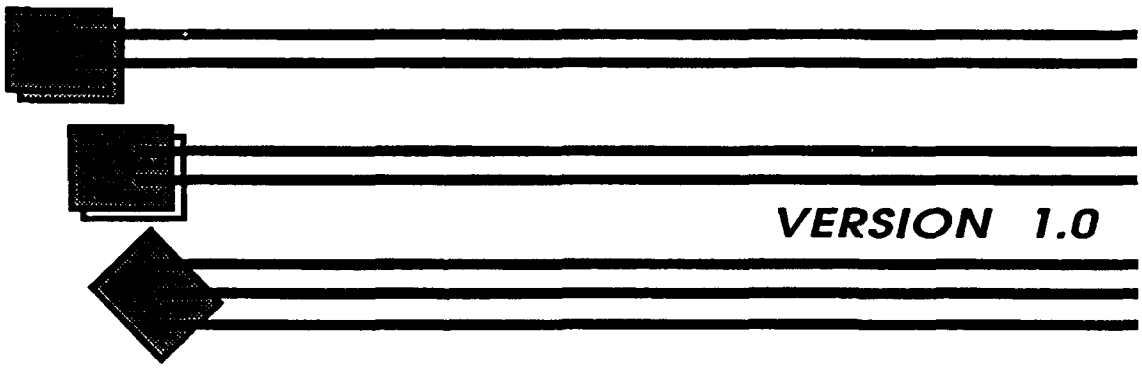
Defense Information Systems Agency
Joint Interoperability Engineering Organization
Center for Information Management
701 South Courthouse Road; Arlington, VA 22204-2199

Center for Information Management Software Systems Reengineering Process Model



VERSION 1.0

Prepared by

**Software Systems Engineering Directorate
Reengineering Division**

FOREWORD

This document was prepared by the Defense Information Systems Agency, Joint Interoperability Engineering Organization (DISA/JIEO), Center for Information Management, sponsored by the Office of the Director of Defense Information. The Software Systems Engineering Directorate would like to thank the participants in the Software Systems Reengineering Process Model Workshop, held on June 22-24, 1993, for their contribution to the development of the CIM Software Systems Reengineering Process Model, Version 1.0, August 1993. These participants represented the following organizations:

Department of the Army, Army Research Laboratory, Atlanta, Ga

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Defense Information Technology Services Organization, Columbus, Oh

Defense Information Technical Services Organization, Indianapolis, In

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ABSTRACT

The Center for Information Management (CIM) Software Systems Reengineering Process Model provides guidance for applying software reengineering technology for the development and modernization of automated information systems (AISs) within the Department of Defense (DoD). The CIM is chartered to support the Director of Defense Information by providing information management technical services to the DoD community. The services are an integral part of the Corporate Information Management program, a DoD-wide effort to streamline business operations and processes which will help improve the design of cost-effective, standard information systems. This paper defines the CIM software reengineering process composed of activities for creating AISs to support current business needs. The purpose of the CIM Software Systems Reengineering Process Model is to capture the essence of software reengineering as it applies in the DoD Information Management (IM) community. The activities described in the Model compose the software reengineering process, including Define Project (initial project planning), Reverse Engineer, and Forward Engineer. The Model is represented using the IDEF0 Activity Modeling technique, the DoD standard for process modeling. The intended audience for the Model is any organization within DoD tasked to reengineer AISs. Functional Process Improvement drives the overall software reengineering process, by guiding managers to identify the current business needs and implement business process improvements.

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1. INTRODUCTION

The Center for Information Management (CIM) Software Systems Reengineering Process Model provides guidance for applying software reengineering technology for the development and migration of automated information systems (AISs) within the Department of Defense (DoD). The CIM is chartered to support the Director of Defense Information OSD (DDI) by providing information management technical services to the DoD community. The services are an integral part of the Corporate Information Management program, a DoD-wide effort to streamline business operations and processes which will help improve the design of cost-effective, standard information systems. This document introduces the reader to the CIM software reengineering process composed of activities for creating AISs to support current business needs. The activities in the CIM Software Reengineering Process Model provide this introduction through a textual and graphical representation.

1.1 Purpose

The purpose of the CIM Software Systems Reengineering Process Model is to capture the essence of software reengineering as it applies in the DoD Information Management (IM) community. Two broad concepts guide software reengineering in the DoD. The first concept is the prevention of duplication by joint use of personnel, information systems, facilities, and services across DoD. The second concept is conformance to new regulations, policy, standards, and guidelines for software acquisition and support. These standards include using the Ada Programming language (MIL-STD-1815A), moving towards open systems environments (FIPS 146-2, Government Open-Systems Interconnection Protocol), and complying with POSIX (FIPS 151-1, Portable Operating System Interface Exchange). Guidelines include integrating Commercial-Off-The-Shelf (COTS) products whenever possible, including Computer-Aided Software Engineering (CASE) products. The Model integrates the software reengineering process with the mechanisms provided by these available

technologies that provide the software engineering environment and the regulations, policy, standards and guidelines governing software development and maintenance under DoD IM.

Only recently have there been reengineering efforts of the magnitude to produce data that is useful in predicting the success of reengineering. Some of these efforts have defined process models and were examined in preparation for defining the CIM Software Systems Reengineering Process Model [1, 2, 7, 8, 9]. The Model represents a view of software reengineering that is independent of specific tools, methodologies, and domains.

1.2 Viewpoint

The intended audience for the CIM Software Systems Reengineering Process Model is any organization within DoD tasked to reengineer AISs. The Model serves as a guide for planning and implementing software reengineering for a variety of software engineering needs. Any part of the Model may be tailored and implemented to meet organizational goals through software reengineering technology.

Reengineering emerges as a strategy for bringing the cost of developing and maintaining software under control. The need for a comprehensive plan to apply software reengineering technology is the driving force behind the CIM Reengineering Program. The CIM Software Systems Reengineering Process Model will assist managers facing this situation.

1.3 Context

The software reengineering process for DoD AIS is defined by the process model described in this document. This process is composed of activities that examine existing software systems and utilize resources extracted from these systems to develop new AISs. Figure 1 presents a frame of reference for this reengineering process. It relates systems reengineering to other processes within the IM domain. For clarity, Figure 1 shows only major inputs and outputs.

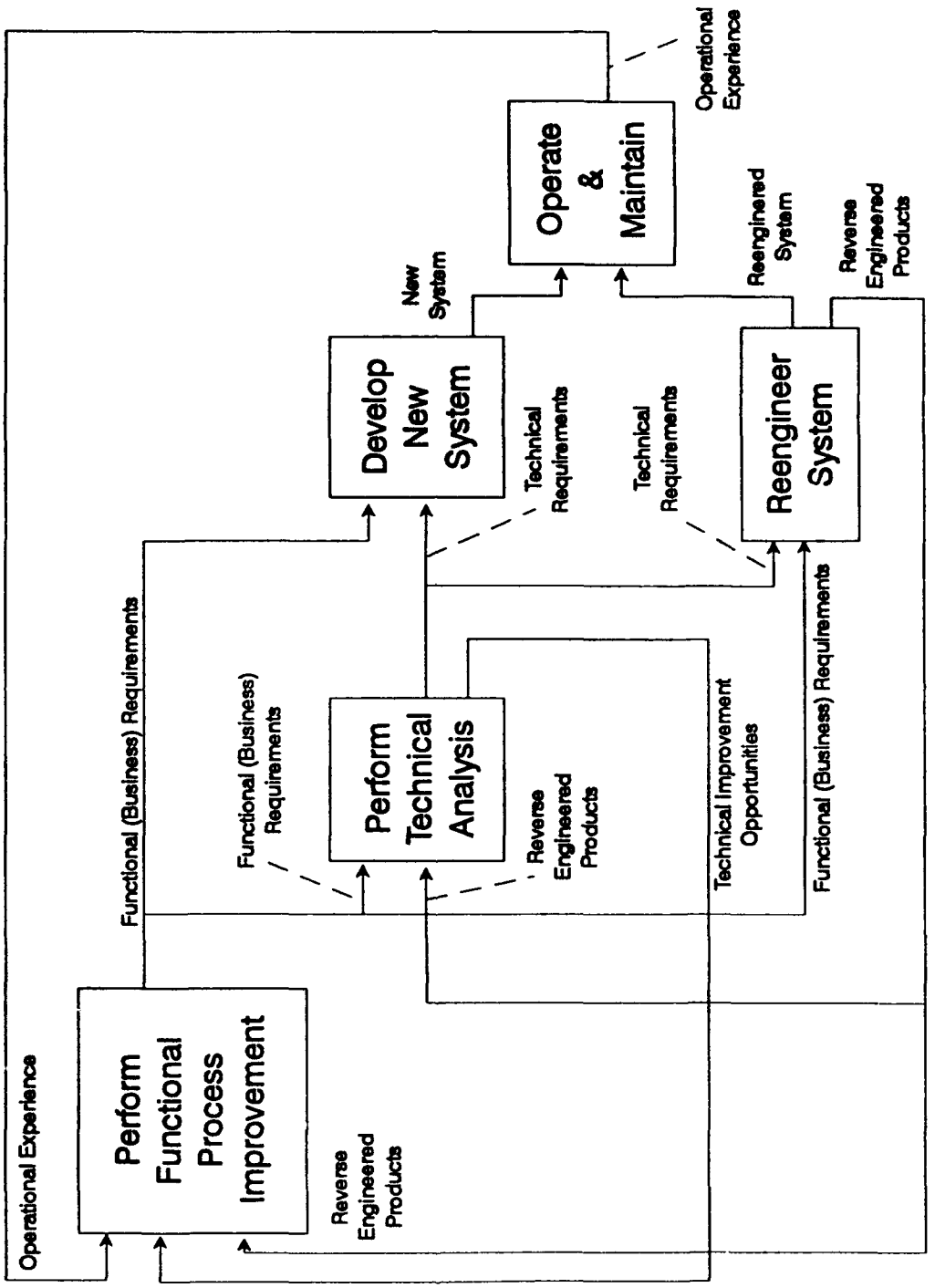

Figure 1. Context for Software Reengineering

Functional Process Improvement (FPI) drives the overall software reengineering process [3]. FPI guides managers to identify the current business needs and implement business process improvements. Reverse engineering is employed to obtain an accurate description of the current AIS environment. The functional requirements are forward engineered into new AISs according to appropriate standards. These standards include DoD-STD-2167A, Defense System Software Development; MIL-STD-7935A, DoD AIS Documentation Standards; the proposed MIL-STD-SDD, Software Development and Documentation; and DoD-STD-1703 (NS), Software Product Standards. A process for performing reengineering is defined by the CIM Software Systems Reengineering Process Model described in this paper.

FPI programs enable functional managers to identify current problems, including poor business practices, establish costs for business activities, propose changes and implement business improvements. Improvement opportunities may result from technology changes identified in the Technical Analysis Process or operational experience with existing AISs. In addition, reverse engineered products, including business rules, process models, and data models, may be required if information on the existing business processes are not well documented.

Technical analysis is performed to determine the technical and economic feasibility of using AISs to support the business processes. Characteristics of the current AIS environment are compared with the functional requirements and available commercial technologies. Reverse engineered products may be required if an accurate description of the current AIS baseline does not exist. The technical analysis process produces recommendations on the use of technology and eventually an implementation plan.

The functional and technical requirements are then used to develop a new system or reengineer an existing system. New systems follow processes specified in existing military or commercial standards. The software reengineering process is defined in the CIM Software Systems Reengineering Process Model. After development or reengineering, AISs are operated and maintained under configuration control.

1.4 Process Model Overview

The activities described in the CIM Software Systems Reengineering Process Model capture the essence of the software reengineering process as it applies in the DoD IM community. This process is composed of three high-level activities, including Define Project (initial project planning), Reverse Engineer, and Forward Engineer.

Initial project planning establishes a framework in which the reengineering effort must conform to resource limitations and organizational goals, while adhering to the functional process improvement initiative expressed in the DoD Enterprise Model and Functional Area Models.

This Model serves as a guide to performing software reengineering to develop and support automated information systems which implement functional and technical requirements, while in the context of the DoD Enterprise Model.

1.5 IDEF Activity Modeling Overview

The CIM Software Systems Reengineering Process Model is represented using the Integrated Computer-Aided Manufacturing (ICAM) DEFinition language (IDEF). IDEF was developed in the United States Air Force ICAM program. Today, the IDEF method is required for all activity modeling [3]. IDEF0 is used to produce a functional model that is a structured representation of activities or functions and the relationship between those activities.

IDEF0 models are composed of activities ("what is done") and interfaces, including inputs, controls, outputs, and mechanisms (Figure 2). Activities are represented as boxes and the interfaces are depicted as arrows, entering and leaving the boxes. Inputs enter from the left and outputs leave from the right of the box; the activity transforms inputs to outputs. Controls enter at the top of the box; they provide direction and constraint. Mechanisms, representing the means used to perform the activity, enter from the bottom. Mechanisms may include, people, databases, or equipment that support or perform the activity.

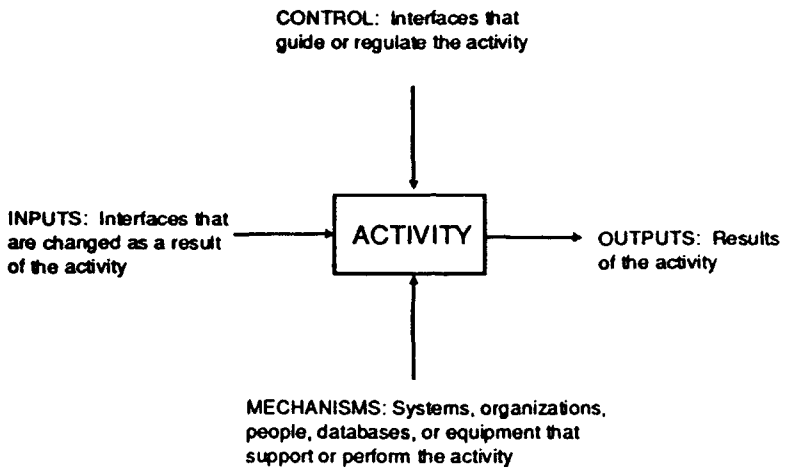

Figure 2. IDEF Activity Model

The organization of the IDEF0 activities and their relationships with each other are not related to, concerned with, or limited by time. These activities are refined into greater detail in subsequent diagrams.

2. CIM SOFTWARE SYSTEMS REENGINEERING PROCESS MODEL

The CIM Software Systems Reengineering Process Model diagrams are shown in Appendix A of this document.

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3. GLOSSARY

The Glossary for the CIM Software Systems Reengineering Process Model is located in Appendix B of this document.

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APPENDIX A. CIM Software Systems Reengineering Process Model Diagrams

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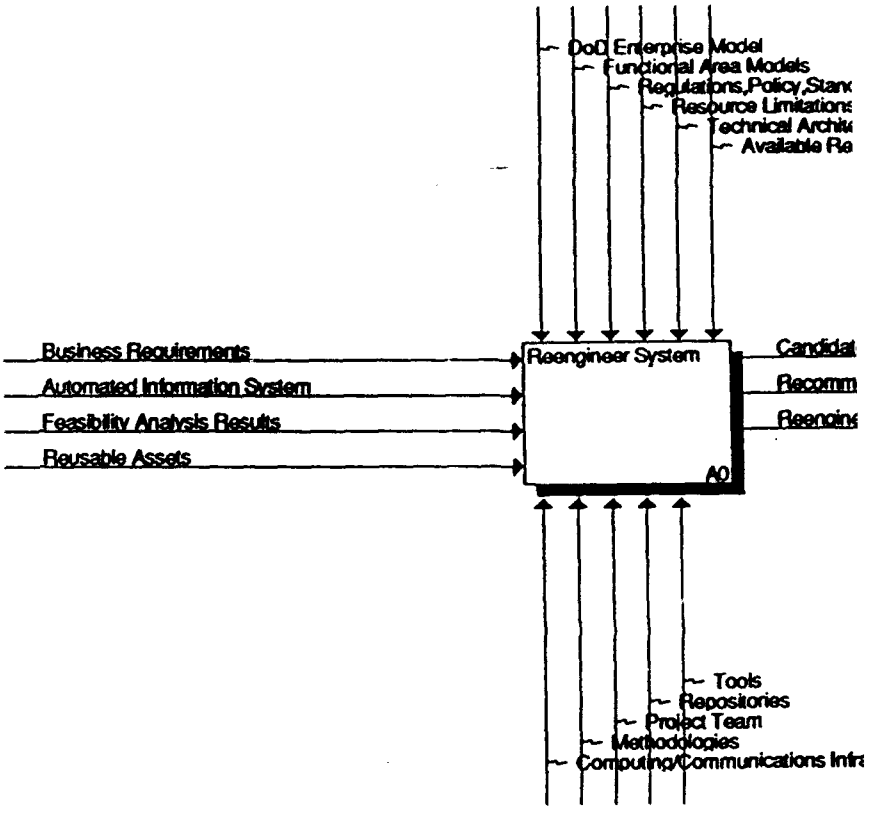

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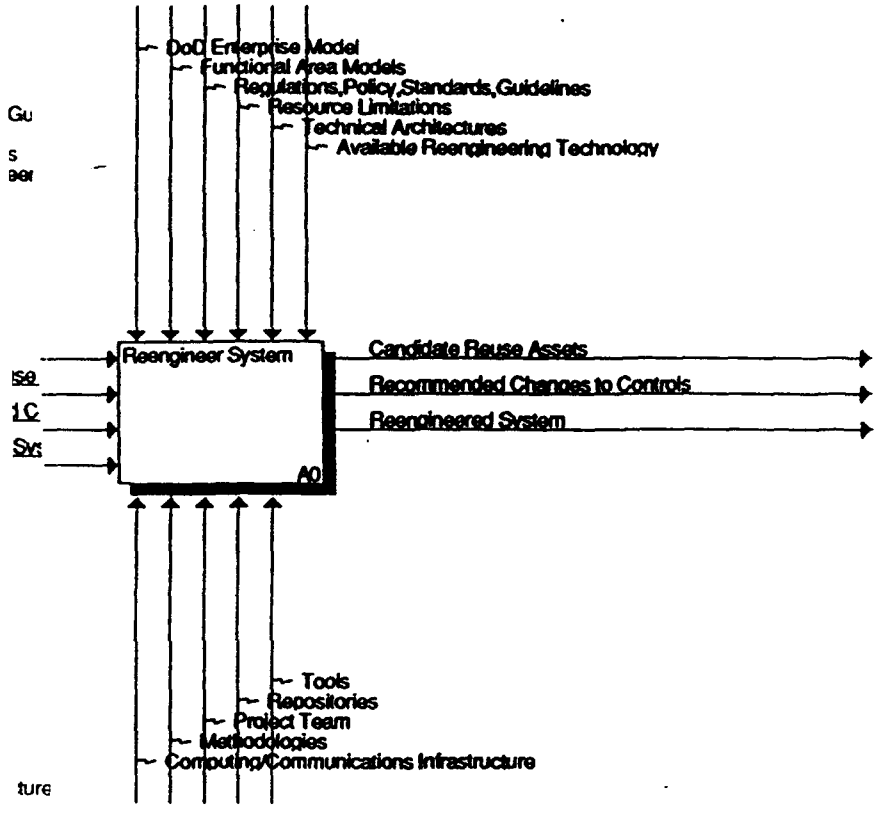

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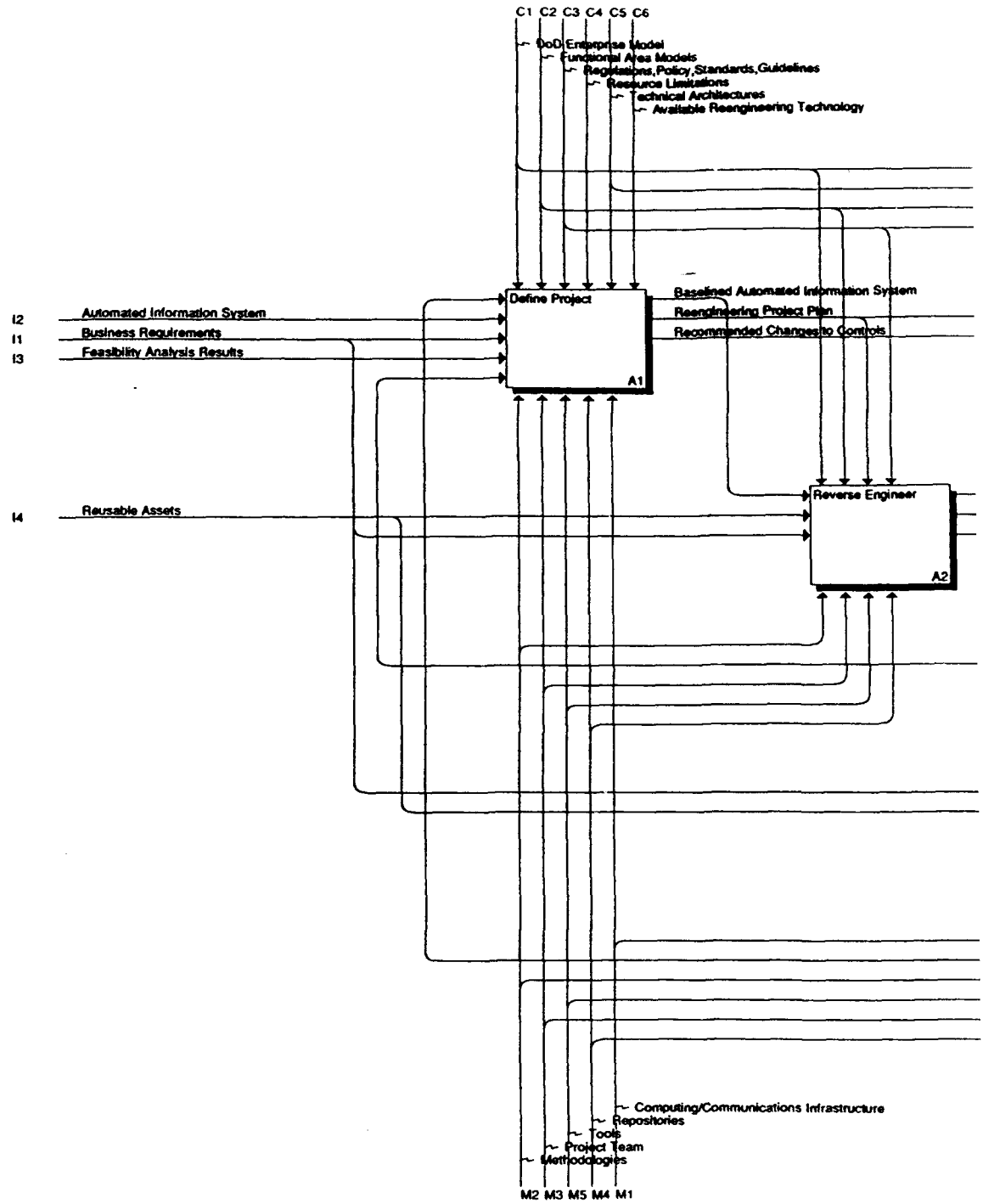

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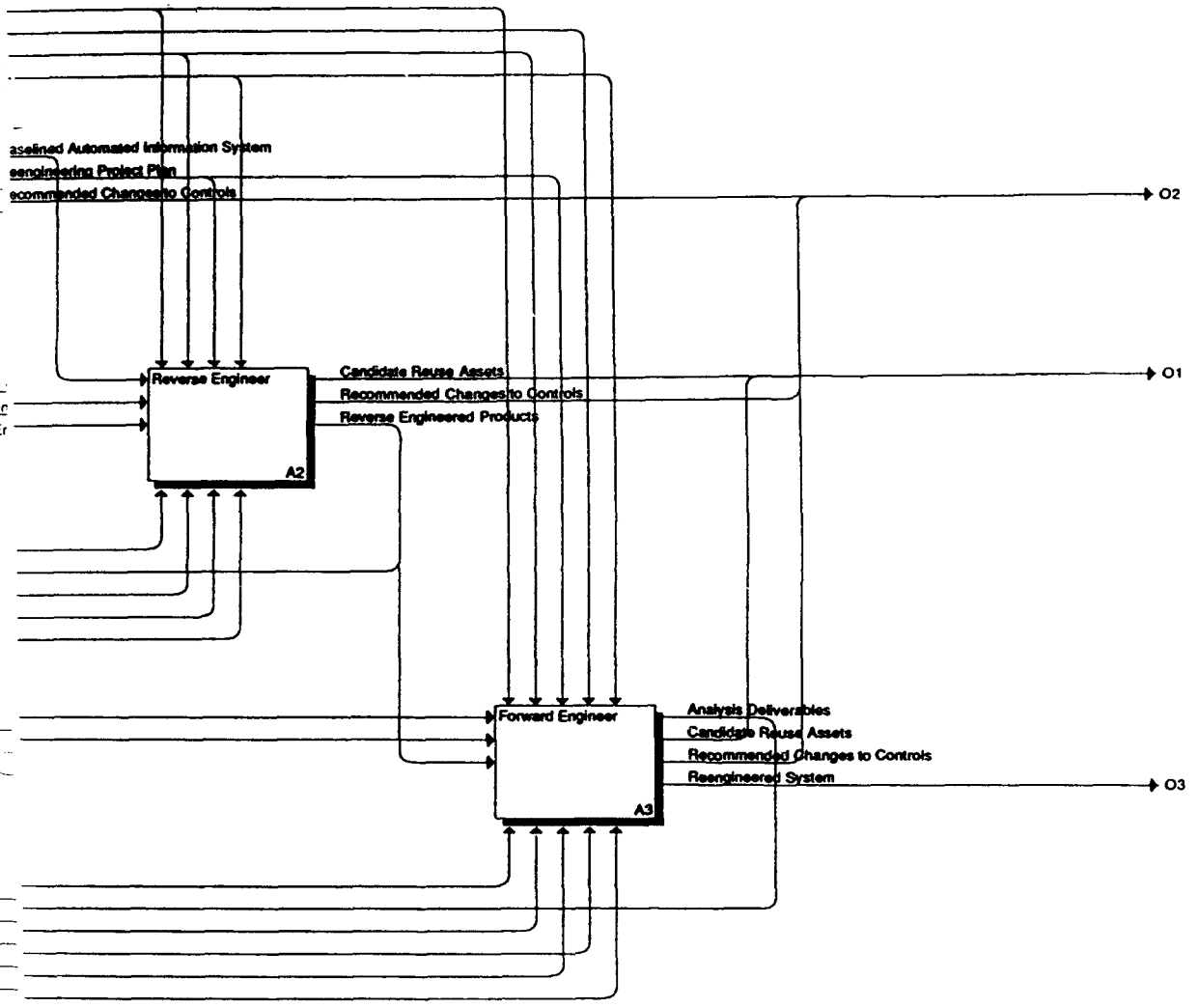

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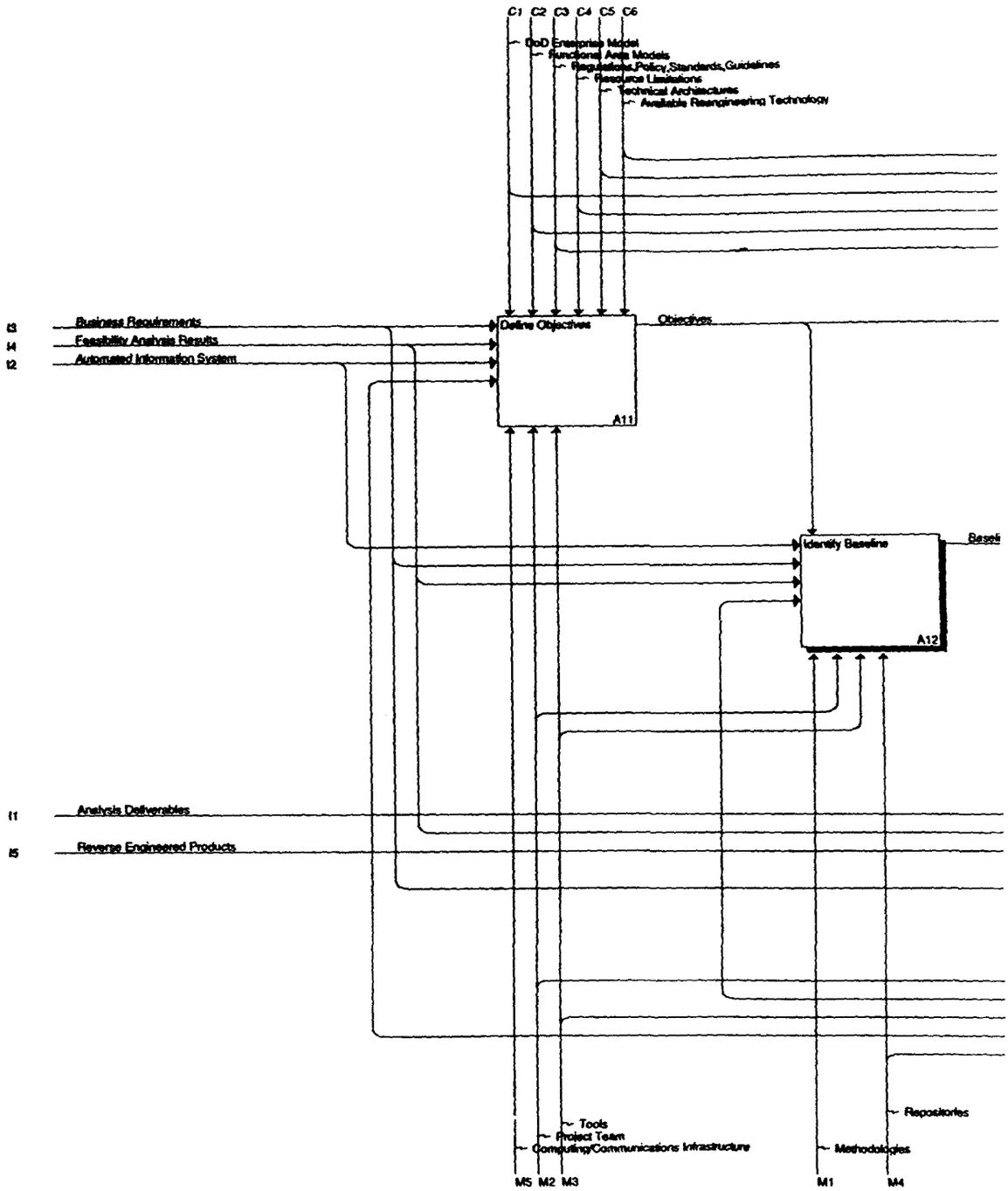

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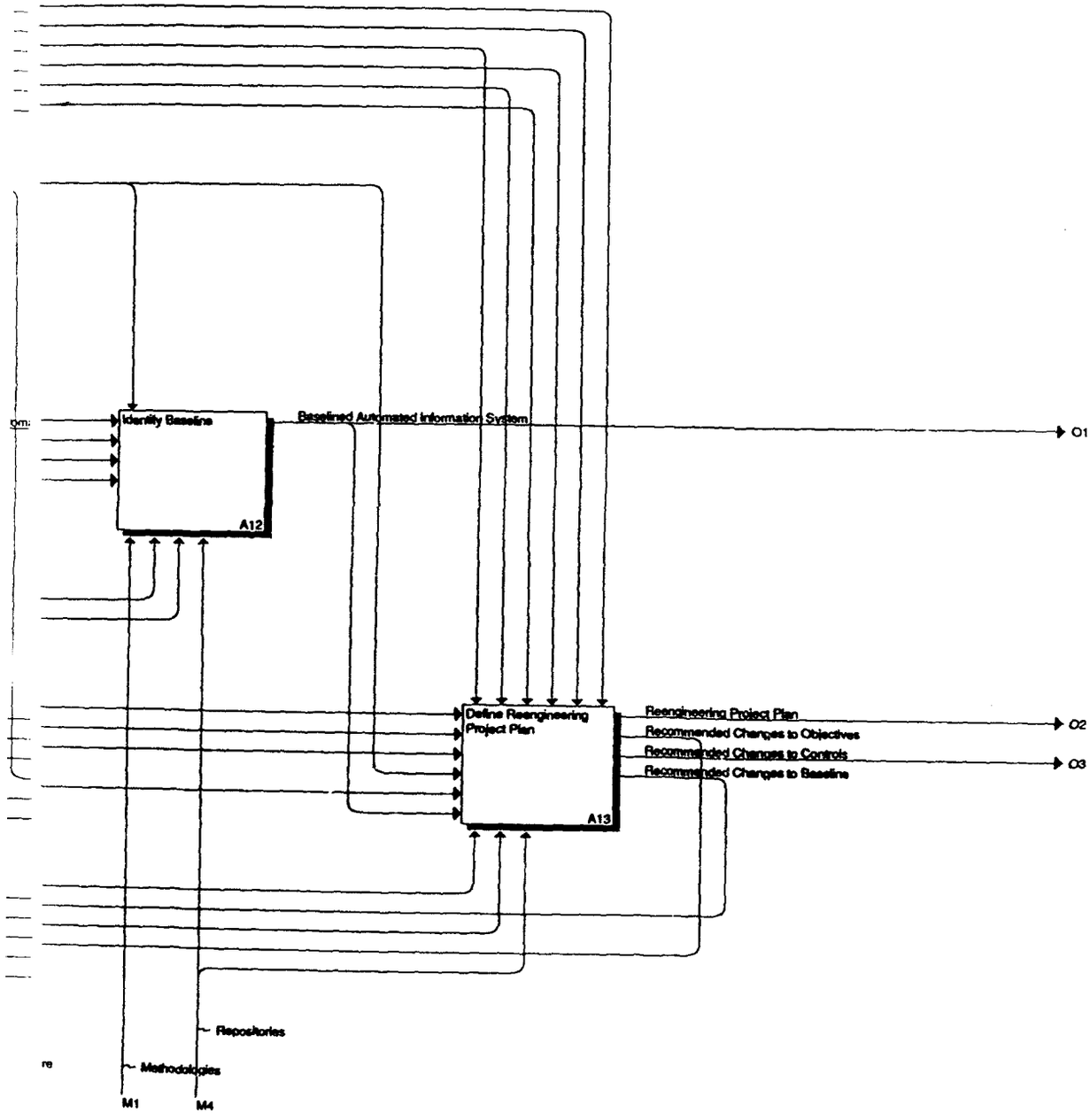

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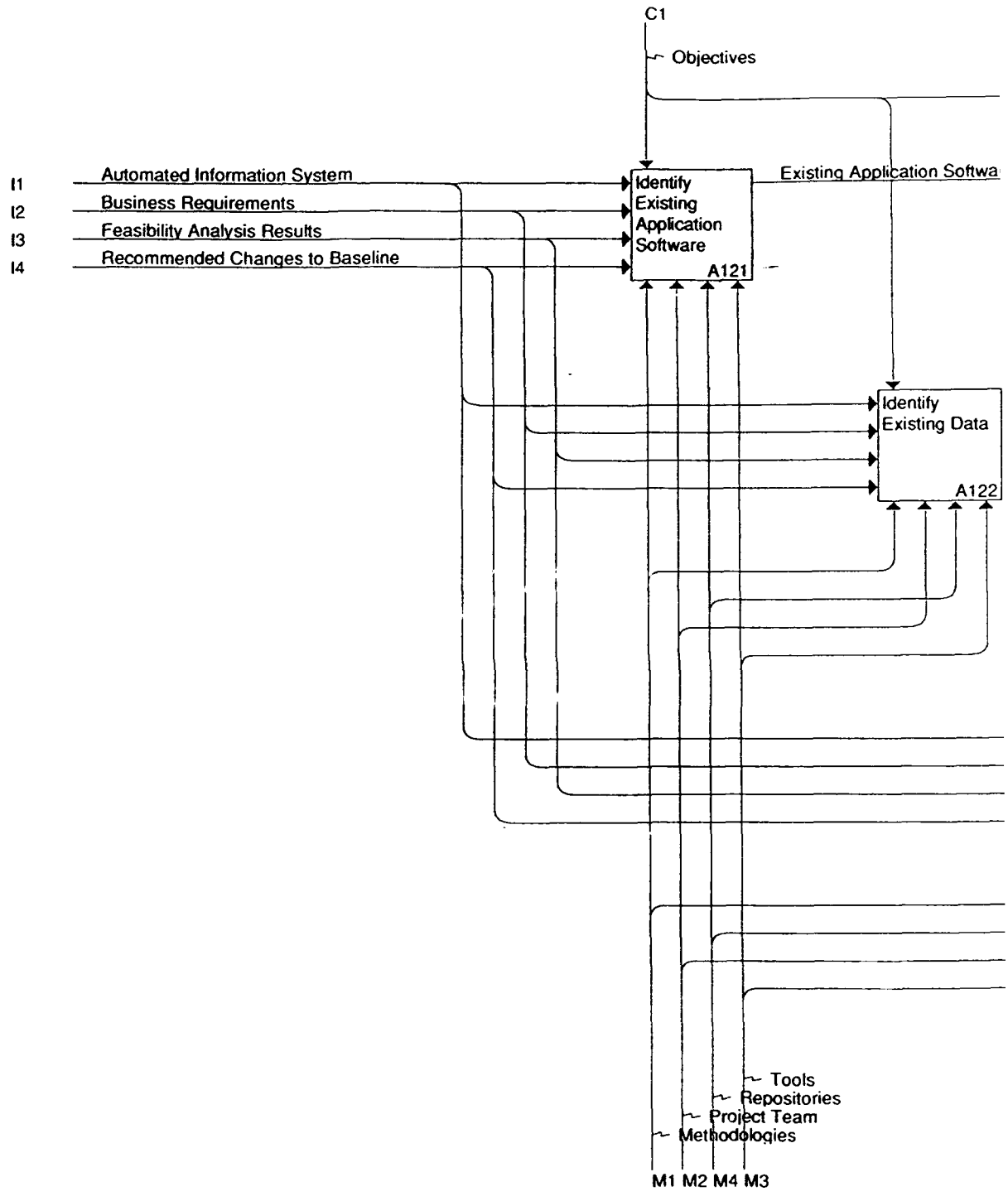

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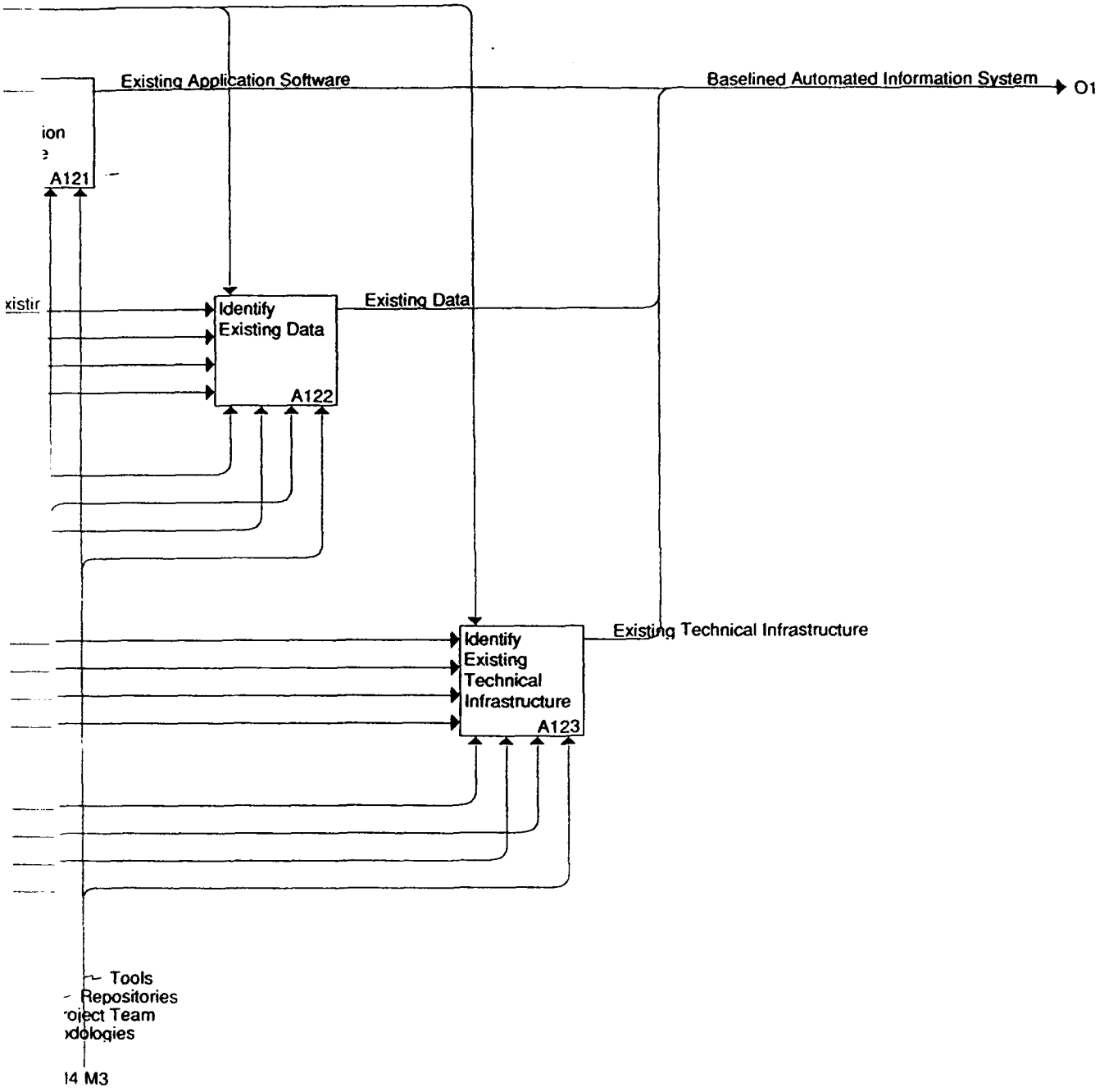

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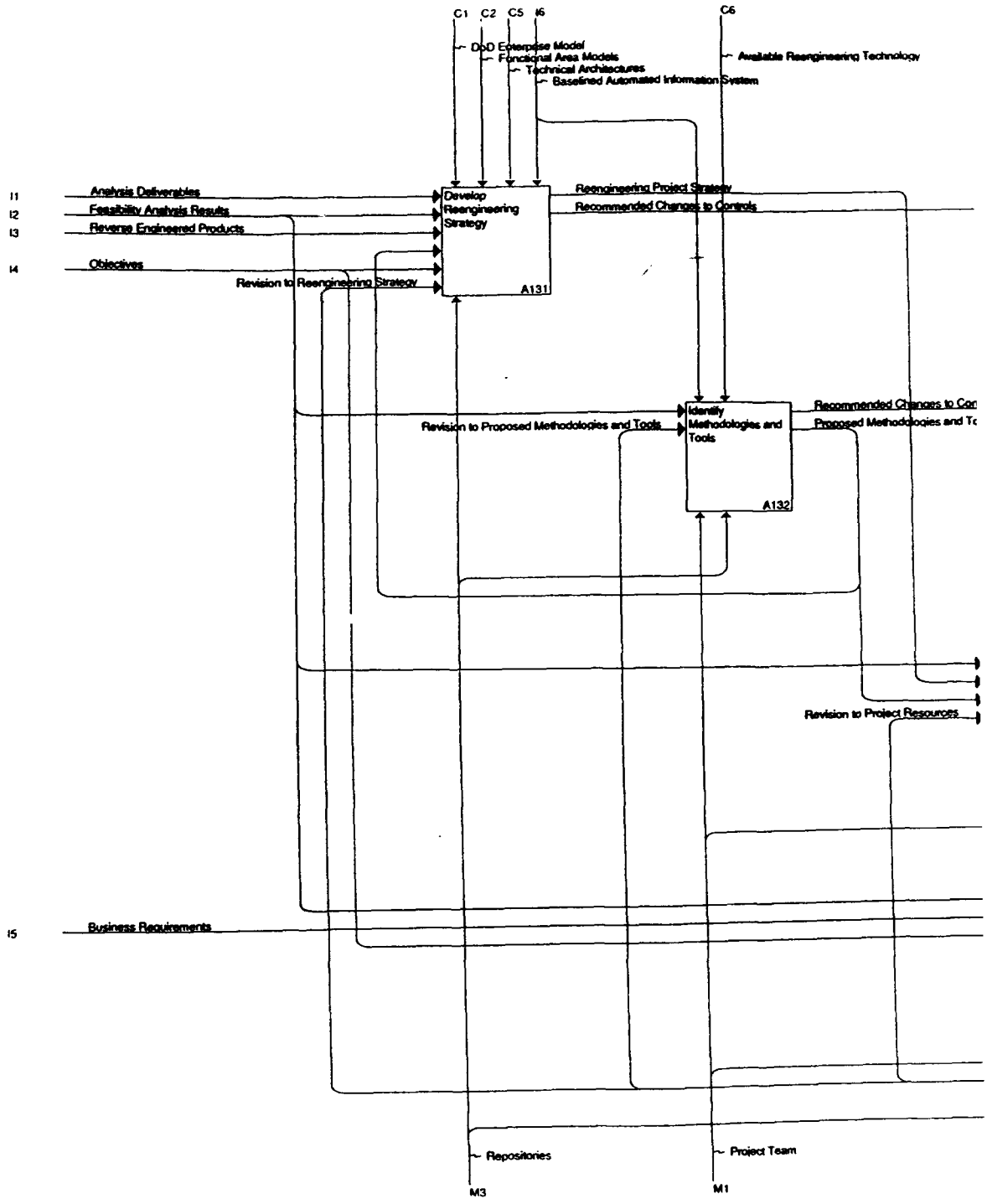

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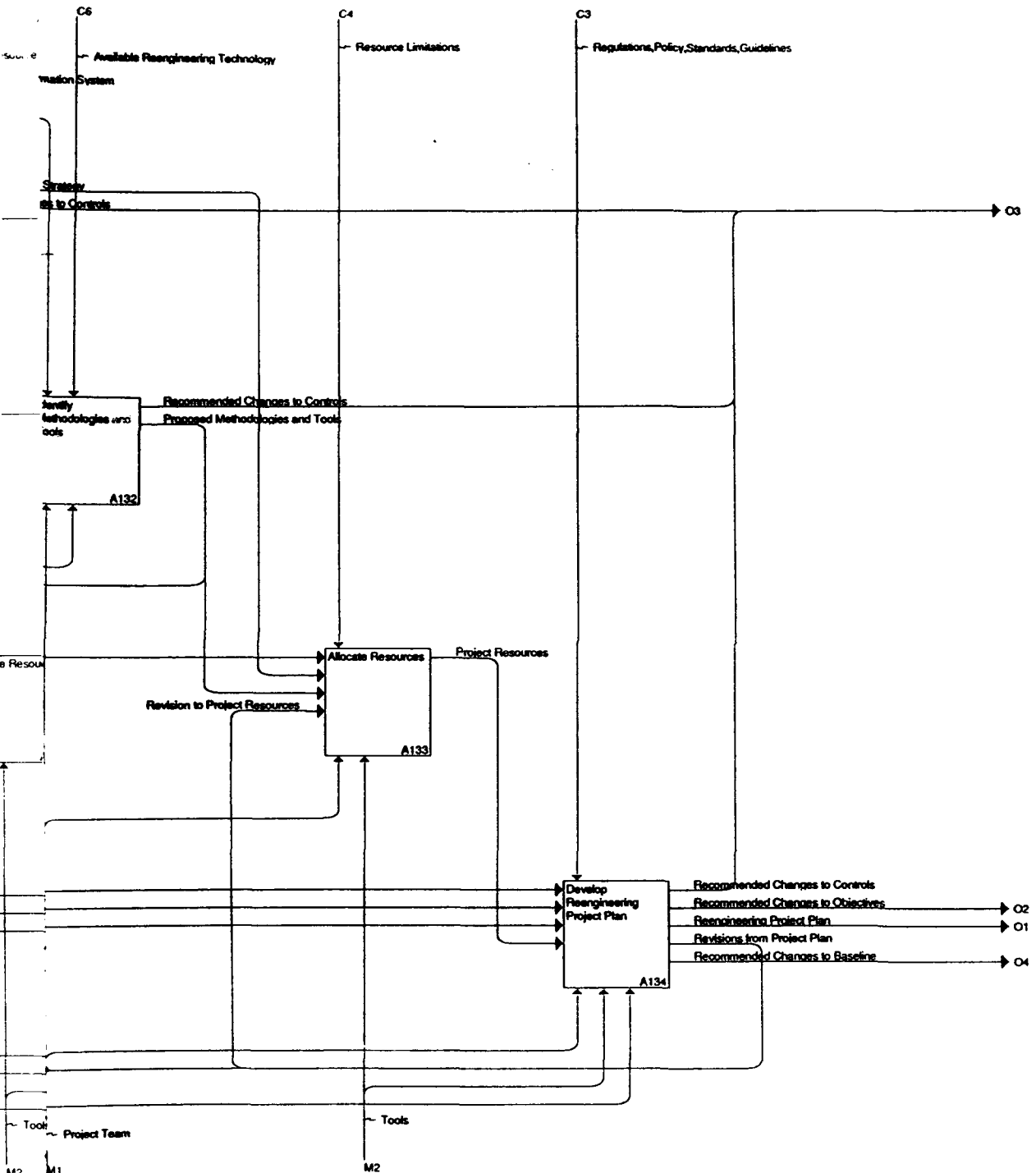

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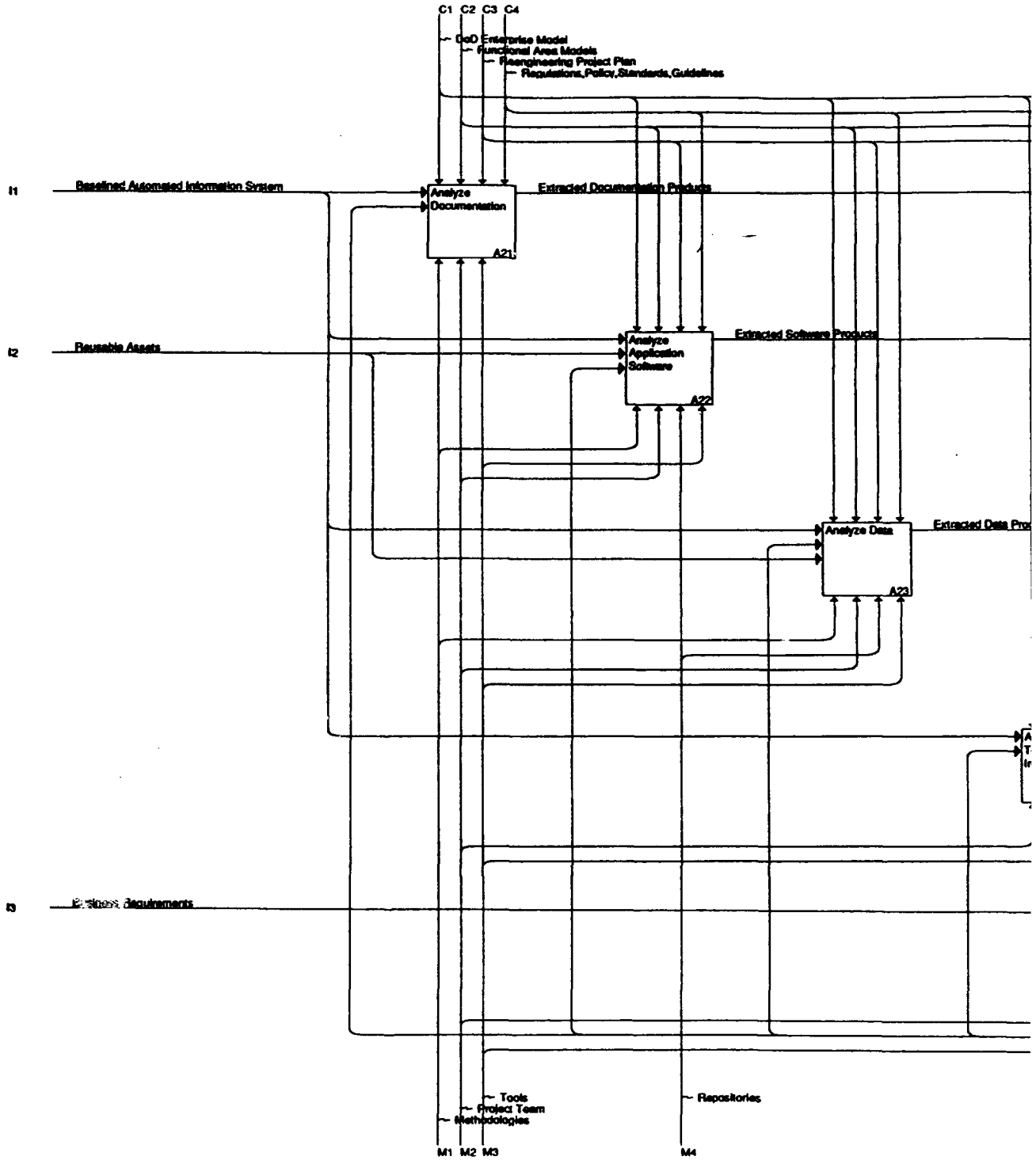

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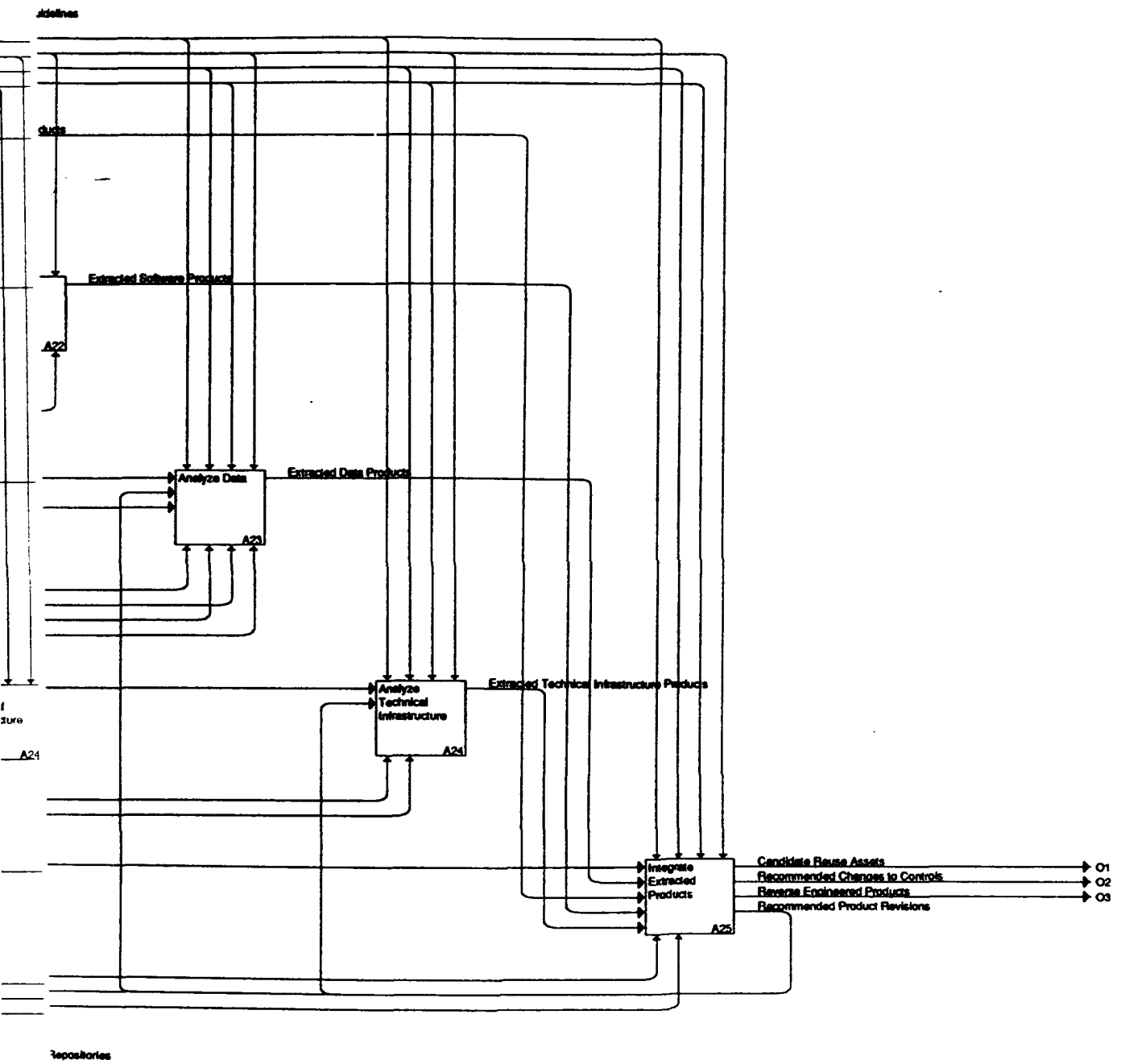

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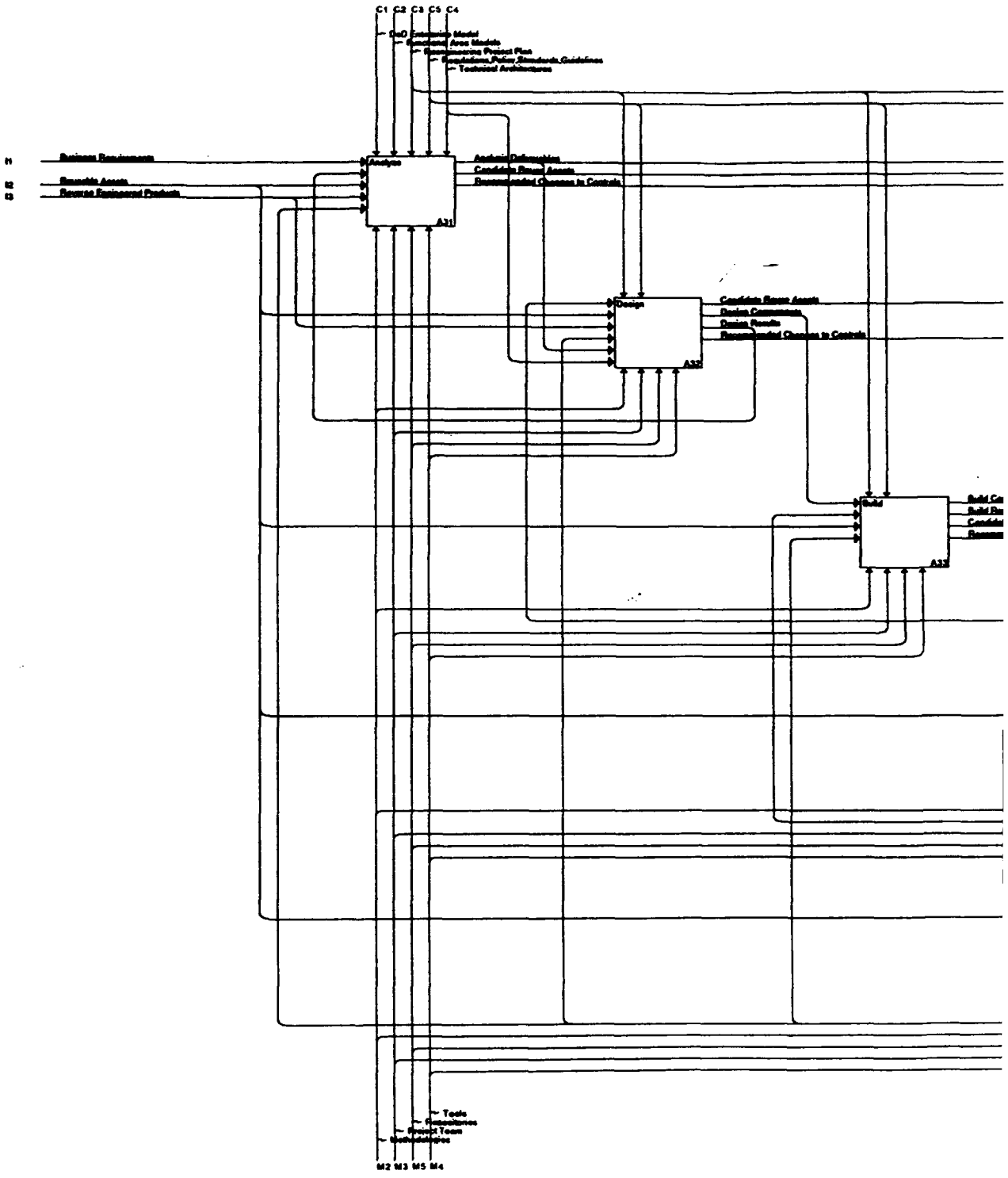

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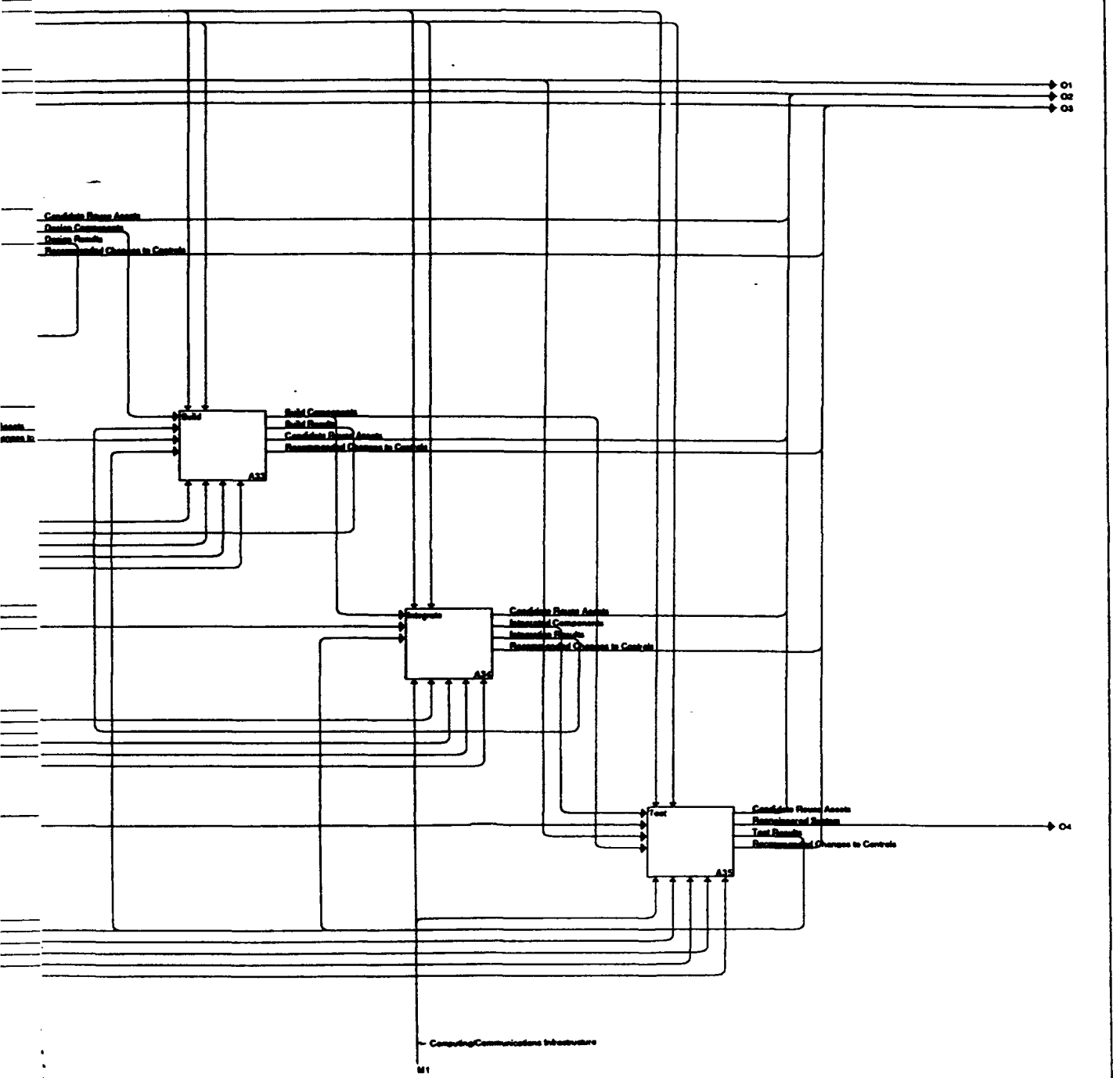

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APPENDIX B. CIM Software Systems Reengineering Process Model Glossary

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The Glossary for the CIM Software Systems Reengineering Process Model is divided into (1) Activities and the (2) Concepts. All activities identified in the Model are defined in Activities; Concepts contain definitions of all the inputs, controls, outputs, and mechanisms for each of these activities.

1. Activities

Allocate Resources

Define the resources for performing the reengineering project, including allocation of funds, personnel, tools, and computer resources. Available funding and computer resource support for methodologies and tools are determined. Necessary training for personnel on computer resources, methodologies, and tools is also determined.

Analyze

The Business Requirements and the Reverse Engineered Products are analyzed during this activity to generate the Analysis Deliverables. Reengineering Project Plan and Regulations, Policy, Standards, and Guidelines analysis define this activity, including the Analysis Deliverables. The Analysis Deliverables include requirements for Testing and a formal specification of the analyzed Business Requirements which are not addressed in the Reverse Engineered Products and must be forward engineered.

Analyze Application Software

This activity analyzes the existing application software to extract software products, including but not limited to process models and the information needed to define the business rules, design model, system specification, functional requirements, metric data, data models, and design decisions.

Analyze Data

This activity analyzes the existing data to extract data products, including but not limited to data models and the information needed to define the business rules, design model, system specification, functional requirements, metric data, process models and design decisions.

Analyze Documentation

This activity analyzes the existing documentation to extract documentation products, including but not limited to information needed to define the business rules, design model, system specification, technical infrastructure capabilities, data models, process models, and design decisions.

Analyze Technical Infrastructure

This activity analyzes the existing technical infrastructure to extract technical infrastructure products including, but not limited to the technical infrastructure and the information needed to define metric data and design decisions.

Build

The Design Components are used to generate the Build Components. Reusable Assets are employed as possible. The Test Results verify whether the Build Components conform to specification. The Reengineering Project Plan and Regulations, Policy, Standards, and Guidelines concerning build procedures define this activity, the structure for the Build Components and the expected Build Results.

Define Objectives

The objectives of the reengineering effort are identified by the organizational goals of the reengineering effort, including objectives for using the system, supporting the system, and the objectives of utilizing reengineering technology. The Project Team identifies the objectives and interviews those individuals whose objectives are to be included as part of the reengineering effort.

Development of concrete measurable objectives is an essential step in establishing the foundation for developing a project strategy contained to guide the efforts of the reengineering effort. The expression of these goals should show how the business needs of the organization and new system requirements will be met, and how Regulations, Policy, Standards, and Guidelines, and the schedule will control the reengineering effort, and what is expected of the methodologies and tools that will be applied during the reengineering effort.

Define Project

The Project Team defines the Reengineering Project Plan during the Define Project activity by examining the organization's Business Requirements, the existing Automated Information System and Available Reengineering Technology. Any Feasibility Analysis Results that are available should be examined for information useful in defining this plan.

The business requirements which can be reverse engineered and those which must be implemented during the Forward Engineer activity are identified and reconciled during the Define Project activity. The identity of those requirements addressed in the existing AIS may not be available until the AIS is reverse engineered. Reverse Engineered Products are used to update and revise the Reengineering Project Plan accordingly. Analysis Deliverables supply information about the Business Requirements to be implemented during Forward Engineering and are used to update and revise the Reengineering Project Plan.

The Define Project activity also identifies critical success factors which will indicate whether the reengineering effort was successful. The Project Team should employ Methodologies and Tools for planning the project, including project and configuration management tools. Repositories are used to retrieve information about Available Reengineering Technology and the Automated Information System. Define Project is composed of the activities: Define Objectives, Identify Baseline, and Define Reengineering Project Plan.

Define Reengineering Project Plan

Define a structured plan for accomplishing the reengineering. This plan will dictate how Regulations, Policy, Standards, and Guidelines will be conformed. The plan includes the activities of Develop Reengineering Strategy, Identify Tools and Methodologies, Allocate Resources, and Develop Reengineering Project Plan for implementing the reengineering.

Design

The Analysis Deliverables and the Reverse Engineered Products concerning Design are used to generate the Design Components during this activity. The Reengineering Project Plan and Regulations, Policy, Standards, and Guidelines concerning Design define this activity, the structure for the Design Components and the expected Design Results.

Develop Reengineering Project Plan

The Project Plan is developed by reconciling the Project Resources, Project Strategy, and Project Methodologies and Tools. The Plan must adhere to applicable Regulations, Policy, Standards, and Guidelines. The Plan is validated against the Objectives for the Project. Recommended changes to the Functional Area Models, Technical Architectures, and Objectives may be generated. A procedure for tracing the products of the reengineering effort to the Objectives and Business Requirements are outlined.

Develop Reengineering Strategy

The Project Strategy identifies reengineering alternatives which include scenarios, possible incorporation of new technology and approaches, and the use of methodologies and tools. Possible scenarios include, but are not limited to restructuring, redocumentation, and data rationalization. The alternatives are evaluated with respect to objectives, risks, impacts, and requirements. A strategy for reengineering is selected from the possible alternatives.

The Project Strategy drives the selection of methodologies and tools, requiring these to adequately support the Project Strategy through Revisions to Proposed Methodologies and Tools.

Forward Engineer

Within the context of reengineering, forward engineering is the software engineering activities that consume the products of reverse engineering and reuse activities, and new system requirements to produce a target system. The Project Team performs traditional life-cycle development that is moving from high-level abstractions and logical implementation-independent design to the physical implementation of the system. DoD Enterprise Model and Functional Area Models are employed. Regulations, Policy, Standards, and Guidelines concerning application software are complied and the schedule adhered.

All of the components should be implemented during forward engineering as Candidate Reusable Assets. Appropriate standards, including DOD-STD-2167A, the proposed DOD-STD-SDD and subsequent standards which should be followed when producing the applicable documents.

Forward Engineering is composed of the activities called Analyze, Design, Build, Integrate, and Test.

Identify Baseline

The Project Team will identify the configuration items which comprise the current automated information system. This activity does not analyze these configuration items, but simply identifies the system upon which the reengineering activities will be performed. These items include, but are not limited to the technical infrastructure, data, application software, and all associated documentation. Methodologies and Tools are available which assist in identifying these configuration items.

Objectives may control the activity of Identify Baseline by impacting the identification of the Baselined Automated Information System. Examples of such Objectives include the objective to reengineer a previous identification version or the objective to reconcile several versions of the same system.

Identify Existing Application Software

Identify the application software for this information system. This software does not include Commercial-Off-The-Shelf (COTS) software.

Identify Existing Data

Identify the existing data configuration items for this information system.

Identify Existing Technical Infrastructure

Identify the technical infrastructure for this information system.

Identify Methodologies and Tools

Proposed Methodologies and Tools are identified by an analysis of Available Reengineering Technology. The Proposed Methodologies and Tools must integrate into the sponsoring organizations current software engineering environment and support the automation of activities defined by the Project Strategy. The Define Project Strategy may require Revisions in Selected Methodologies and Tools to adequately support the Project Strategy. The Allocate Resources activity may require Revisions in Selected Methodologies and Tools to insure these adhere to Project Resources. The Generate Reengineering Project Plan may also require Revisions in Selected Methodologies and Tools to insure overall compliance with the controls and Business Requirements.

Integrate

Any number of Build Components are integrated to form Integrated Components. This activity insures the interfaces between Build Components are complete. Regulations, Policy, Standards, and Guidelines concerning integration procedures and the Reengineering Project Plan define this activity, including the structure for the Integrated Components and the expected Integration Results.

Integrate Extracted Products

This activity integrates the information contained in the Extracted Documentation Products, Extracted Software Products, Extracted Data Products, and the Extracted Technical Infrastructure Products to form the Reverse Engineered Products. The Reverse Engineered Products may include, but are not limited to the business rules, design models, system specifications, functional requirements, metric data, data models, process models, and design decisions.

Reengineer System

Reengineering describes the activities supporting the development and migration of automated information systems based on the examination and alteration of existing software systems.

The Business Requirements are those requirements which are proposed for implementation in the Reengineered System. Some of these requirements may be implemented in the existing automated information system, while others may have to be implemented during the forward engineering process. Feasibility Analysis Results may be available to provide information to support the comprehensive reengineering project. Reusable Assets should be explored for use throughout the reengineering effort.

The DoD Enterprise Model provides the high-level vision for the Reengineered System, while Functional Area Models govern the domain in which this system will operate. Regulations, Policy, Standards, and Guidelines govern the activities and products to be produced during the reengineering. Resource Limitations provide the scope in which the reengineering effort is supported. Technical Architectures provide an infrastructure in which the Reengineered System must execute. Available Reengineering Technology is examined for its applicability in this specific project.

The reengineering effort often produces a complete Reengineered System, as well as Candidate Reuse Assets which may support other development and migration efforts. As experience in reengineering increases, Recommended Changes to Controls governing these activities will help improve the processes.

Software Engineering Environment which supports software reengineering is composed of a Project Team, Methodologies, Tools, Repositories, and a Computing/Communications Infrastructure.

The selection of the members of the Project Team is key to a successful project. Matching skills with the activities described in this model insures productivity and minimizes risk. The activities described in this model support an overall migration plan. The selection of automated information systems for reengineering supports successful process improvement. The selection of team members, migration plan development, and candidate selection are not addressed in this model, but support the overall reengineering process.

The Reengineer System activity is composed of three activities: Define Project, Reverse Engineer, and Forward Engineer.

Reverse Engineer

The Project Team examines the Baselined Automated Information System by analyzing the documentation, application software, data structures and the technical infrastructure within which the information system operates. This analysis is performed to identify the system components and their interrelationships, and to create representations of the system in another form or at a higher abstraction level to provide a better understanding of the system.

Reusable Assets should be used to compose these representations. Reverse Engineering Tools are used in this process to produce manageable and usable Reverse Engineered Products which become the foundation or framework to Forward Engineer. These generated representations should be developed for reuse. These are submitted to a reuse certification program as Candidate Reuse Assets.

Reverse Engineer is composed of the activities called: Analyze Documentation, Analyze Data, Analyze Application Software, Analyze Technical Infrastructure, and Integrate Extracted Products.

Test

The Integrated Components are tested using a testing plan developed from the requirements defined in the Analysis Deliverables. Individual Build Components are also tested according to the individual component specifications. The Reengineering Project Plan and Regulations, Policy, Standards, and Guidelines concerning test procedures and the Reengineering Project Plan define this activity and the expected Test Results.

2. Concepts

Analysis Deliverables

Required documentation summarizing the results of the analysis phase. Refer to DOD-STD-2167A, the proposed DOD-STD-SDD and subsequent standards for guidelines on producing these documents.

The Analysis Deliverables include the requirements for testing the reengineered system and its components. These requirements are sent to the Test activity in forward engineering.

The Analysis Deliverables also provide information which impacts the Reengineering Project Plan. This information is provided to the Define Project activity for updating the Plan.

Automated Information System

(AIS) Consists of any combination of computer hardware, computer software, telecommunications, information technology, personnel, and other sources which collect, record, process, store, communicate, retrieve, and display information. More than one system or parts of different systems may be input to the software reengineering activity.

Available Reengineering Technology

Available Reengineering Technology identifies proposed methodologies and tools available for automating software reengineering. The Available Reengineering Technology constrains the Reengineering Project Plan, by impacting the Methodologies and Tools available for automating the software reengineering effort. It also impacts the schedule and funding by the training necessary to use this technology and the productivity improvements in automating the software reengineering process. Repositories may exist that provide information on Available Reengineering Technology.

Baselined Automated Information System

The selected information system comprised of the technical infrastructure, data, and application software which will be used during the reengineering project. The baselined system includes all associated documentation.

The Baselined Automated Information System is composed of (Existing Technical Infrastructure), (Existing Application Software), and (Existing Data)

Build Components

Constructed system parts to be interfaced during the Integrate activity, including the required documentation summarizing the results of the coding phase. Refer to DOD-STD-2167A, the proposed DOD-STD-SDD and subsequent standards for guidelines on producing these documents.

Build Results

A description of the results of the Build activity either confirming that the Build Components have been constructed or a request for clarification on a design issue that is preventing the completion of the Build activity.

Business Requirements

Current organizational goals and the requirements for the reengineered software system. Some of these requirements may be automated in existing AIS, while others may have to be implemented as part of the new system.

Candidate Reuse Assets

Candidate Reuse Assets are potential reusable assets identified during the reengineering effort. Like Reusable Assets, the Candidate Reuse Assets are software work products, including source code, documentation, designs, test data, tools, and specifications. These candidates are input to a reuse certification program for verification and validation as to potential usability in multiple software systems.

Candidate Reuse Assets may describe repeatable processes such as reengineering strategies, maintenance processes, or new business practices.

Computing/Communications Infrastructure

A service utility that provides common shared computing and communications capabilities, including data base, common networks, electronic messaging, and computing platforms.

Data Model

A graphical and textual representation of analysis that identifies the data needed by an organization to achieve its mission, functions, goals, objectives, and strategies and to manage and operate the organization. It identifies the data, their attributes, and relationships or associations with other data. Data Models include the logical, physical, and/or normalized models.

Ref.: DoD Technical Architecture Framework for Information Management (Architecture Guidance and Design Concepts), Version 1.1, Vol. 2, Center for Information Management, Arlington VA, 22204-2199, October 1992.

Design Components

Modules representing a design of the system parts to be constructed during the Build activity, including the required documentation summarizing the results of the design phase. Refer to DOD-STD-2167A, the proposed DOD-STD-SDD and subsequent standards for guidelines on producing these documents.

Design Results

A description of the results of the Design activity either confirming that the Design Components have been constructed or a request for clarification of an analysis issue that is preventing the completion of the Design activity.

DoD Enterprise Model

The DoD Enterprise Model is a representation of the activities and data of the Department of Defense (DoD) needed to accomplish the defense mission, from warfighting to acquisition and logistics support. This Model is the basis for defining, coordinating and integrating DoD missions and functions. It enables leaders and managers to better understand and direct their areas of responsibility, and to integrate functional process improvement initiatives within and across functional and organizational boundaries.

Ref.: The DoD Enterprise Model, A White Paper, February 1993, Smith, Ms Mary H., OASD(C3I)/DDI, 1225 Jefferson Davis Highway, Suite 910, Arlington, VA 22202-4301.

Existing Application Software

Description of the application software within the AIS. This software was developed specifically for the existing automated information system and does not include any commercially produced software.

Existing Data

Description of the data utilized within the AIS, including the data elements and their implemented data structure.

Existing Technical Infrastructure

Description of the technical infrastructure portion of the AIS. This infrastructure may include, but is not limited to the information describing the capabilities and the structure of the hardware, operating system, and integrated Commercial-Off-the-Shelf (COTS) products.

Extracted Data Products

These products may include, but are not limited to data models and the information needed to define business rules, design models, system specifications, functional requirements, metric data, process models, and design decisions.

Extracted Documentation Products

These products may include, but are not limited to the information needed to define business rules, design models, system specifications, technical infrastructure capabilities, data models, process models, and design decisions.

Extracted Software Products

These products may include, but are not limited to process models and the information needed to define business rules, design models, system specifications, functional requirements, metric data, data models, and design decisions.

Extracted Technical Infrastructure Products

These products may include, but are not limited to the technical infrastructure capabilities and the information needed to define metric data and design decisions.

Feasibility Analysis Results

The results from any study that may have been performed prior to the start of the reengineering project to scope the feasibility of reengineering should be used as input to the reengineering process. These results may identify and explore information necessary to perform the reengineering project. The results of this analysis should be input to the Software Reengineering Process Model and the members of the Reengineering Project Team should participate in the performance of this analysis.

These results may serve as controls on an activity, but may also serve as inputs which are consumed and altered by an activity, including new business requirements, critical success factors, and objectives. Therefore, the results from any feasibility analysis are represented as an input to the Reengineer System activity.

The results of the analysis may include, but are not limited to a cost/benefit analysis results and a technical justification for the reengineering. The cost/benefit analysis determines the cost of performing the reengineering compared to the benefits expected from reengineering. The technical justification includes a description of how the reengineering project is justified based on the technical aspects of the effort.

Functional Area Models

Representations of functional areas which reflect commonality and reuse opportunities in a group of similar systems identified as part of a particular mission.

Integrated Components

The interfaced Build Components representing part or all of the system to be tested during the Test activity. The Integrated Components include the required documentation summarizing the results of the Integrate phase.

Integration Results

A description of the results of the Integrate activity either confirming that the Build Components have been interfaced successfully or a request for clarification on an interface or build issue that is preventing the completion of the Integrate activity.

Methodologies

The systems of principles, procedures, and practices applied to the development, operation, reengineering and support of a software system. Reengineering methodologies are subdivided into reverse and forward engineering methodologies. These methodologies support various software engineering methodologies, which should be carefully investigated to insure efficient technical integration into the sponsoring organizations existing software engineering environment.

Objectives

Objectives for using the system include performance issues from a user's perspective and the user interface. The objectives for supporting the system include improvements in maintenance and extending life expectancy. The objectives of utilizing reengineering technology include proof-of-concepts and identification of risks.

Objectives are viewed as input and not output, since these are desired goals of the reengineering effort which are subject to change based on actual implementation of reengineering technology. Objectives may also be functional or technical requirements that are to be implemented or met (as performance issues) in the

Reengineered System. How these Objectives are addressed during the reengineering is determined as part of the Reengineering Project Plan. Recommended Changes to Objectives are derived from the Objectives.

Process Model

A graphical and textual representation for organizing the data and processes into manageable groups to facilitate their shared use and control throughout the organization. This representation provides a framework for identifying, defining, and organizing business strategies, business rules, and processes needed to manage and support the way an organization does or wants to do business. Process Models include the logical, physical, and/or normalized models.

Ref.: DoD 5000 11-M, DoD Data Administration Procedures, Department of Defense Manual, June 1991.

Project Resources

The resources for this reengineering project, including personnel, computer resources, and tools. These resources must remain within the constraint of Resource Limitations.

Project Team

The personnel who will perform the reengineering effort form a team. The members of this team may include, but are not limited to experts in the following areas: software/system engineering, technical infrastructure, function/mission of the system domain, users of the application software, and reengineering technology. Specifically, the Project Team should involve the functional customer as much as possible throughout the reengineering effort.

Proposed Methodologies and Tools

The proposed methodologies and tools for implementing the Reengineering Project Strategy. The Proposed Methodologies and Tools are defined by Available Reengineering Technology according to the characteristics of the Baseline Automated Information System and must be within available resources as determined by Allocate Resources.

Recommended Changes to Baseline

Recommended Changes to Baseline are suggested by the Develop Reengineering Project Plan activity. These changes scope the reengineering effort by suggesting an alternative baseline. These changes usually result from limitations resulting from the Project Strategy, Project Resources, and Proposed Methodologies and Tools. These changes may impact the software, data, or technical infrastructure of the baseline.

The Develop Reengineering Project Plan may send Recommended Changes to Baseline based on information in the Reverse Engineered Products and the Analysis Deliverables.

Recommended Changes to Controls

Recommended changes to specific controls on this activity resulting from experience and knowledge gained by performing reengineering. These controls may include any of the following: Regulations, Policy, Standards, and Guidelines, Functional Area Models, Technical Architectures, and DoD Enterprise Model.

Recommended changes to Regulations, Policy, Standards, and Guidelines may include information describing the impact of certain regulations, policy, standards, and guidelines on reengineering which may necessitate modification or clarification of these controls.

Recommended changes to Functional Area Models may include new business practices uncovered during reverse engineering which may necessitate clarification or enhancement to these models.

Recommended changes to Technical Architectures may include lessons learned when utilizing the technical architectures during reengineering which may necessitate clarification or modification to these architectures.

Recommended changes to the DoD Enterprise Model may include information gathered during the reengineering process which supports the DoD Enterprise Model or broadens its use.

Recommended Changes to Objectives

Recommended Changes to Objectives are suggested by the Develop Reengineering Project Plan activity and result from attempts to adequately address these Objectives in the Reengineering Project Plan. These changes usually result from limitations resulting from the Project Strategy, Project Resources, and Proposed Methodologies and Tools. Recommended Changes to Objectives are derived directly from the Objectives.

The Develop Reengineering Project Plan activity may send Recommended Changes to Objectives based on information in the Reverse Engineered Products and the Analysis Deliverables.

Recommended Product Revisions

Recommended Product Revisions are generated during the Integrated Extracted Products activity when an inconsistency is detected between one or more of the following: Extracted Documentation Products, Extracted Software Products, Extracted Data Products, and Extracted Technical Infrastructure Products. These inconsistencies must be corrected as part of these products.

Reengineered System

The reengineered system is generated from the reengineering activities described within this model. It consists of software, data, technical infrastructure, and all associated documentation.

Reengineering Project Plan

The Reengineering Project Plan documents the Objectives, identifies the Baselined Automated Information System, the Project Resources, and Project Strategy. This plan includes a formalization of the Business Requirements for the Reengineered System. The requirements available in the Baselined Automated Information System are confirmed through the reverse engineering process and those to be implemented during forward engineering are identified as part of the Analysis Deliverables.

The Reengineering Project plan defines the Objectives and depicts how the reengineering will meet these objectives. The Plan includes critical success factors and markers for proving these factors were achieved. The Plan also outlines how the Business Requirements map to the specified requirements for the reengineered system.

Reengineering Project Strategy

Description of how the automated information system will be reengineered. This strategy includes the identification and integration of reengineering methodologies into a cohesive strategy for accomplishing the organizational goals of the reengineering project. The strategy drives the identification and utilization of tools to automate the reengineering. The strategy also identifies and describes the structure of the products expected from the reengineering.

Regulations,Policy,Standards,Guidelines

Documents containing the principle rules designed for governing and influencing decisions and actions during software engineering activities.

Repositories

A mechanism for storing and retrieving information or reusable assets. Examples of repositories include the Defense Software Repository System (DSRS), DoD Data Repository System (DDRS), and the proposed Integrated Computer-Aided Software Engineering (I-CASE) Repositories. The DDRS and the DSRS are managed by the CIM Data Administration Program Office and the Reuse Program Office respectively. Repository-based technology may also be used to store and retrieve information generated during the reengineering project, including Reverse Engineered Products and the Reengineered System components.

Resource Limitations

Estimated limitations on available resources, including manpower, funding, scheduling deadlines, and computer resources for performing the reengineering.

Reusable Assets

Reusable assets are software work products, including source code, documentation, designs, test data, tools, and specifications. Reusable assets are stored in repositories and should be explored for use throughout the software reengineering effort.

Reverse Engineered Products

Products resulting from the reverse engineering effort which are used in the forward engineering process. These products include, but are not limited to the business rules, design model, system specification, functional requirements, metric data, data models, process models, and design decisions. Reverse engineered products reveal the business requirements fulfilled by the existing AIS.

The Reverse Engineered Products also provide information to the Define Project activity which impacts the Reengineering Project Plan. All of the business requirements implemented in the existing AIS may not be known at the start of the reengineering effort. The business rules fulfilled in the existing AIS are determined as a result of the Reverse Engineer activity. The Reverse Engineered Products are provided to the Define Project activity for updating the Reengineering Project Plan.

Revision to Project Resources

Recommended changes to the Project Resources based on constraints from Regulations, Policy, Standards, and Guidelines or an inability to reconcile these Resources to the Reengineering Strategy and/or Methodologies and Tools.

Revision to Proposed Methodologies and Tools

Recommended changes to the Selected Methodologies and Tools based on constraints from Regulations, Policy, Standards, and Guidelines or an inability to reconcile the Methodologies and Tools to the Project Budget and/or Reengineering Project Strategy.

Revision to Reengineering Strategy

Request for a revision to the Reengineering Strategy based on constraints from Regulations, Policy, Standards, and Guidelines or an inability to reconcile the Reengineering Strategy to the Project Budget and/or Methodologies and Tools.

Revisions from Project Plan

Revisions from Project Plan includes Revisions to Project Resources, Revisions to Selected Methodologies and Tools, and Revisions to Reengineering Strategy.

Technical Architectures

Representation of the structure of technical infrastructure components, including computer platforms, support software, and communications; their relationships and interactions.

Test Results

Required documentation summarizing the results of the testing phase. Refer to DOD-STD-2167A, the proposed DOD-STD-SDD and subsequent standards for guidelines on producing these documents.

Tools

Automated and manual implements used to improve productivity in performing or accomplishing the activities espoused in a methodology. These tools should integrate into the sponsoring organization's software engineering environment. Several organizations currently support tool evaluation and should be contacted to support the selection of tools appropriate for the individual needs of the reengineering project.

Reengineering tools can be described in several categories, including:

Project management
Redocumentation
Restructuring
Reverse engineering
    source code analyzers
    design recovery

Forward engineering
    code generators
    requirements analysis
    design support tools
    test case generators
    integration support tools