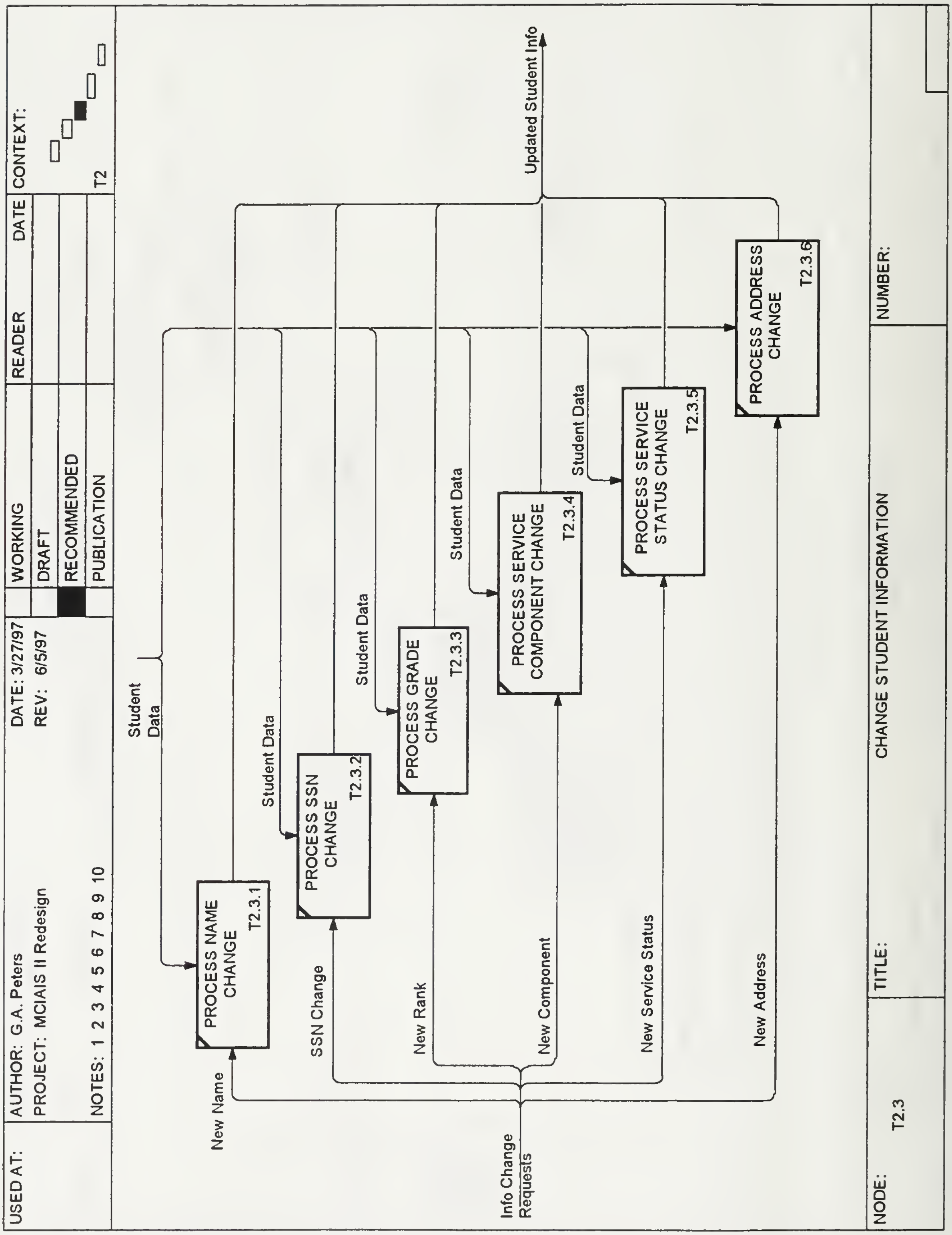


Figure C-17. To-Be Process Model IDEF0 Diagram (T2.3).

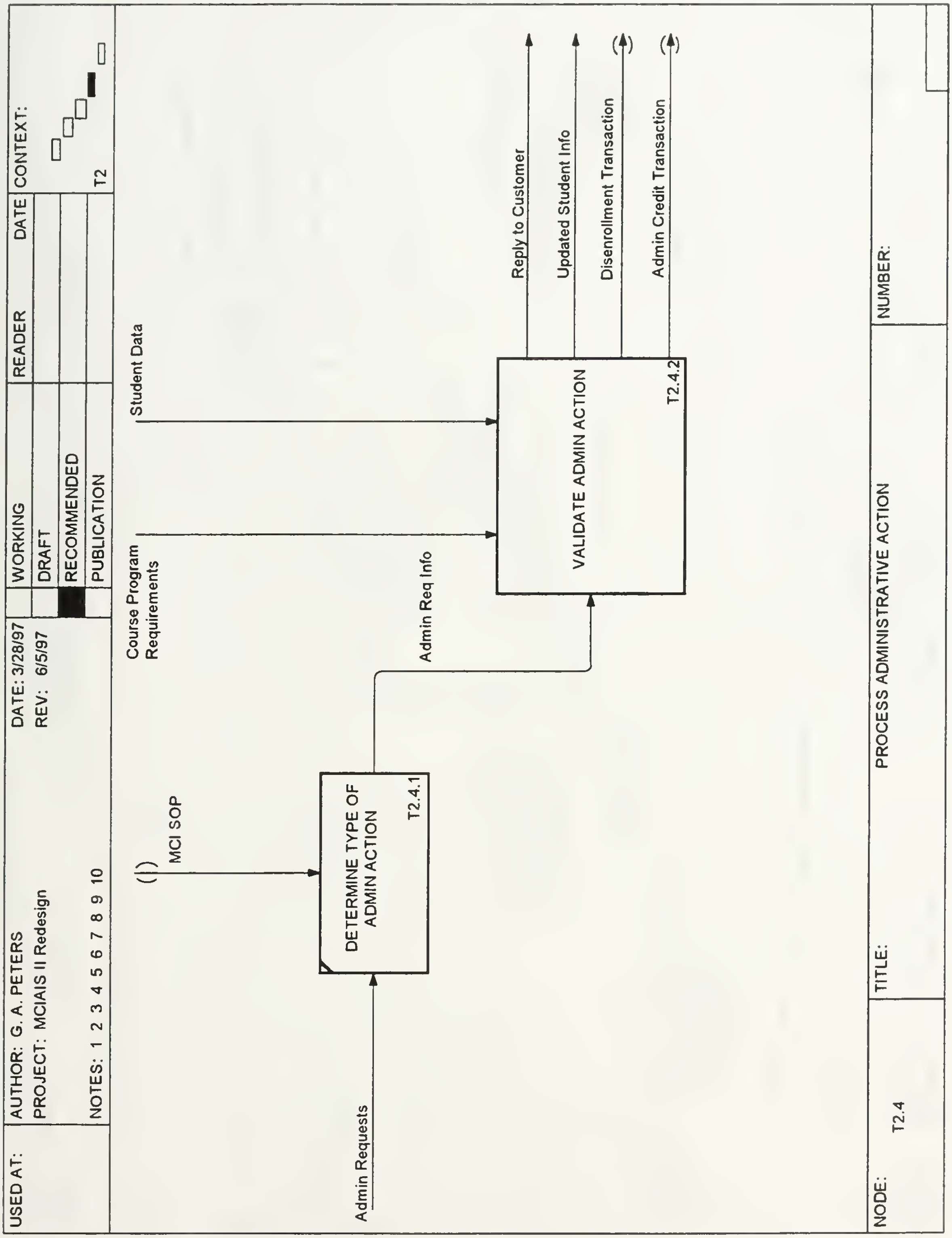


Figure C-18. To-Be Process Model IDEF0 Diagram (T2.4).

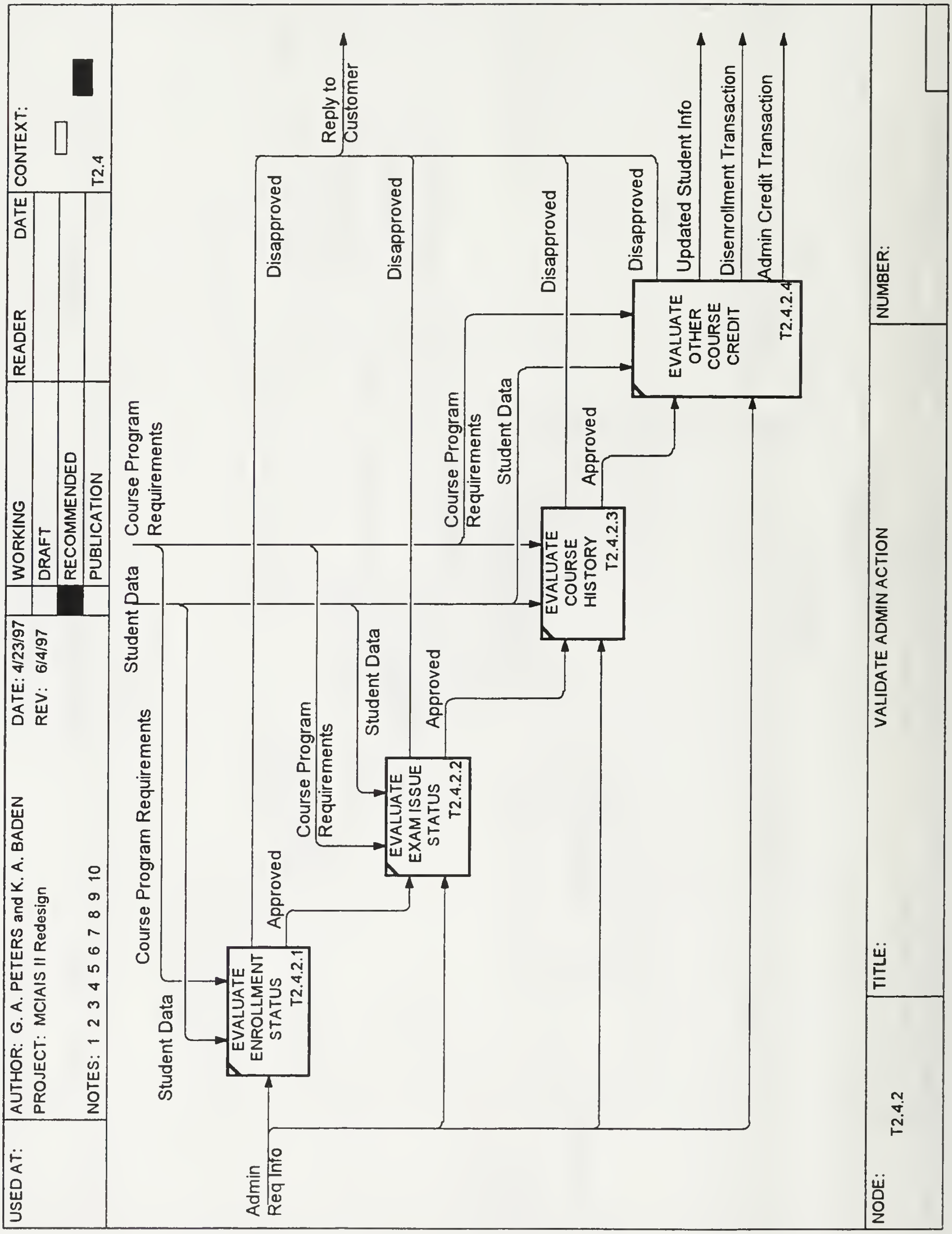


Figure C-19. To-Be Process Model IDEF0 Diagram (T2.4.2).

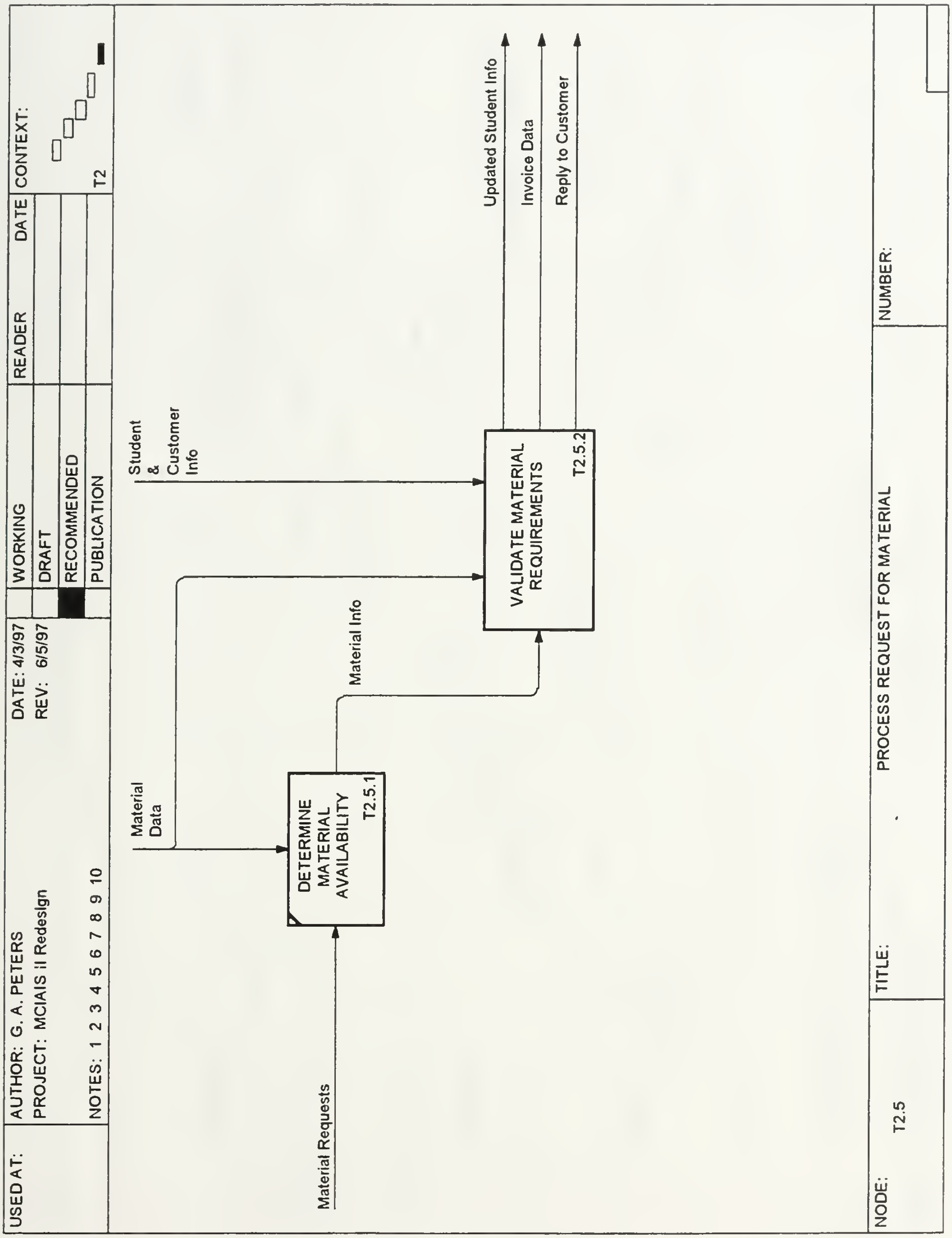


Figure C-20. To-Be Process Model IDEF0 Diagram (T2.5).

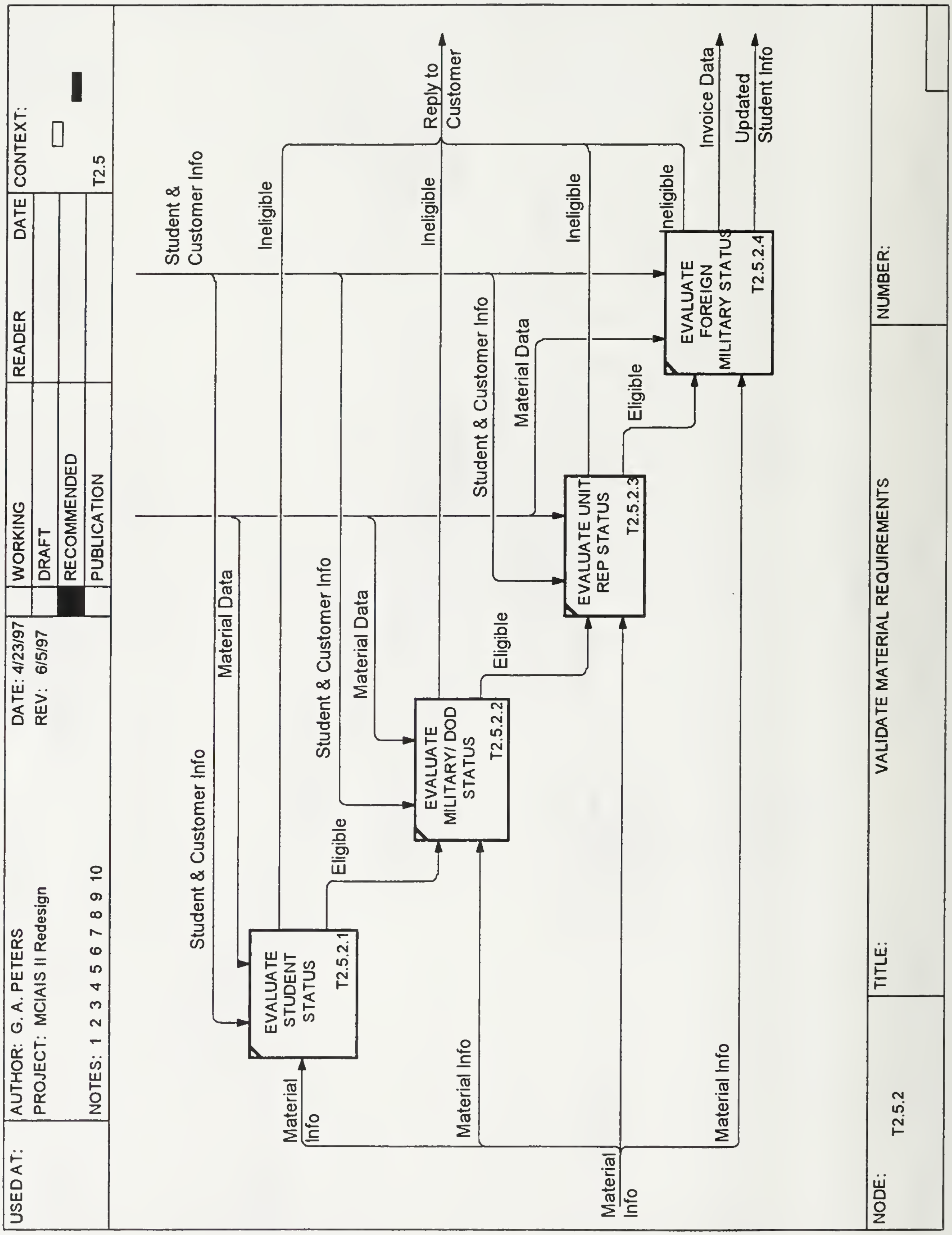


Figure C-21. To-Be Process Model IDEF0 Diagram (T2.5.2).

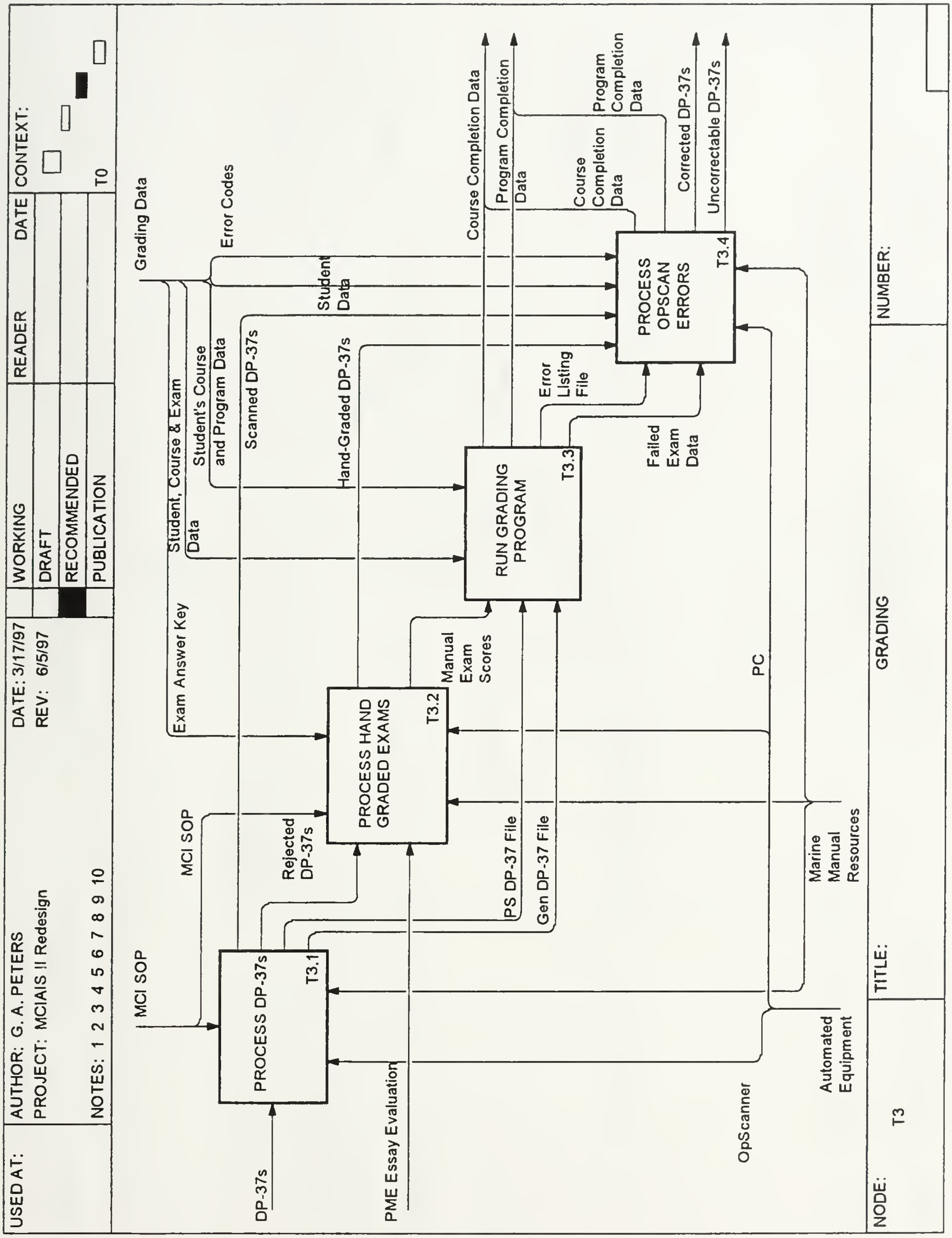


Figure C-22. To-Be Process Model IDEF0 Diagram (T3).

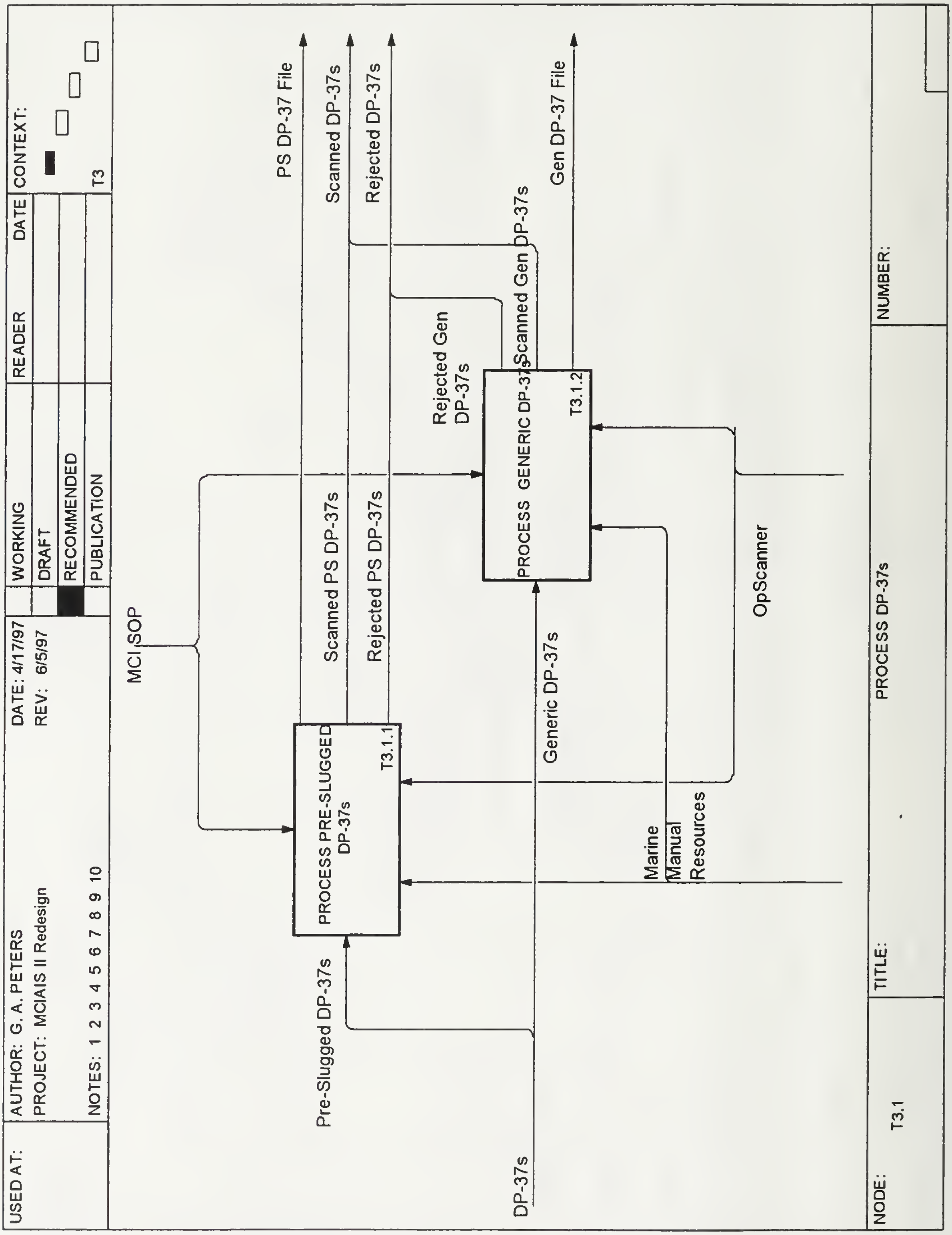


Figure C-23. To-Be Process Model IDEF0 Diagram (T3.1).

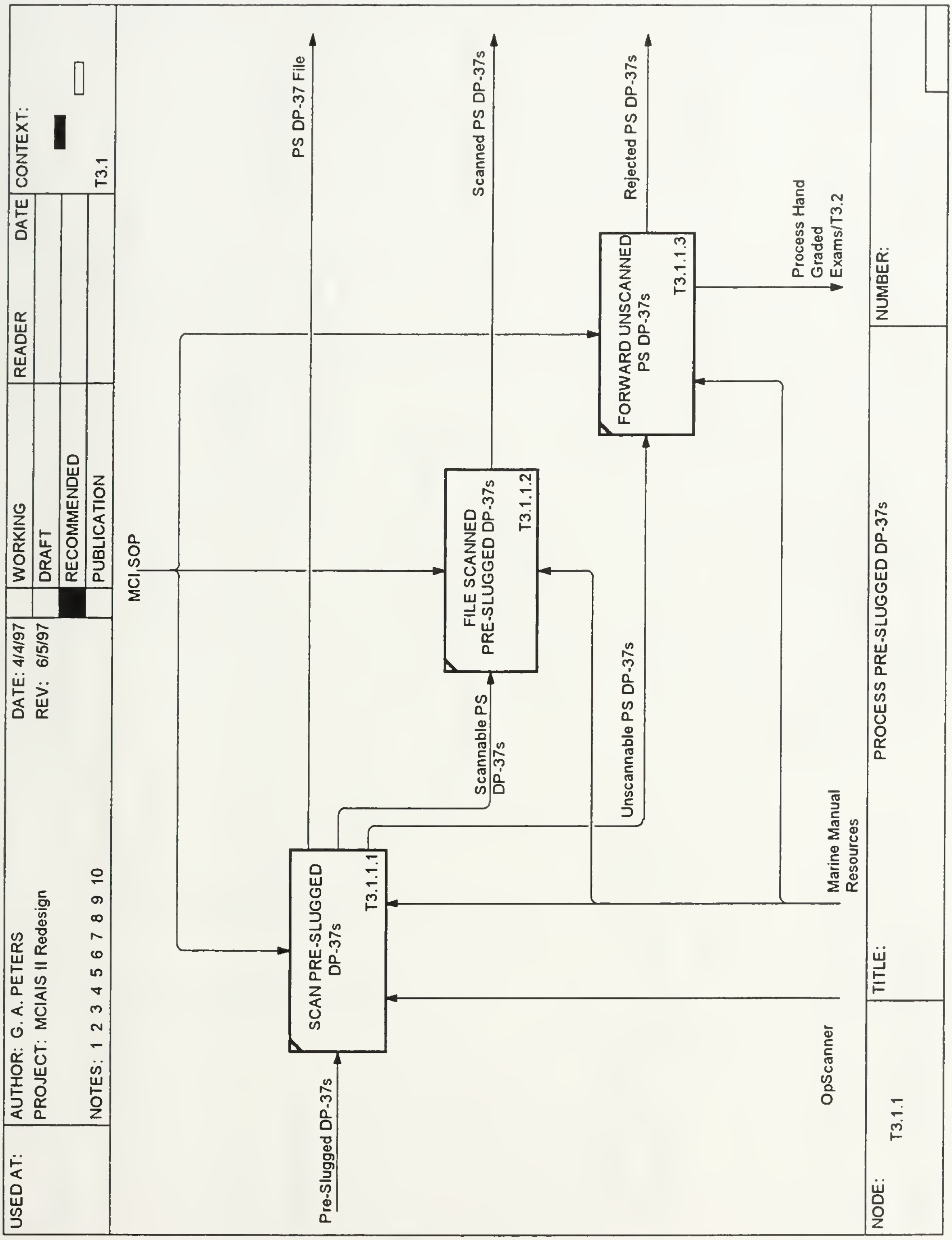


Figure C-24. To-Be Process Model IDEF0 Diagram (T3.1.1).

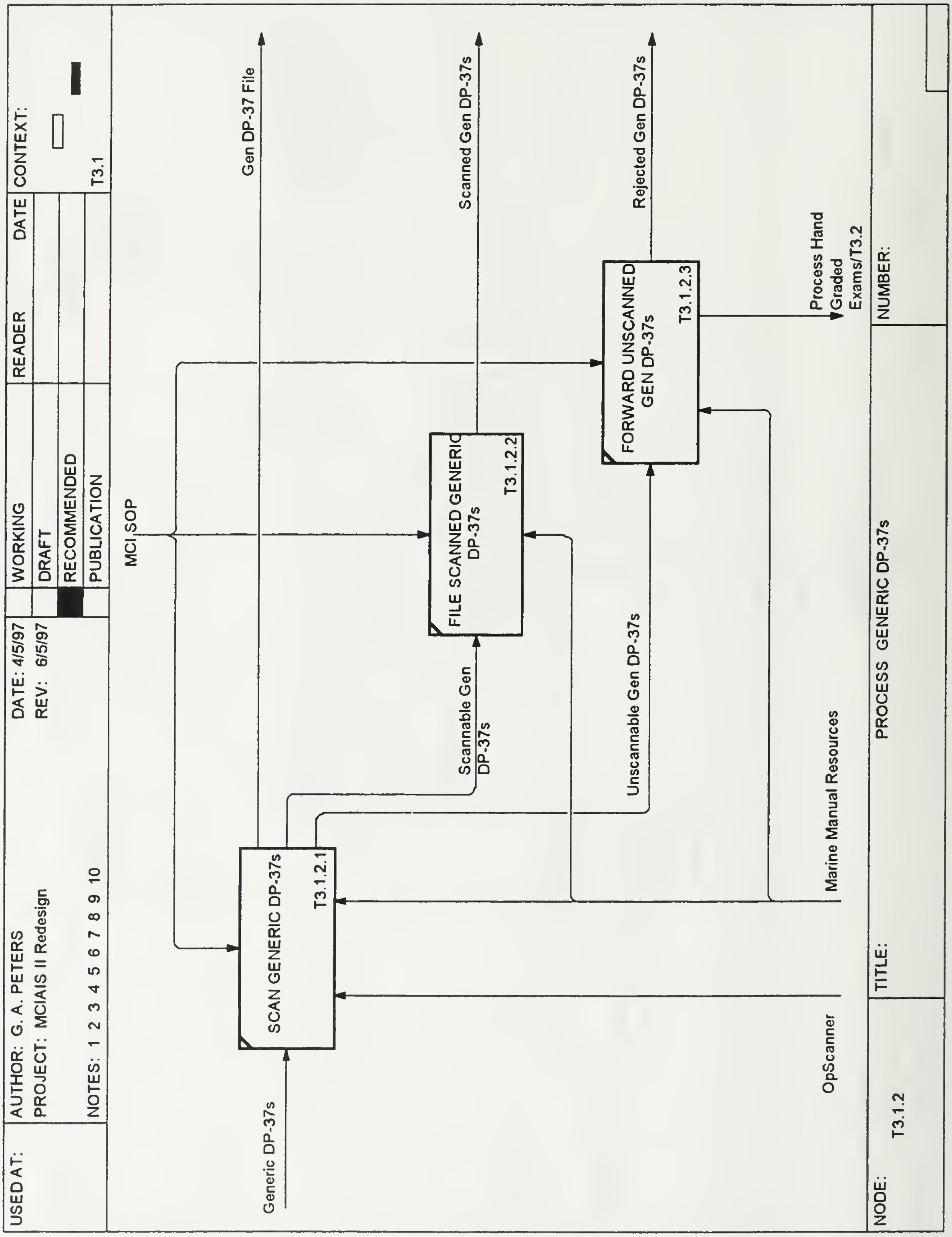


Figure C-25. To-Be Process Model IDEF0 Diagram (T3.1.2).

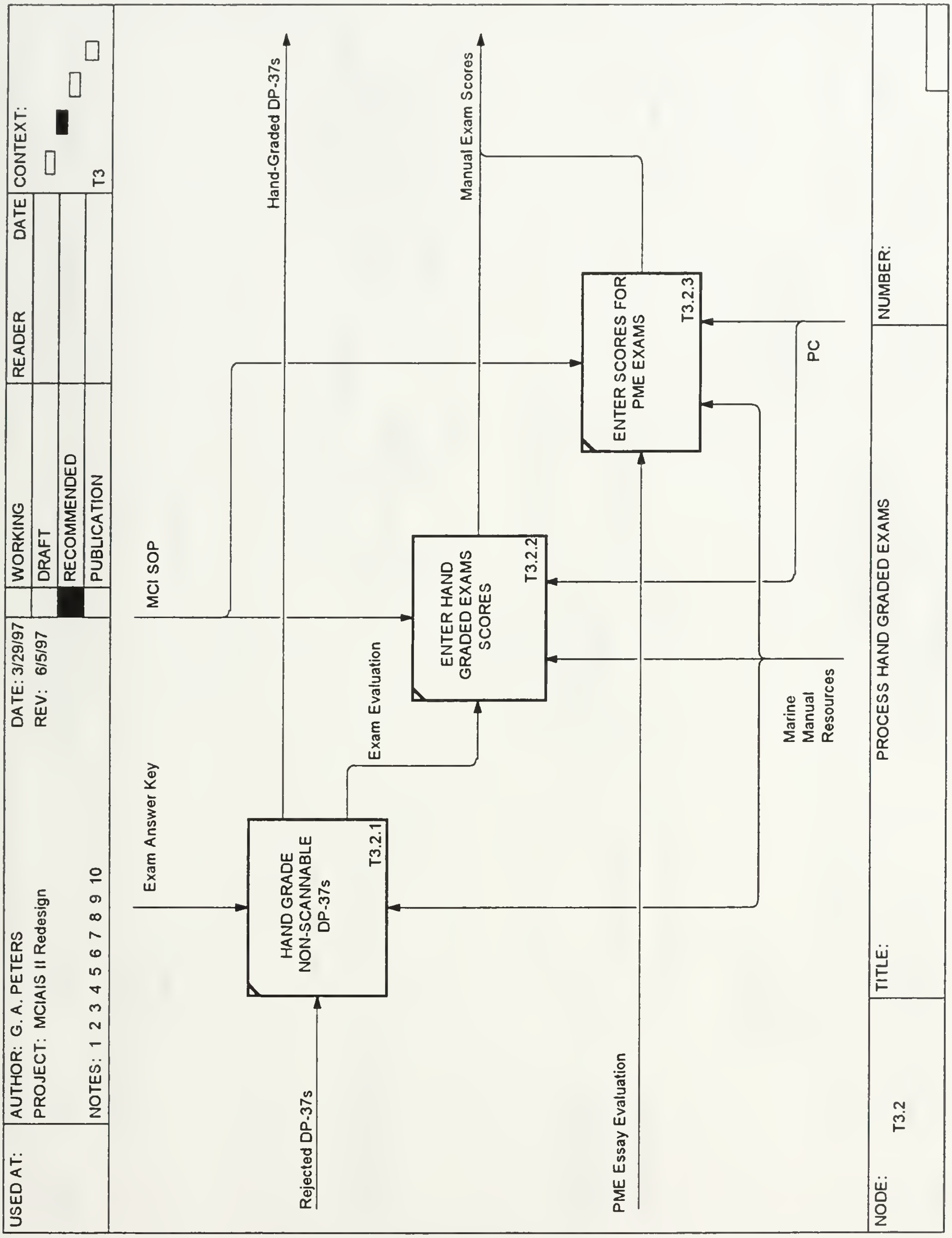


Figure C-26. To-Be Process Model IDEF0 Diagram (T3.2).

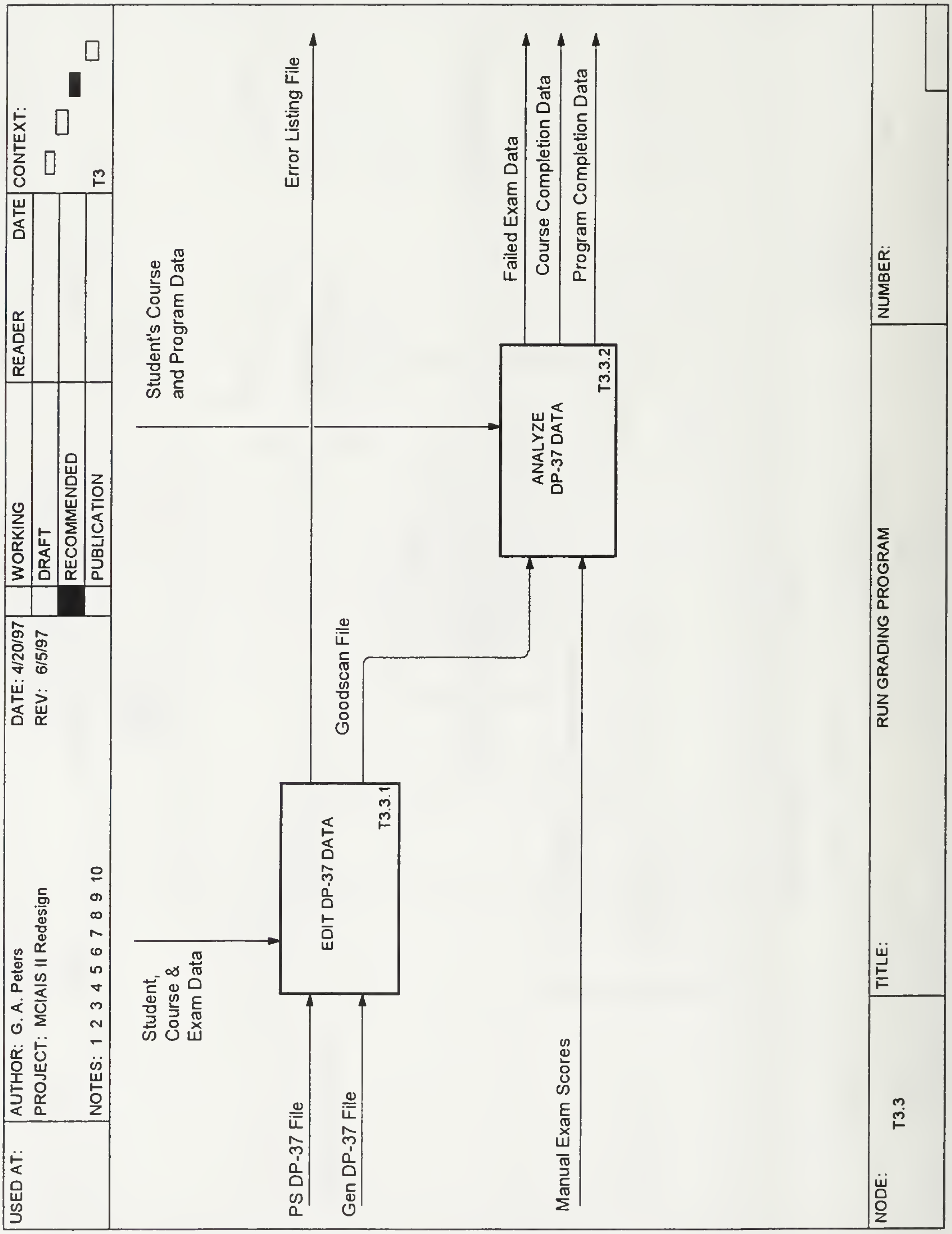


Figure C-27. To-Be Process Model IDEF0 Diagram (T3.3).

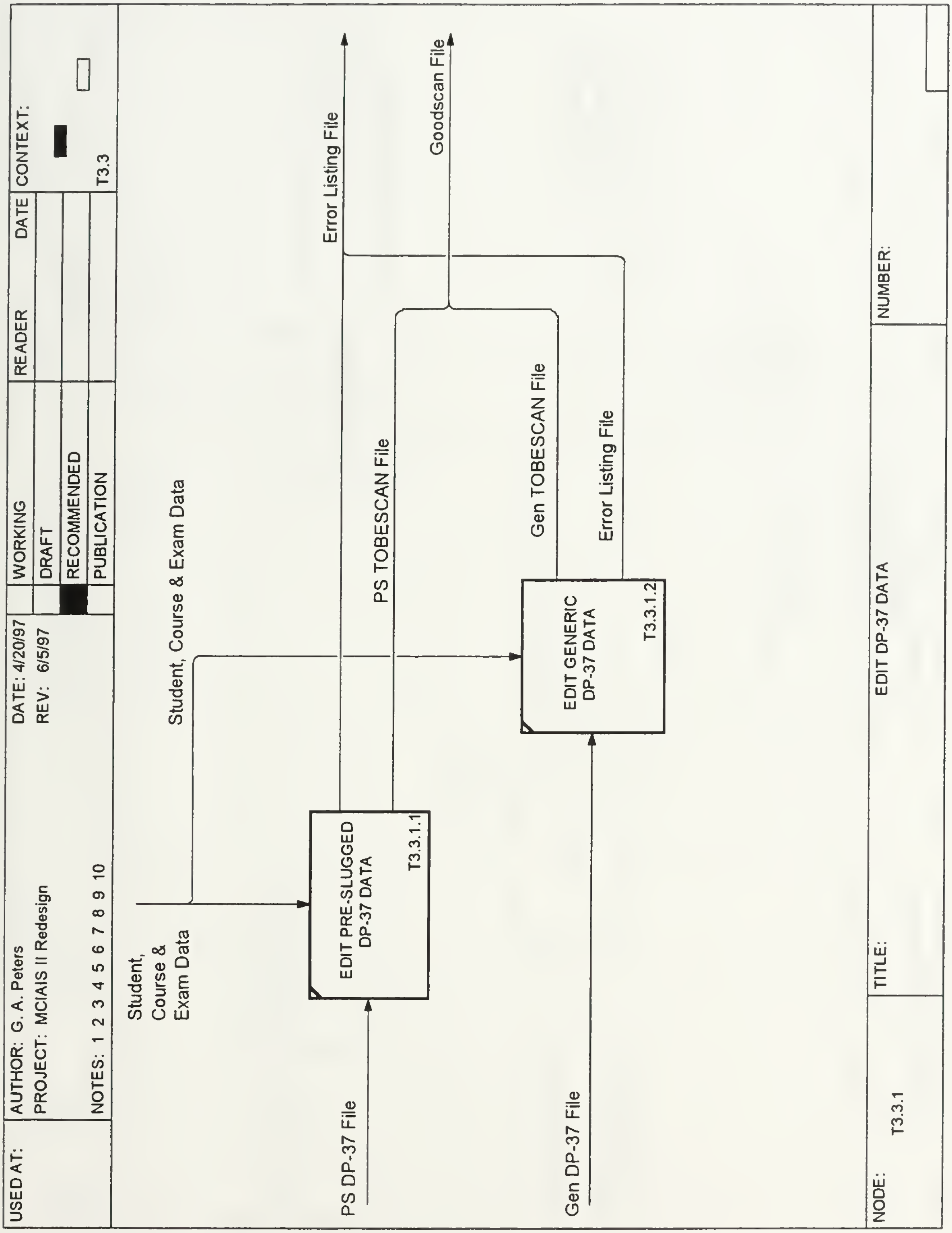


Figure C-28. To-Be Process Model IDEF0 Diagram (T3.3.1).

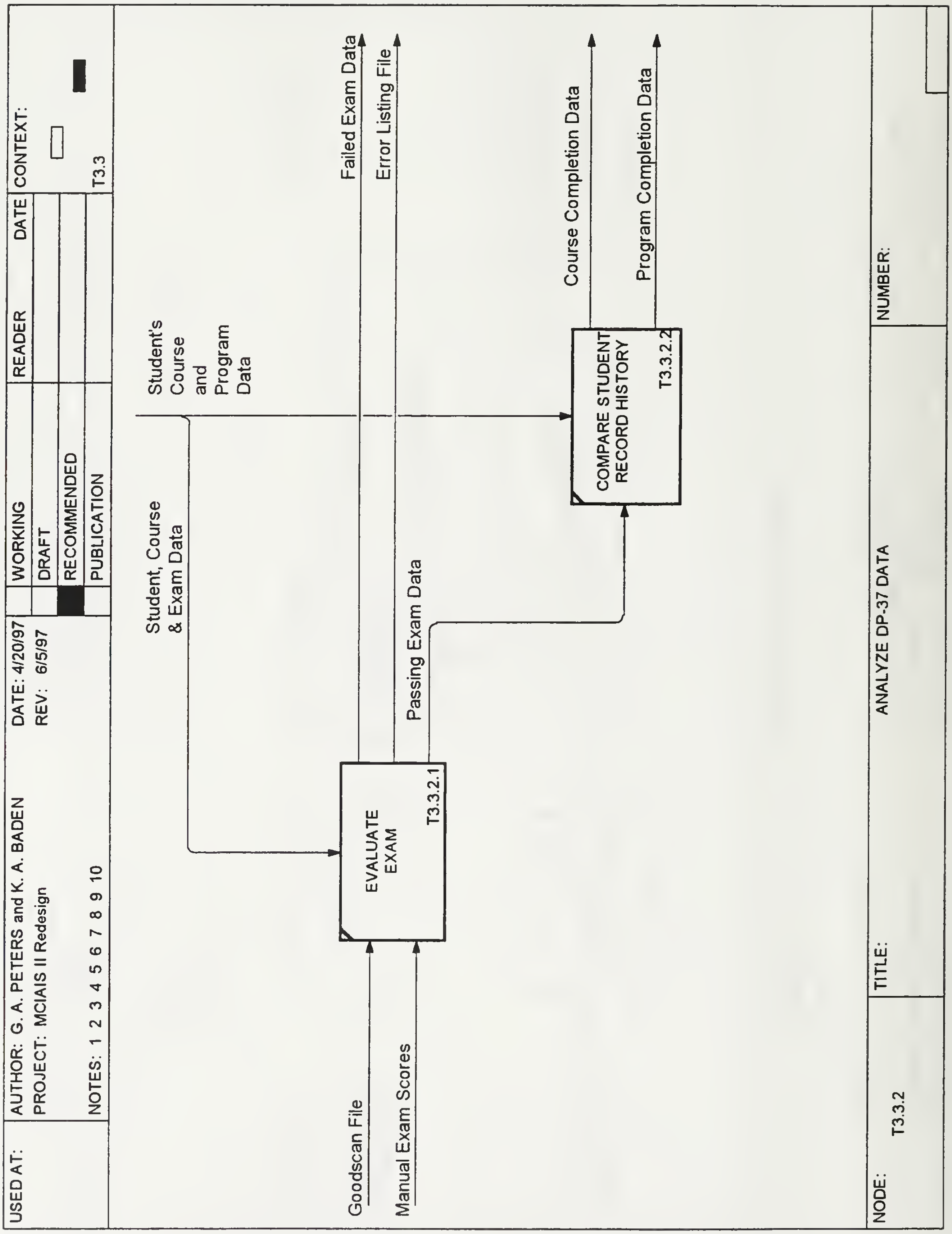


Figure C-29. To-Be Process Model IDEF0 Diagram (T3.3.2).

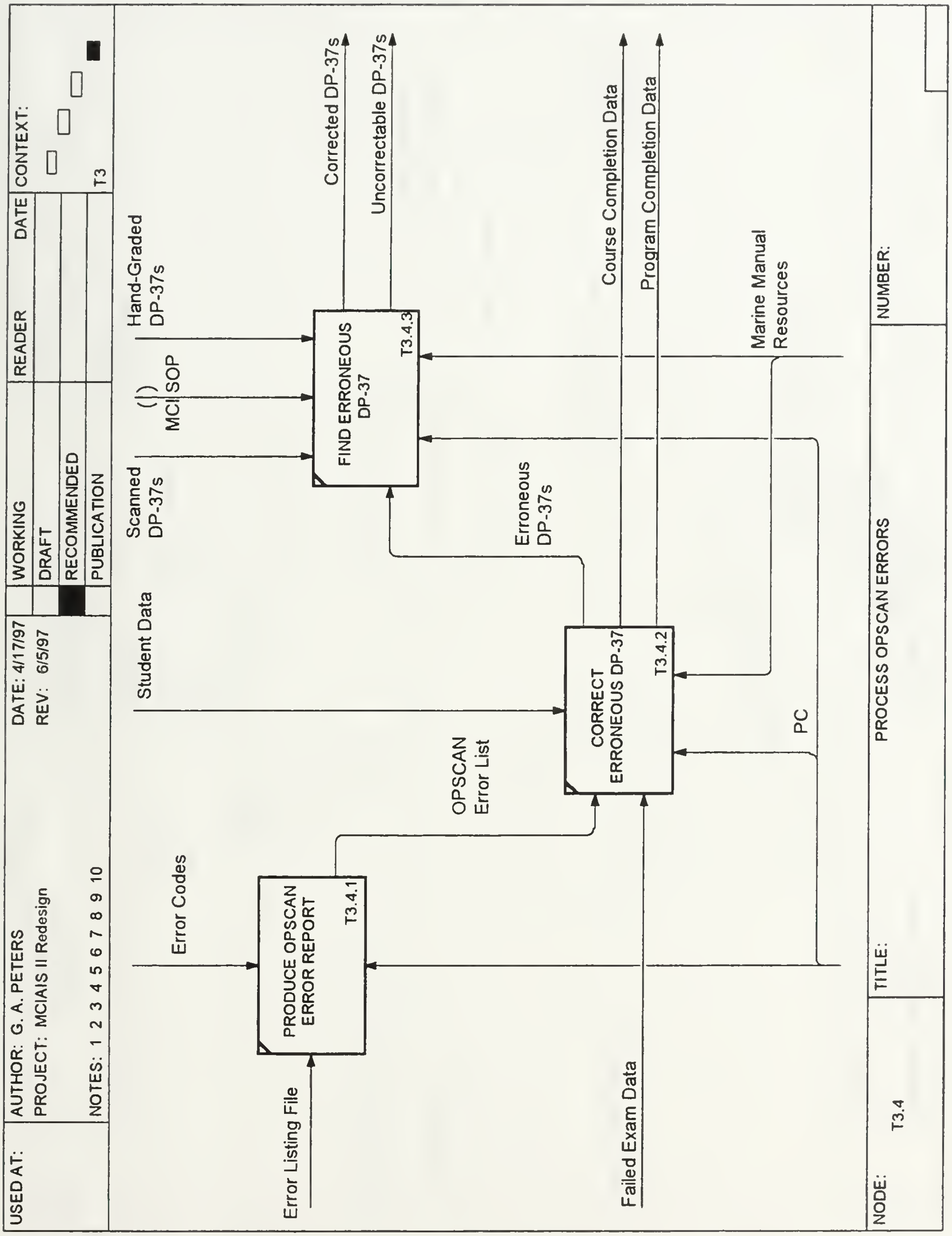


Figure C-30. To-Be Process Model IDEF0 Diagram (T3.4).

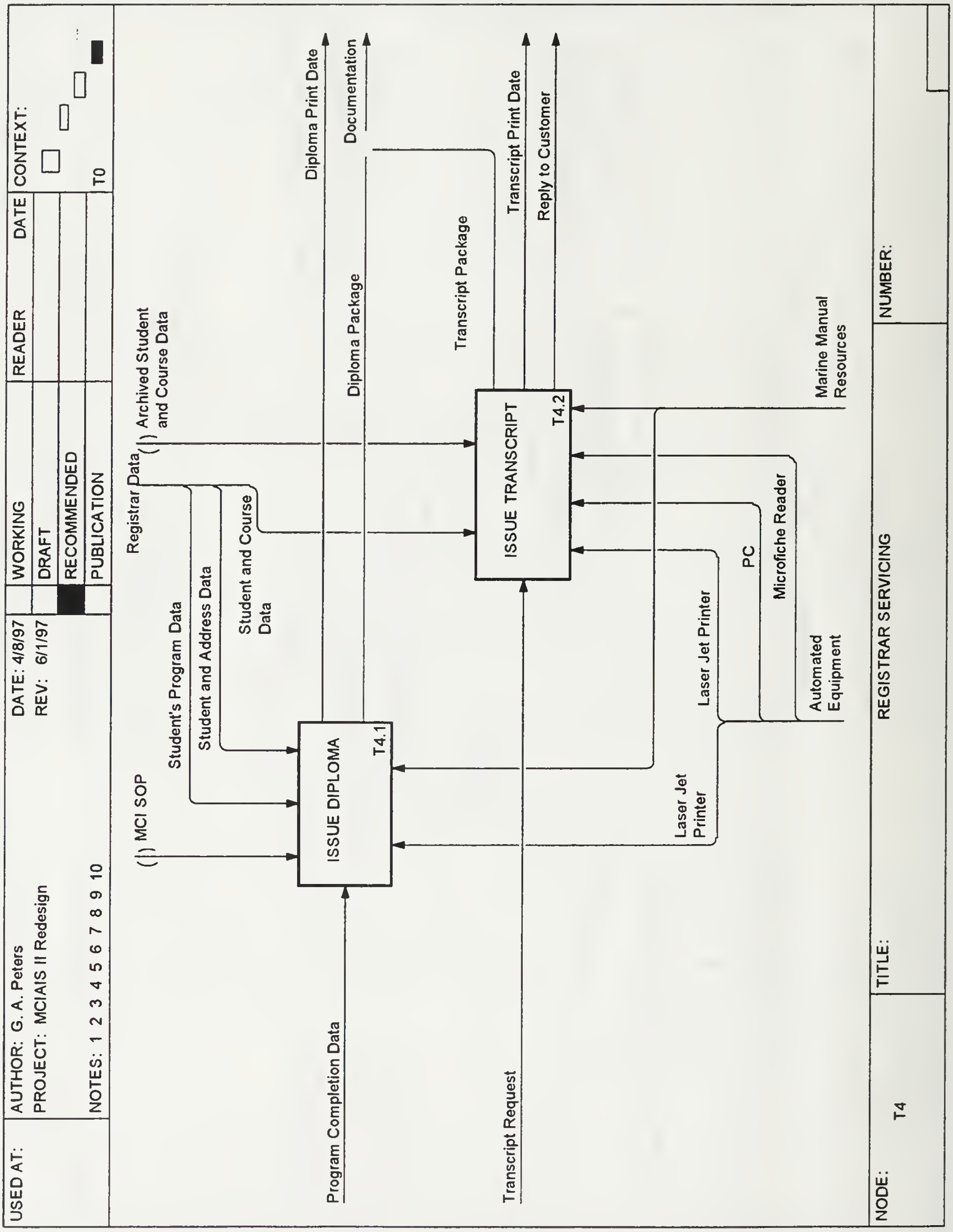


Figure C-31. To-Be Process Model IDEF0 Diagram (T4).

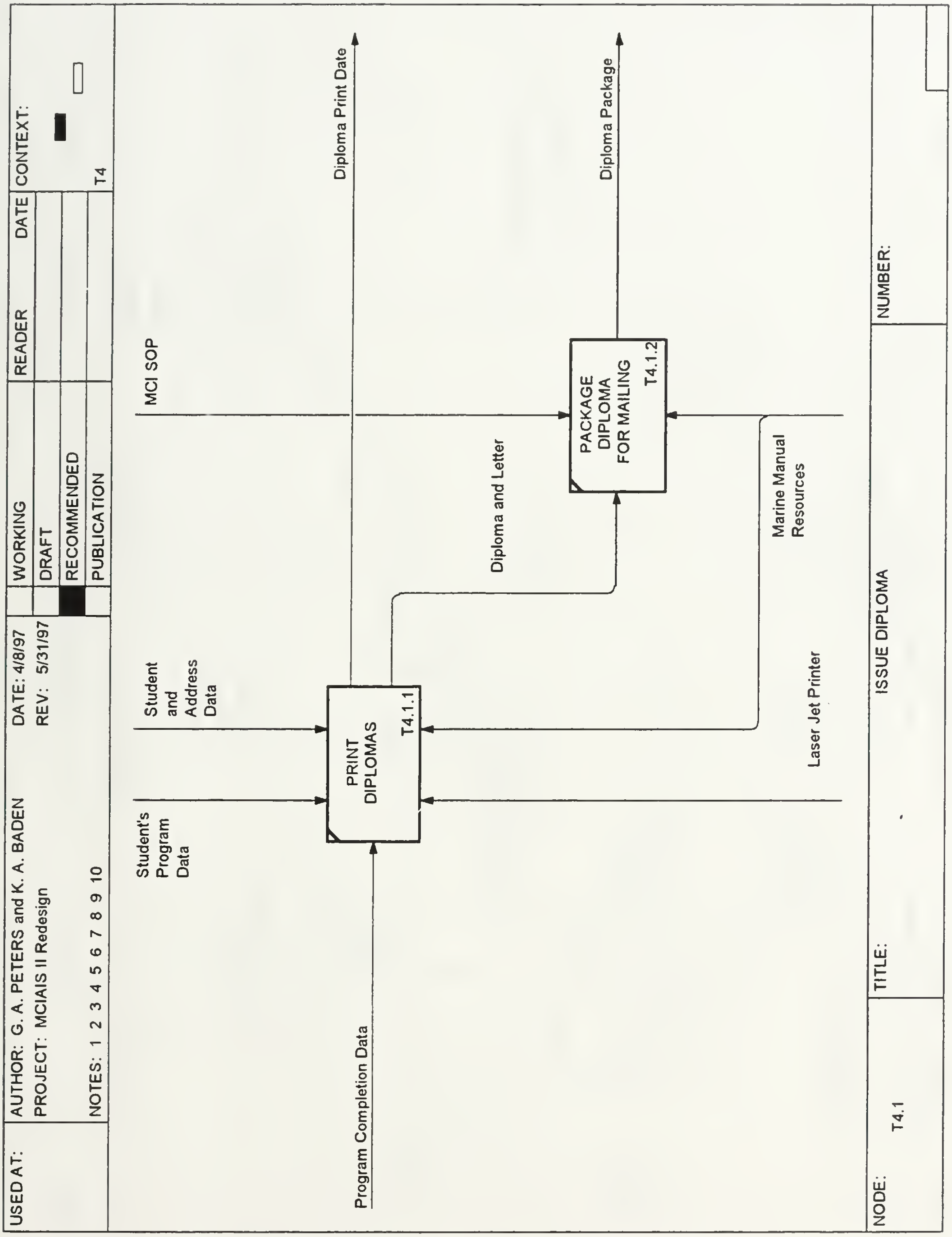


Figure C-32. To-Be Process Model IDEF0 Diagram (T4.1).

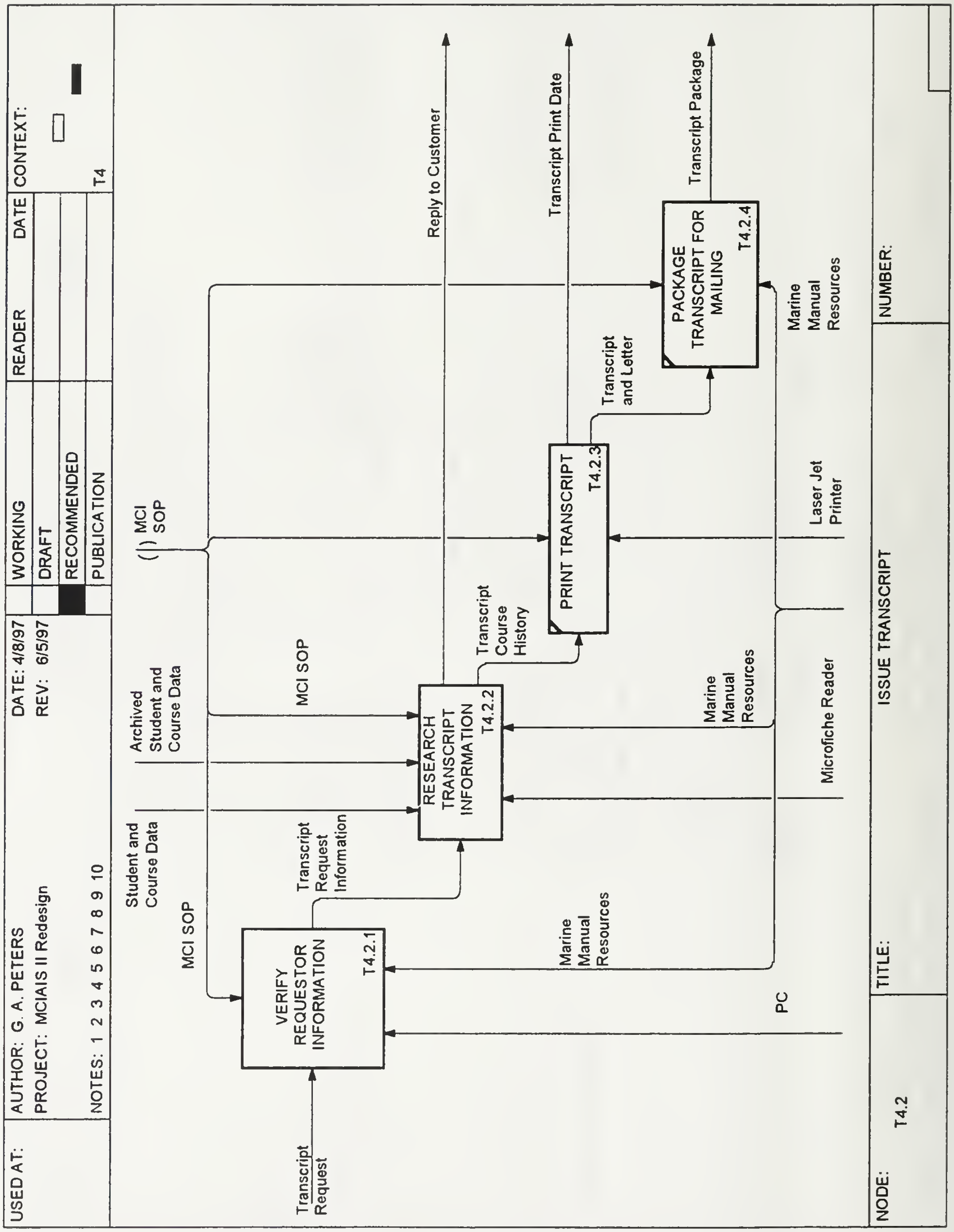


Figure C-33. To-Be Process Model IDEF0 Diagram (T4.2).

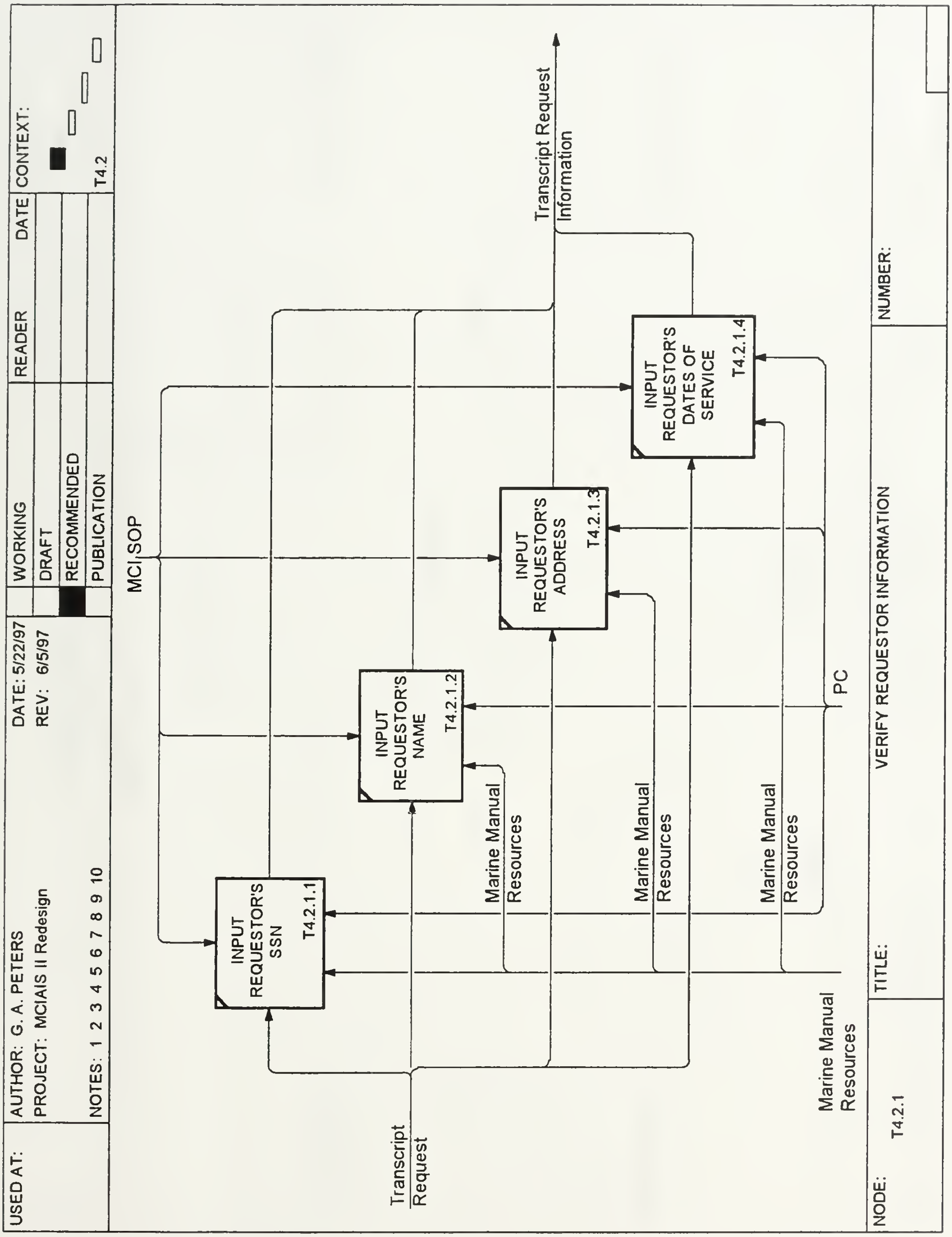


Figure C-34. To-Be Process Model IDEF0 Diagram (T4.2.1).

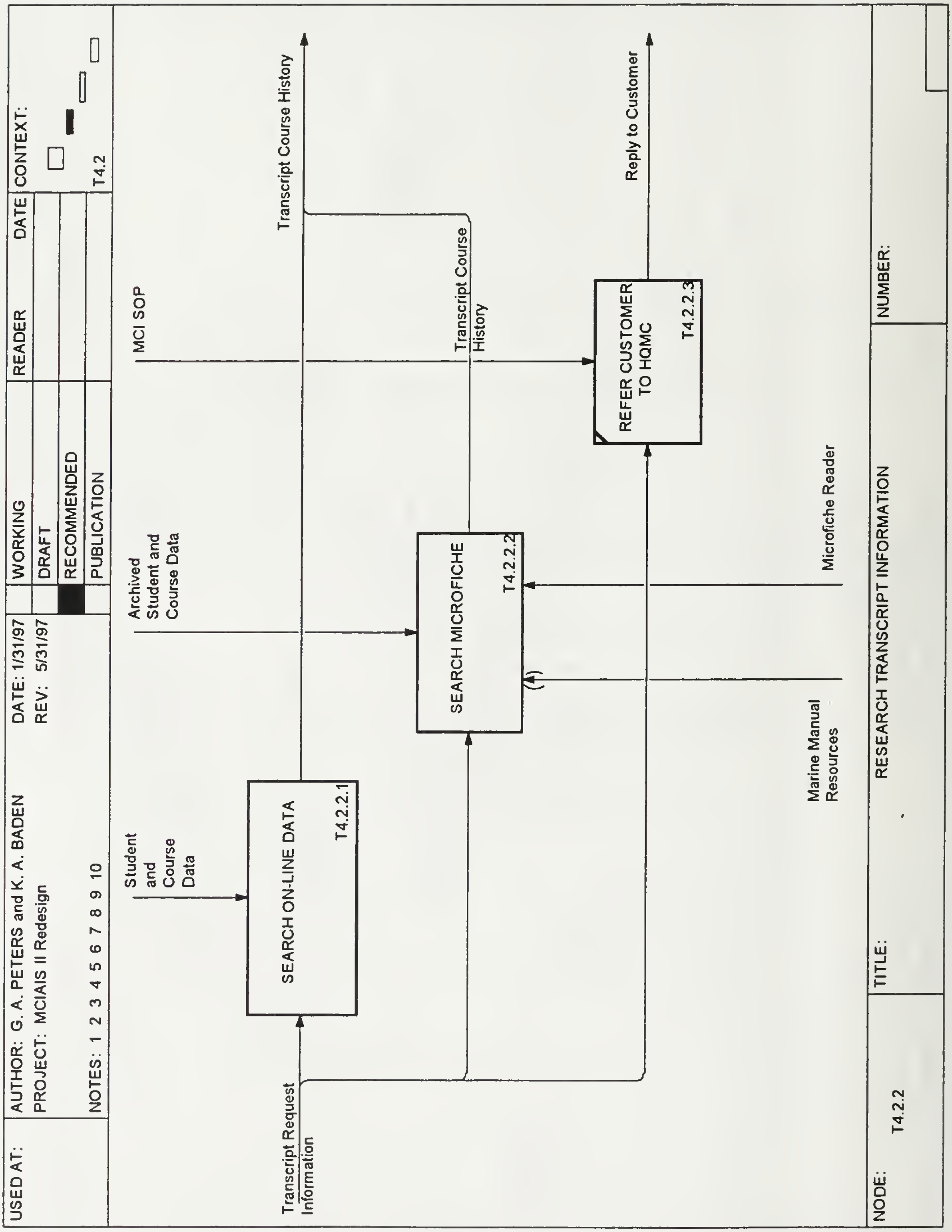


Figure C-35. To-Be Process Model IDEF0 Diagram (T4.2.2).

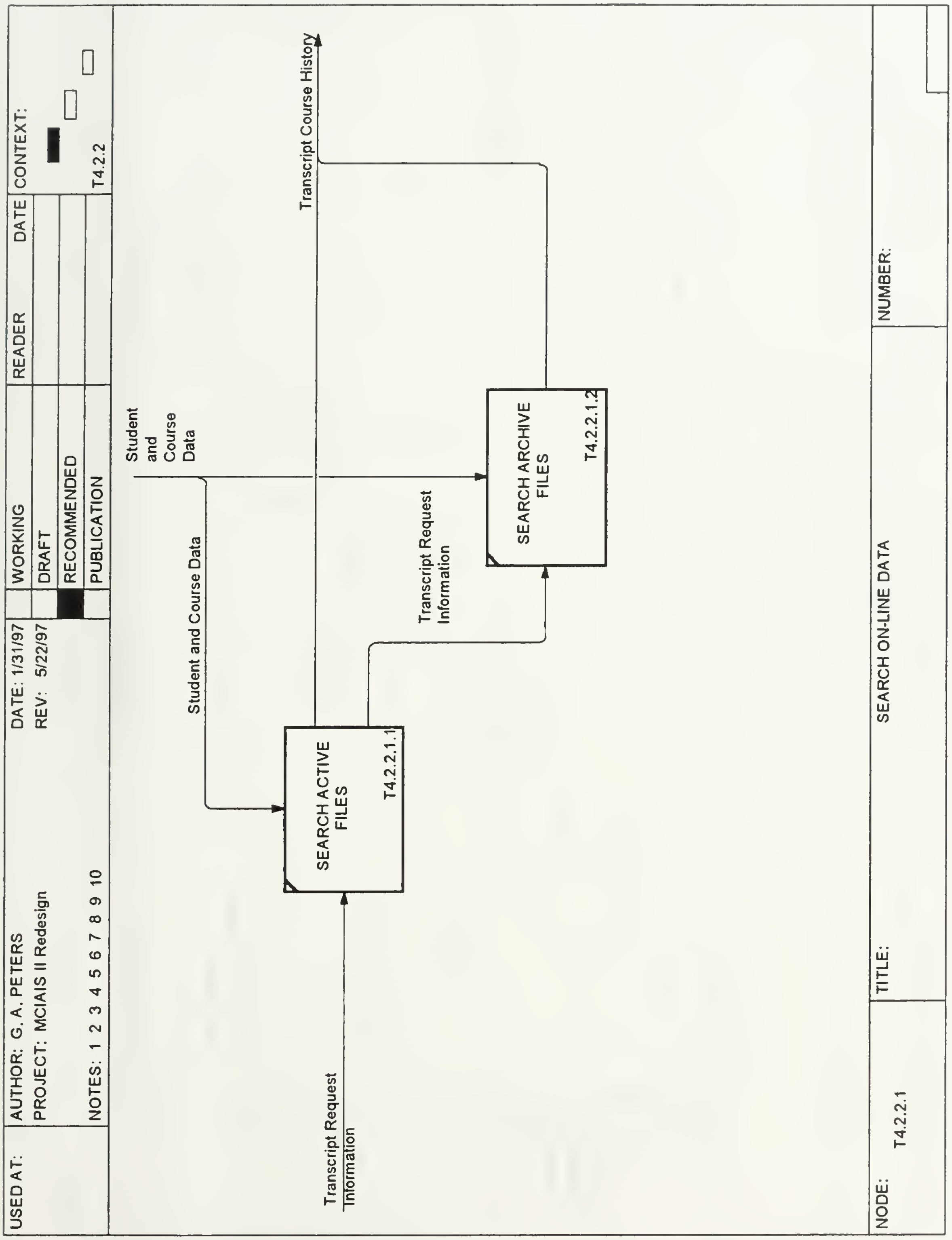


Figure C-36. To-Be Process Model IDEF0 Diagram (T4.2.2.1).

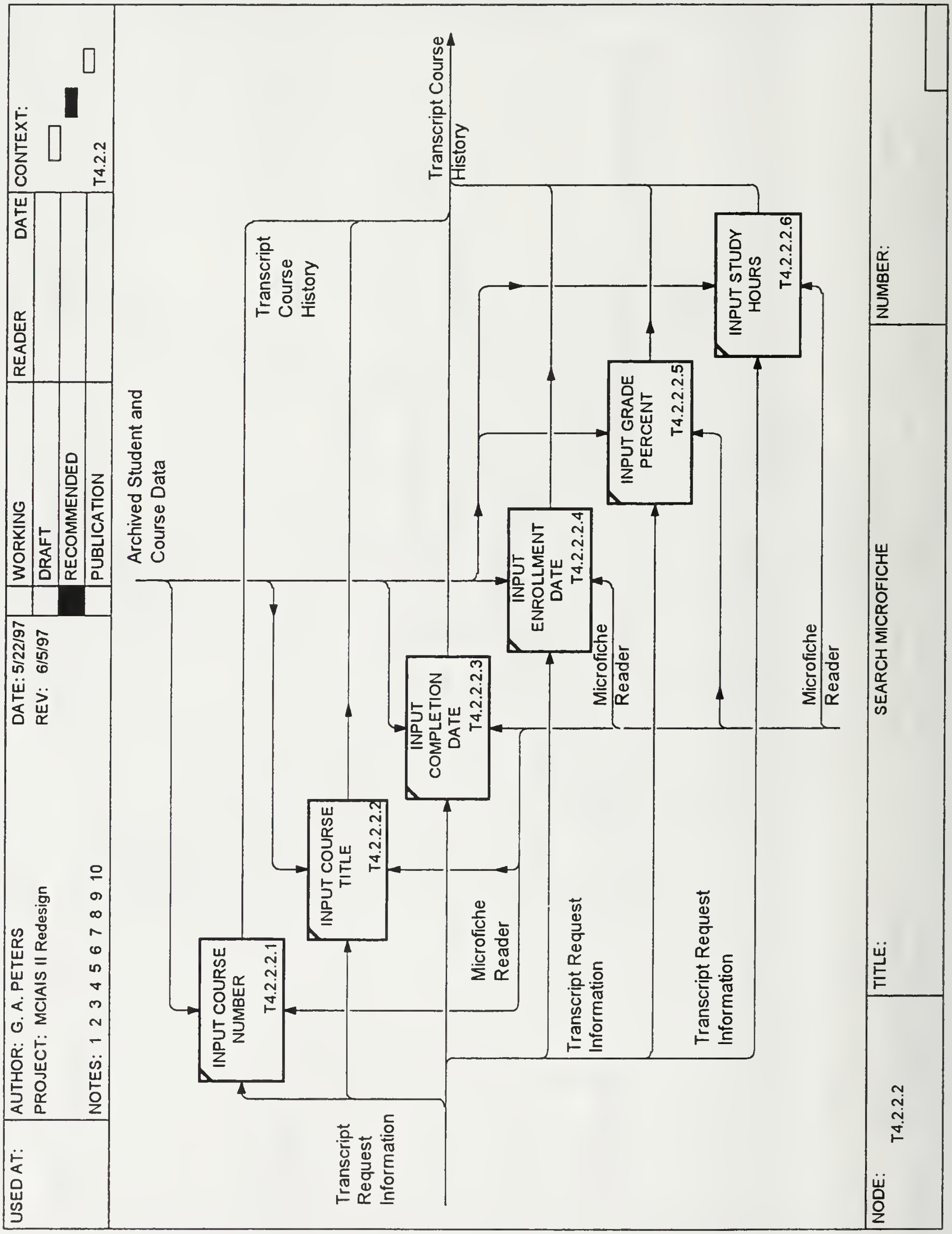


Figure C-37. To-Be Process Model IDEF0 Diagram (T4.2.2.2).

Activity Name \ Entity Name	ANSWER_CODE	CATEGORY_CODE	COMPONENTS	COMPONENT_LINE_ITEM	COURSE	COURSE_COMPONENTS_X	COURSE_LINE_ITEM	COURSE_PREREQ	COURSE_PROGRAM_X	CUSTOMER	ED_LEVEL	ERR_ANS_STRING	ERROR_CODES	ERROR_LISTING	EXAM	EXAM_COMPONENT_X	GRADE	INVOICE	JOB_AID	JOB_AID_COMPONENTS_X	JOB_AID_LINE_ITEM	MCTF_PERS	MULTIPLE_CHOICE_EXAM	NON_MARINE_STUDENT_ADDRES	PROG_COMPONENT_X	PROG_PREREQ	PROGRAM	PROGRAM_LINE_ITEM	RANK	REMEDIATION_METHOD	REPORTING_UNIT_CODE	SERVICE_COMPONENT	SSD_CLERK	STATE	STATUS_CODE	STUD_CRS_TRAN_X	STUD_PRG_TRAN_X	STUDENT	STUDENT_ANSWERS	STUDENT_COURSE_EXAM_X	STUDENT_COURSE_X	STUDENT_PROGRAM_X	TRANSACTION_CODES	TRNG_NCO_LINE_ITEM	TRNG_NCO_MATERIAL
STUDENT SERVICE SUPPORT																																													
CUSTOMER SERVICING									R													R									R					RU	RU	R			R	R			
OBTAIN CUSTOMER INPUT																																													
PROCESS INCOMING PHONECALLS																																													
PROCESS WALK-IN CUSTOMERS																																													
SORT INCOMING U.S. MAIL																																													
SEGREGATE STUDENT COURSE INPUT																																													
SEGREGATE FEEDBACK FORMS																																													
SEGREGATE GENERIC DP-37s																																													
SEGREGATE PRE-SLUGGED DP-37s																																													
SEGREGATE ESSAY EXAMS																																													
SEGREGATE MAILED INQUIRIES																																													
SEGREGATE UNIT INPUT																																													
SORT INCOMING E-MAIL																																													
SEGREGATE E-MAIL STATUS REQUEST																																													
SEGREGATE E-MAIL STATUS CHANGES																																													
SEGREGATE E-MAIL MATERIAL REQUESTS																																													
SEGREGATE E-MAIL UAR RESPONSE																																													
SEGREGATE PERSONAL E-MAIL																																													
PROVIDE UNIT ACTIVITY SERVICES									R													R									R					RU	RU	R			R	R			
PREPARE UARs									R													R									R					R	R	R			R	R			
WORK RETURNED UARs									R													R									R					RU	RU	R			R	R			
STUDENT ACTIVITY SERVICING			R	CRU	R	R	CRU	R	R	CRU				R	R	R	R	CRU	R	R	CRU	R		CRU	R	R	R	CRU	R			R			R	CRU	CRU	CRU		CRU	CRU	CRU	R	CRU	R
PROCESS ENROLLMENT					R			R	R													R		CRU		R	R					R			R	CRU	CRU	R		CRU	CRU	CRU	R		
DETERMINE TYPE OF ENROLLMENT																																													
VALIDATE ENROLLMENT REQUIREMENTS					R			R	R													R		CRU		R	R									CRU	RU	R			CRU	CRU	R		
EVALUATE SERVICE COMPONENT					R																	R					R					R						R							
EVALUATE GRADE					R												R					R					R											R							
EVALUATE COURSE/PROGRAM HISTORY					R			R	R													R		R		R	R											R			R	R			
PROCESS STATUS REQUEST					R				R	R								R																	R			R		R	R	R			
PROCESS COURSE STATUS REQUEST					R				R																		R											R		R	R	R			
DETERMINE ENROLLMENT STATUS																																						R			R	R			
DETERMINE COURSE STATUS					R				R																		R								R			R			R	R			
DETERMINE EXAMINATION STATUS					R									R																								R		R	R	R			
DETERMINE CERTIFICATION STATUS									R					R																								R		R	R	R			
PROCESS TRANSCRIPT STATUS REQUEST										R								R																		R	R								
DETERMINE PROGRESS OF RESEARCH																																													
DETERMINE TRANSCRIPT SHIP DATE										R								R																		R	R								
PROCESS MATERIAL STATUS REQUEST			R	R	R		R			R								R	R		R	R		R				R										R			R	R		R	R
DETERMINE COURSE MATERIAL STATUS					R		R			R								R										R								R	R	R					R		
DETERMINE COMPONENT SHIP STATUS			R	R						R								R																						R					
DETERMINE JOB AID SHIP STATUS										R								R	R		R																								
DETERMINE CERTIFICATION SHIP STATUS									R																													R			R	R			
DETERMINE UNIT MATERIAL SHIP DATE										R								R																										R	R
CHANGE STUDENT INFORMATION									R	RU							R					R		RU					R			R				CRU	CRU	RU		RU	RU	RU			
PROCESS NAME CHANGE																						R														CRU	CRU	RU							
PROCESS SSN CHANGE																						R														CRU	CRU	RU		RU	RU	RU			
PROCESS GRADE CHANGE																	R					R							R							CRU	CRU	RU							
PROCESS SERVICE COMPONENT CHANGE																						R										R				CRU	CRU	RU							
PROCESS SERVICE STATUS CHANGE																						R										R				CRU	CRU	RU							
PROCESS ADDRESS CHANGE										RU												R		RU												CRU	CRU	RU							
PROCESS ADMINISTRATIVE ACTION					R			R	R													R		R		R	R									CRU	CRU	R			RU	RU			
DETERMINE TYPE OF ADMIN ACTION																																													
VALIDATE ADMIN ACTION					R			R	R													R				R	R									CRU	CRU	R			R	R			
EVALUATE ENROLLMENT STATUS					R				R																		R											R			R	R			
EVALUATE EXAM ISSUE STATUS									R					R																								R		R	R	R			
EVALUATE COURSE HISTORY									R																													R			R	R			
EVALUATE OTHER COURSE CREDIT					R			R	R																	R	R											R			R	R			
PROCESS REQUEST FOR MATERIAL			R	CRU	R	R	CRU		R	CRU						R		CRU	R	R	CRU	R		R	R		R	CRU										R			R	R		CRU	R
DETERMINE MATERIAL AVAILABILITY			R		R	R			R						R	R			R	R					R		R								R										R
VALIDATE MATERIAL REQUIREMENTS			R		R	R																R		R			R														R				
EVALUATE STUDENT STATUS																																						R			R	R			
EVALUATE MILITARY/DOD STATUS					R				R										R								R					R													R
EVALUATE UNIT REP STATUS																						R																							
EVALUATE FOREIGN MILITARY STATUS					R				R										R			R		R			R					R													R
GRADING	R	R							R			CRU	R	CRUD	R							R	R													CRU	CRU	R	CRU	RU	RU	RU	R		
PROCESS DP-37s																																													
PROCESS PRE-SLUGGED DP-37s																																													
SCAN PRE-SLUGGED DP-37s																																													
PROCESS GENERIC DP-37s																																													
SCAN GENERIC DP-37s																																													
FILE SCANNED PRE-SLUGGED DP-37s																																													
FORWARD UNSCANNED PS DP-37s																																													
FILE SCANNED GENERIC DP-37s																																													
FORWARD UNSCANNED GEN DP-37s																																													
PROCESS HAND GRADED EXAMS									R														R																	RU			R		
HAND GRADE NON-SCANNABLE DP-37s									R														R																						
ENTER HAND GRADED EXAMS SCORES									R																															RU			R		
ENTER SCORES FOR PME EXAMS									R																															RU		R	R		
RUN GRADING PROGRAM	R	R							R			CRU		CRUD	R								R													R	R		CRU	RU	R	R	R		
EDIT DP-37 DATA																																							CRU						
EDIT PRE-SLUGGED DP-37 DATA																																							CRU	RU					
EDIT GENERIC DP-37 DATA																																							CRU	RU					
ANALYZE DP-37 DATA	R	R							R			CRU		CRU	R								R							R						R	R		R	RU	R	R	R		
EVALUATE EXAM	R	R										CRU		CRU	R								R							R						R	R		R	RU	R	R	R		
COMPARE STUDENT RECORD HISTORY									R																													R		R	R				
PROCESS OPSCAN ERRORS												RU	R	CRUD								R																R					R		
PRODUCE OPSCAN ERROR REPORT												R	R	R																															
CORRECT ERRONEOUS DP-37									R			RU	R	RUD								R																R			R		R		
FIND ERRONEOUS DP-37																																													
REGISTRAR SERVICING									R	CRU								CRU						R							R	R					CRU	R			R	R	R		
ISSUE DIPLOMA									R													R		R							R	R					CRU	R			R	R	R		
PRINT DIPLOMAS									R													R		R							R	R					CRU	R			R	R	R		
PACKAGE DIPLOMA FOR MAILING																																													
ISSUE TRANSCRIPT										CRU								CRU				R		R							R	R						R			R		R		
VERIFY REQUESTOR INFORMATION										CRU								CRU																				R			R				
INPUT REQUESTOR'S SSN																																													
INPUT REQUESTOR'S NAME																																													
INPUT REQUESTOR'S ADDRESS																																													
INPUT REQUESTOR'S DATES OF SERVICE																																													
RESEARCH TRANSCRIPT INFORMATION																																						R			R				
SEARCH ON-LINE DATA																																						R			R				
SEARCH ACTIVE FILES																																						R			R				
SEARCH ARCHIVE FILES																																						R			R				
SEARCH MICROFICHE																																													
INPUT COURSE NUMBER																																													
INPUT COURSE TITLE																																													
INPUT COMPLETION DATE																																													
INPUT ENROLLMENT DATE																																													
INPUT GRADE PERCENT																																													
INPUT STUDY HOURS																																													
REFER CUSTOMER TO HQMC																																													
PRINT TRANSCRIPT																																						R			R				
PACKAGE TRANSCRIPT FOR MAILING																																													

Figure C-38. To-Be Process Model Matrix.

Activity Name \ Entity Name	STUD_CRS_TRAN_X	STUD_PRG_TRAN_X	STUDENT	STUDENT_COURSE_X	STUDENT_PROGRAM_X	COURSE_PROGRAM_X	MCTF_PERS	REPORTING_UNIT_CODE	NON_MARINE_STUDENT_ADDRES	COURSE	PROGRAM	TRANSACTION_CODES	SERVICE_COMPONENT	JOB_AID	TRNG_NCO_MATERIAL	PROG_PREREQ	COURSE_PREREQ	COMPONENTS	COURSE_COMPONENTS_X	EXAM_COMPONENT_X	PROG_COMPONENT_X	STATUS_CODE	GRADE	RANK	CUSTOMER	INVOICE	COMPONENT_LINE_ITEM	COURSE_LINE_ITEM	JOB_AID_LINE_ITEM	PROGRAM_LINE_ITEM	TRNG_NCO_LINE_ITEM	JOB_AID_COMPONENTS_X	STUDENT_COURSE_EXAM_X	ERR_ANS_STRING	ERROR_LISTING	STUDENT_ANSWERS	EXAM	MULTIPLE_CHOICE_EXAM	ERROR_CODES	ANSWER_CODE	CATEGORY_CODE	REMEDIATION_METHOD	SSD_CLERK	ED_LEVEL	STATE
STUDENT SERVICE SUPPORT	C	C	C	C	C	R	R	R	C	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	C	C	C	C	C	C	R	C	C	C	C	R	R	R	R	R	R			
CUSTOMER SERVICING	C	C	R	R	R	R	R	R																																					
PROVIDE UNIT ACTIVITY SERVICES	C	C	R	R	R	R	R	R																																					
PREPARE UARs	R	R	R	R	R	R	R	R																																					
WORK RETURNED UARs	C	C	R	R	R	R	R	R																																					
STUDENT ACTIVITY SERVICING	C	C	C	C	C	R	R		C	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	C	C	C	C	C	C	R	C		R		R								
PROCESS ENROLLMENT	C	C	R	C	C	R	R		C	R	R	R	R			R	R					R											C												
VALIDATE ENROLLMENT REQUIREMENTS	C	C	R	C	C	R	R		C	R	R	R				R	R																												
CHANGE STUDENT INFORMATION	C	C	C	C	C	R	R		C				R										R	R	C								C												
PROCESS NAME CHANGE	C	C	C				R																																						
PROCESS SSN CHANGE	C	C	C	C	C		R																										C												
PROCESS GRADE CHANGE	C	C	C				R																R	R																					
PROCESS SERVICE COMPONENT CHANGE	C	C	C				R						R																																
PROCESS SERVICE STATUS CHANGE	C	C	C				R						R																																
PROCESS ADDRESS CHANGE	C	C	C				R		C																C																				
PROCESS ADMINISTRATIVE ACTION	C	C	R	C	C	R	R		R	R	R					R	R																												
VALIDATE ADMIN ACTION	C	C	R	C	C	R	R			R	R					R	R																												
EVALUATE SERVICE COMPONENT			R				R			R	R		R																																
EVALUATE GRADE			R				R			R	R												R																						
EVALUATE COURSE/PROGRAM HISTORY			R	R	R	R	R		R	R	R					R	R																												
PROCESS STATUS REQUEST			R	R	R	R				R												R			R	R							R												
PROCESS COURSE STATUS REQUEST			R	R	R	R				R	R																						R												
DETERMINE ENROLLMENT STATUS			R	R	R																																								
DETERMINE COURSE STATUS			R	R	R	R				R	R											R																							
DETERMINE EXAMINATION STATUS			R	R	R					R																							R		R										
DETERMINE CERTIFICATION STATUS			R	R	R	R																											R		R										
PROCESS TRANSCRIPT STATUS REQUEST	R	R																							R	R																			
DETERMINE TRANSCRIPT SHIP DATE	R	R																							R	R																			
PROCESS MATERIAL STATUS REQUEST			R	R	R		R		R	R				R	R			R							R	R	R	R	R	R	R														
DETERMINE COURSE MATERIAL STATUS	R	R	R							R		R													R	R		R		R															
DETERMINE COMPONENT SHIP STATUS																		R							R	R	R						R												
DETERMINE JOB AID SHIP STATUS														R											R	R			R																
DETERMINE CERTIFICATION SHIP STATUS			R	R	R	R																																							
DETERMINE UNIT MATERIAL SHIP DATE															R										R	R					R														
EVALUATE ENROLLMENT STATUS			R	R	R	R				R	R																																		
EVALUATE EXAM ISSUE STATUS			R	R	R	R																											R		R										
EVALUATE COURSE HISTORY			R	R	R	R																																							
EVALUATE OTHER COURSE CREDIT			R	R	R	R				R	R					R	R																												
PROCESS REQUEST FOR MATERIAL			R	R	R	R	R		R	R	R			R	R			R	R	R	R				C	C	C	C	C	C	C	R													
DETERMINE MATERIAL AVAILABILITY						R				R	R			R	R			R	R	R	R	R										R					R								
VALIDATE MATERIAL REQUIREMENTS				R			R		R	R	R							R	R																										
EVALUATE STUDENT STATUS			R	R	R																																								
EVALUATE MILITARY/ DOD STATUS						R				R	R		R	R	R																														
EVALUATE UNIT REP STATUS							R																																						
EVALUATE FOREIGN MILITARY STATUS						R	R		R	R	R		R	R	R																														
GRADING	R	R	R	R	R	R	R					R																					C	C	C	C	R	R	R	R	R				
PROCESS HAND GRADED EXAMS						R						R																					C					R							
HAND GRADE NON-SCANNABLE DP-37s						R																																R							
ENTER HAND GRADED EXAMS SCORES						R						R																					C												
ENTER SCORES FOR PME EXAMS					R	R						R																					C												
RUN GRADING PROGRAM	R	R		R	R	R						R																					C	C	C	C	R	R		R	R				
EDIT DP-37 DATA																																				C									
EDIT PRE-SLUGGED DP-37 DATA																																	C			C									
EDIT GENERIC DP-37 DATA																																	C			C									
ANALYZE DP-37 DATA	R	R		R	R	R						R																					C	C	C	R	R	R		R	R	R			
EVALUATE EXAM	R	R		R	R							R																					C	C	C	R	R	R		R	R	R			
COMPARE STUDENT RECORD HISTORY			R	R		R																											R												
PROCESS OPSCAN ERRORS			R				R					R																						C	C				R						
PRODUCE OPSCAN ERROR REPORT																																		R	R				R						
CORRECT ERRONEOUS DP-37			R	R		R	R					R																						C	C				R						
REGISTRAR SERVICING		C	R	R	R	R	R	R	R			R	R												C	C																			
ISSUE DIPLOMA		C	R	R	R	R	R	R	R			R	R																																
PRINT DIPLOMAS		C	R	R	R	R	R	R	R			R	R																																
ISSUE TRANSCRIPT			R	R			R	R	R			R	R												C	C																			
VERIFY REQUESTOR INFORMATION			R	R																					C	C																			
RESEARCH TRANSCRIPT INFORMATION			R	R																																									
SEARCH ON-LINE DATA			R	R																																									
SEARCH ACTIVE FILES			R	R																																									
SEARCH ARCHIVE FILES			R	R																																									
PRINT TRANSCRIPT			R	R																																									

Figure C-39 To-Be Process Model Clustered CR Matrix.

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