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# THESIS

MODELING PROCESS REDESIGN

by

Scott Alan White

September 1992

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This thesis introduces the usage of the IDEF (ICAM [Integrated Computer Manufacturing] **Definitions** Language) methodology to model process redesign. A research team was assembled at the Naval Postgraduate School in Monterey, California to attend a five-day IDEF conference to create a model of process redesign. This model will be used to develop a handbook for functional managers to evaluate and redesign their own business processes.

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Modeling Process Redesign

by

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Submitted in partial fulfillment of the requirements for
the degree of

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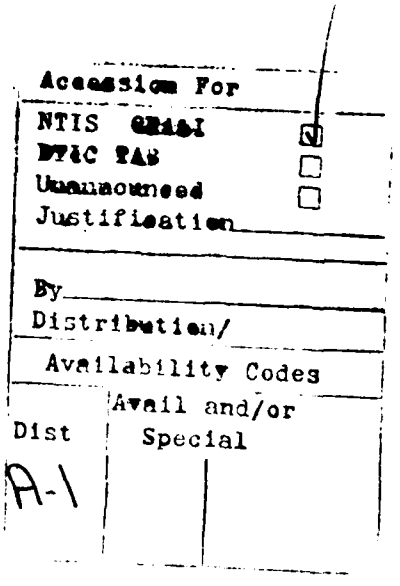
# ABSTRACT

This thesis introduces the usage of the IDEF (ICAM [Integrated Computer Manufacturing] Definitions Language) methodology to model process redesign. A research team was assembled at the Naval Postgraduate School in Monterey, California to attend a five-day IDEF conference to create a model of process redesign. This model will be used to develop a handbook for functional managers to evaluate and redesign their own business processes.



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# I. INTRODUCTION

## A. BACKGROUND

For the Corporate Information Management (CIM) initiative to be considered a success, CIM must produce $30 billion in predetermined savings between 1991 and 1995. [U.S. Department of Defense, 1989] Line (functional) managers will be responsible for executing CIM savings and since money has already been cut from the ADP (Automated Data Processing) acquisition budget, there is no choice but to realize these savings. But how? Managers faced with budget cuts are scrambling to apply technology to automate their business processes to make them more efficient and less expensive, but the CIM (Corporate Information Management) office will not approve a major system purchase unless the system applies to processes that have been satisfactorily evaluated and re-engineered. Automating an inferior business process produces a more sophisticated, high-tech configuration of an inferior process that may not even pay for itself, let alone realize any significant savings. Businesses gain strategic advantage by changing the way they do business, not by automating old or inefficient processes. Cost savings are realized not only from automation and use of today's information systems, but from evaluating and redesigning business processes from the ground up. Automating the process may be desired in the long run, but managers should automate a well-designed/value-added business process.

Modeling is used to evaluate and identify changes to processes. Many agencies such as the Army Corps of Engineers are currently using the IDEF modeling methodology to model their business processes. The CIM office raised the question, "can the process of improving business processes be modeled to gain

an understanding of what is required to successfully redesign any process?" What this question is really asking is what are all of the activities associated with the redesign process itself and how do they relate to one another. This thesis explores the results of an exercise that modeled the process of process improvement.

In March 1992, the Redesign Experts and Practices (REAP) team was established. This team was tasked to model the business redesign model itself using the IDEF methodology. Several questions led to the successful completion of the upper level model of this process.

(1) What is a process?

(2) What are the activities involved in successfully evaluating and redesigning a business process?

(3) How do these activities relate to one another and are all activities required for successful redesign?

(4) What does a typical manager (DoD or otherwise) want to accomplish and what are his/her motivations?

(5) Are we modeling the actual "How To's (cookbook)" of process redesign or simply initiating and organizing the "What's Needed" to perform successful process redesign?

The next two sections summarize the history of the IDEF methodology as well as describe some of the nomenclature and basic tools used. Then the paper describes how the REAP team assumed the task of modeling the process for process improvement and the results of the exercise. Finally, the REAP team's observations and recommendations are discussed.

## B. HISTORY OF CORPORATE INFORMATION MANAGEMENT (CIM)

Two things occurred at the end of the 1980s that provided profound implications for information technology in the Department of Defense (DoD): (1)

Congress became displeased with DoD management of information technology and (2) the conclusion of the Cold War started the down-sizing of the defense establishment.

In July 1989, the House Armed Services Committee responded to Government Accounting Office (GAO) reports of mismanagement of automated data processing in DoD by suggesting that funding would no longer be forthcoming for DoD investments in information technology until the department devised a unified, non-duplicative, comprehensive strategy for its information technology (IT). DoD was then spending nine billion dollars annually on IT resources. In response to Congressional criticism, the Secretary of Defense appointed a Deputy Secretary (DSD), with vast experience from the private sector, to manage the DoD comptroller office. The DoD comptroller office includes the office of DoD Information Resources Management (IRM). The DSD brought with him a Corporate Information Management (CIM) strategy that was being implemented by his former employer. That company had devised CIM to bring information resources together across divisional boundaries. [Schweizer, 1991]

In November 1989, a CIM office was created under the DoD deputy comptroller for IRM. She appointed a director of CIM who began implementing the DSD's recipe for unifying and standardizing information resources. The emphasis was on unification and standardization. The IT strategies to be devised by CIM were to be conceived at the DoD level rather than being an amalgam of the parochial interests and historically-evolved systems of the individual services and agencies. The three objectives outlined were:

(1) To ensure the standardization, quality, and consistency of data from DoD's multiple management information systems.

(2) To identify and implement management efficiencies in support of business areas throughout the information system life cycle.

(3) To eliminate duplication of efforts in the development of multiple information systems designed to meet a single functional requirement. [Leong-Hong, 1990]

For FY 91 funding, the CIM office requested $200 million for its operating budget. In October, 1990 the Senate took one billion dollars out of the IT request in the Defense Appropriations Bill and gave it to the CIM office for operations and to begin implementation of CIM initiatives. The bulk of this billion dollars would be returned to the services and agencies from which it was taken, but only if the systems they sought to fund met CIM standards. The message from Capitol Hill was that CIM was a positive response to Congressional concerns and that it was being rewarded with a grant of veto power over investments in IT by the services and federal agencies. An added message was that, from then on, proposals for IT acquisition must possess the inherent capability for DoD-wide integration and standardization. [Schweizer, 1991]

In December 1990, the Secretary of Defense moved the CIM office from the comptroller office and placed it within the domain of the Assistant Secretary of Defense for Command, Control, Communications and Intelligence (ASD[$C^3$I]). The IRM director became the Deputy Assistant Secretary for Information Systems. The Defense Communications Agency was selected as the action agency to embody and carry out the CIM program. It was then renamed the Defense Information Systems Agency. [Schweizer, 1991]

In January 1991, the ASD($C^3$I) created the position of Director of Defense Information (DDI) as a leadership locus for IT across DoD. An IT executive from industry of national repute was appointed to the post early in 1991. Within six

months of his appointment, the DDI, who was the author of books on information payoff and business unit practices, began to expand the CIM concept to encompass business process redesign. The message from the DDI's office was that if DoD was going to be smaller it was also going to work smarter. Rather than making across-the-board cuts in information systems, the DDI sought to squeeze non-value-added elements out of business processes. Only after a business process had been redesigned down to its value-added activities would it be considered for automation. [Schweizer, 1991]

In April 1991, a member of the Naval Postgraduate School (NPS) department of administrative sciences visited the DDI to explore possibilities for CIM-funded research into information systems. The DDI proposed that NPS could assist his office by undertaking research related to the implementation of business process redesign in DoD. He funded a research project to be undertaken in FY 92.

In February 1992, a special assistant to the DDI, formerly a successful practitioner of business process redesign with the Army Corps of Engineers, met with NPS representatives in Monterey to finalize tasking for the research project. An agreement was reached in which a NPS faculty-student research team would model the business process redesign using the IDEF modeling tool. The resultant model of the modeling process would be incorporated into a guide book on process redesign for DoD functional managers. At the end of March, 1992, the NPS research team, joined by the NPS Dean of Computer and Information Services, participated in a five-day IDEF modeling workshop in Monterey conducted by representatives of D. Appleton Company, Incorporated. The team would later call itself REAP (Redesign Experts and Practices).

The REAP team consisted of three research students, three professors, a dean, and two facilitators from D. Appleton Company, Incorporated. The REAP team

decided not to conduct extensive preliminary research pertaining to IDEF prior to the conference. The reason for this decision was to avoid biases that might affect the outcome of the exercise.

The IDEF conference was held in March, 1992 for five days. The team successfully completed a model of the activities required to redesign a process. Additional IDEF conferences are scheduled to complete the model down to its business rule level and write the redesign handbook.

# II. IDEF METHODOLOGY

The following chapter describes why IDEF was chosen to be used to model the process improvement process, presents a brief summary of what IDEF is, and discusses how IDEF functions.

## A. THE ENVIRONMENT

As functional managers are faced with diminishing budgets and the axiom: *do more with less*, they require a method to define and evaluate their business processes to detect ways to improve upon them. Managers who have just had their budgets reduced require imagination when planning to execute their missions with fewer resources. No comprehensive instruction manual or recipe could be found that describes in simple terms how to redesign business activities more efficiently. Books do exist that describe various facets of the redesign process, such as benchmarking. However, no reference could be found that has put together all of the activities required to perform a capacious evaluation and implement changes to a process.

The IDEF modeling tool was chosen by the REAP team to create a model of the activities to perform to implement change because the IDEF modeling tool will also be used by functional managers to model their own processes. The IDEF modeling method takes an activity and breaks it down into a series of inputs, outputs, mechanisms, and controls (ICOM's). The problem the REAP team faced while using IDEF to model the Process Improvement Process (PIP), is that an activity did not yet exist to model.

## B. DEFINING A PROCESS

A process is an activity that occurs over time and transforms inputs (information or materials) into recognizable outputs. The terms process, activity, function, and task are synonymous in the IDEF methodology. The activity is assisted by mechanisms and constrained by controls. An activity could be as large as building an automobile with all of its sub-processes or as small as the act of approving an order. An activity or process should always be labeled using active verbs. [D. Appleton Company, Inc., 1992]

## C. IDEF METHODOLOGY EVOLUTION

The IDEF methodology was developed by the Air Force in the 1970's because the service needed to increase manufacturing productivity through the semantic application of information technology. IDEF was borne from the Integrated Computer-Aided Manufacturing (ICAM) Program. It is currently being used to define advanced concepts, techniques, and procedures for developing logical models to display semantic characteristics of business activities and business rules associated with data structures. [D. Appleton Company, Inc., 1992]

IDEF0 is used to define the broader overall business activities and their relationship to one another. IDEF1X is used to define the actual business rules that apply to the lowest level activities. Activity Based Costing (ABC) correlates business processes to their costs. [D. Appleton Company, Inc., 1992] These costs may be used to evaluate whether or not to implement changes based on expected savings.

## D. THE MODELING PROCESS

The modeling process typically begins with a group exercise. The group has one or more processes to evaluate and change or else the group wants to build processes from scratch. An IDEF expert facilitator explains how the IDEF

modeling process operates and extracts the group's objectives. The facilitator then asks the group to decide which objectives are critical to the success of the exercise.

The group completes the model of the process from the top down. They start with the broader overall process using node trees (a hierarchical view of the upper level activities) and identify subprocesses that are contained within each node using context diagrams (showing only one activity and its ICOM's) and decomposition diagrams (showing an entire level of sub-activities of the parent with their ICOM's). The model contains a glossary that defines all of the terms used in the model. The lines named by nouns that go into or out of activity boxes on the model are called ICOM's (inputs, controls, outputs, and mechanisms).

Although IDEF does not allow for sequencing activities, this can often be implied by their position in the model. For example, one would not want to "approve an order" before "receiving an order."

Appendix A contains an IDEF handbook (Reader's Guide) that explains the basic tools and methodology used in an IDEF exercise.

# III. IDEF EXERCISE RESULTS

Appendix A is the REAP report. It contains the preliminary model of the Process Improvement Process as well as the data definitions and ICOM definitions. It describes in detail how the REAP team conducted its exercise and explains the IDEF methodology.

IDEF is typically used to model manufacturing processes. However, the REAP team was not tasked to model a manufacturing process, but rather to model the more conceptual process of improving processes.

The REAP team used the group accumulation technique to develop and improve the IDEF model. This technique was both a strength and weakness of the IDEF modeling methodology. Its strength lies in the group deliberation of all ideas on each topic; its weakness is the extensive time required to achieve consensus. As the node model suggests, Figure (1), the REAP team determined that the Process Improvement Process model actually consists of three major components:

(1) Create a Process for Improving Process Redesign, which actually models the process of creating the process improvement process.

(2) Pilot a project using the Process Redesign Model which uses the Process Improvement Model to improve a bona fide process such as an accounting system.

(3) Maintain the Model uses redesign personnel's feedback and suggestions for improvement of the model itself.

The REAP team decided to explore only the first node, that is, the Create a Process for Improving Process Redesign. The Pilot a Process for Process Redesign node will be performed by another thesis student. The REAP team foresees the

Maintenance node being controlled by the CIM office subsequent to the implementation of the process improvement handbook.

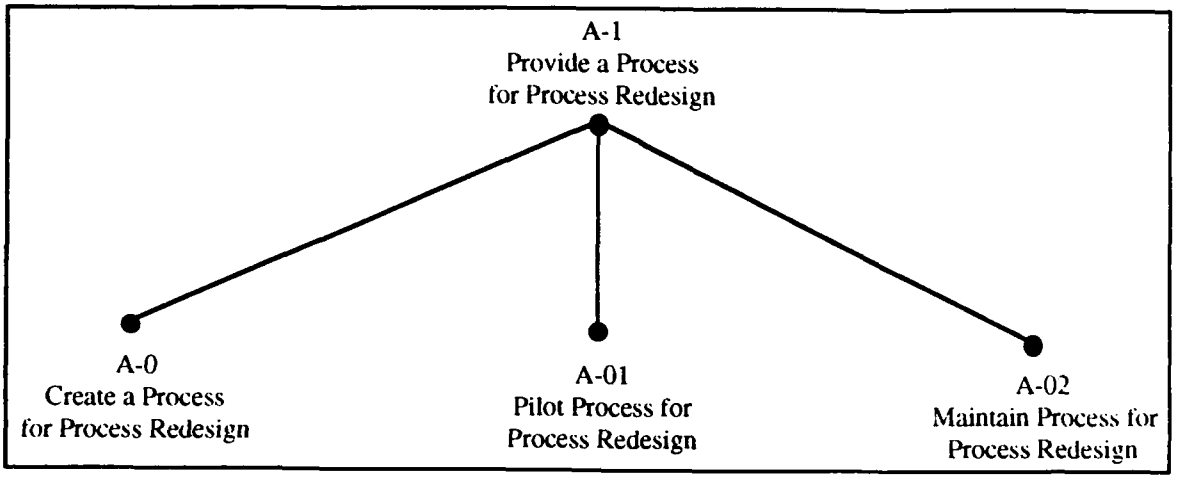


Figure (1) [REAP Report, 1992]

The model of Create a Process for Improving Process Redesign was explored down two levels. These two levels were able to identify "what" was needed to execute the redesign process effectively (i.e. the chapter titles in a handbook for functional managers), but not the exact steps or proven methods available to actually carry out each of these activities. (These "how to's" are the subject of a follow-on IDEF exercise and thesis.)

The IDEF exercise was designed to build a foundation or shell of the Process Improvement Process model. To avoid confusion when reading the model over the next few pages it is imperative to note that REAP first modeled its own process, that is, the process of defining a model for process redesign. Doing this resulted in essentially two models contained in one. The first, higher level model is the "What" model describing the REAP team's process of defining and refining the process improvement model itself. Knowledge and experience gained by the team while developing each activity had an influence on the development of the other activities. The development was somewhat circular because the knowledge and

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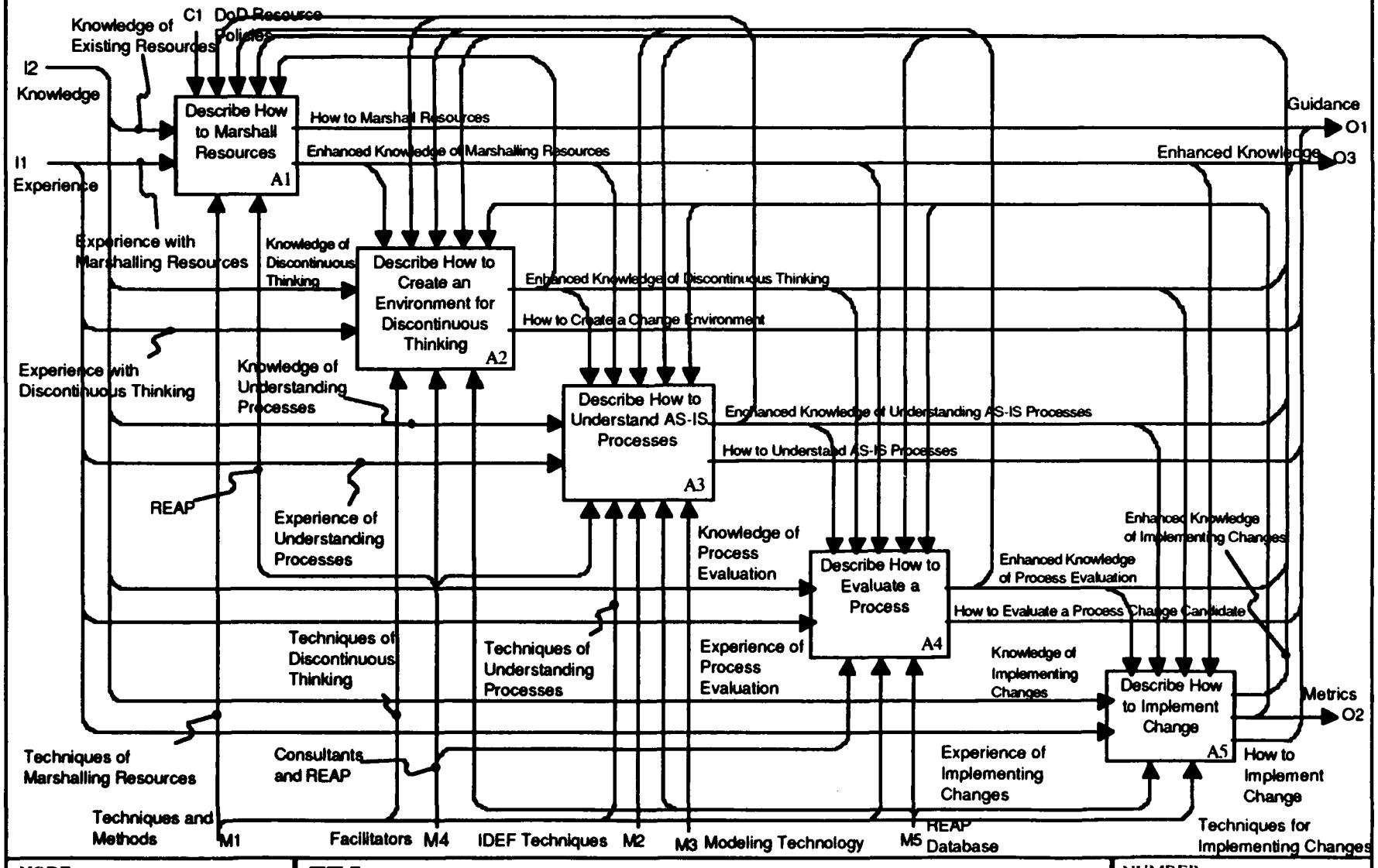


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experience gained during the exercise was used frequently to refine other activities that had been developed earlier in the week. Figure (2) shows the upper level decomposition of the model.

The second, deeper model is the "How to" model that still needs to be completely detailed in subsequent IDEF exercises. Creating the model this way led to much confusion on REAP's part as the team struggled to determine which "hat" applied to each ICOM. On the other hand, trying to develop the model without this top layer may have lead to an incoherent model. The team first had to identify what it was using to develop the model for itself. Without this information, the model's foundation could not be understood by subsequent team members.

The IDEF exercise was conducted in March 1992. After a brief introduction, the facilitators described the IDEF methodology itself. The team members were then asked to state the desired objectives of the consultation. After determining the desired objectives, the team was then asked to identify issues critical to the success of the consultation. The REAP team considered 13 issues to be critical:

(1) The Process Improvement Process (PIP) must be applicable to manufacturing and service operations.

(2) The PIP will be presented as a "cookbook" guide with an explanation of the underlying theory.

(3) The PIP will make process improvement clear and accessible to functional managers.

(4) The PIP will help to identify meaningless activities.

(5) The PIP will be operational.

(6) The PIP will be detailed enough to be implement able.

(7) The PIP will be easily modifiable.

(8) The PIP will either identify improvement methods or a method for identifying improvement methods.

(9) The PIP will be generic enough to be applicable across different levels of management.

(10) The PIP will help identify value-added activities.

(11) The deliverable will completely describe the PIP.

(12) The PIP will provide functional managers with a way to envision alternatives to the current process and will make the paradigm shift obvious.

(13) The existing process must be accurately defined in PIP.

Completing all of these critical success factors was quite ambitious for a five-day exercise, but the REAP team recognized that this consultation was just the beginning of a long-term project. The REAP team was able to establish the shell for the PIP. Because the shell was so important to complete precisely, most of the week was spent deliberating its adequacy and accuracy. The REAP team wanted to keep the model as simple as possible, but the team wanted to be confident that the model was also legitimate. The REAP team envisioned a handbook that was concise so managers would actually read and use it. If supplementary information and further explanation were needed, the handbook would provide the manager with references and an extensive bibliography.

There are five major activities that the REAP team determined must be included in the handbook to implement redesign changes effectively. See Figure (3). They are:

(1) describe how to marshal resources,

(2) describe how to create an environment for discontinuous thinking,

(3) describe how to understand "AS-IS" processes,

(4) describe how to evaluate a process, and

(5) describe how to implement changes.

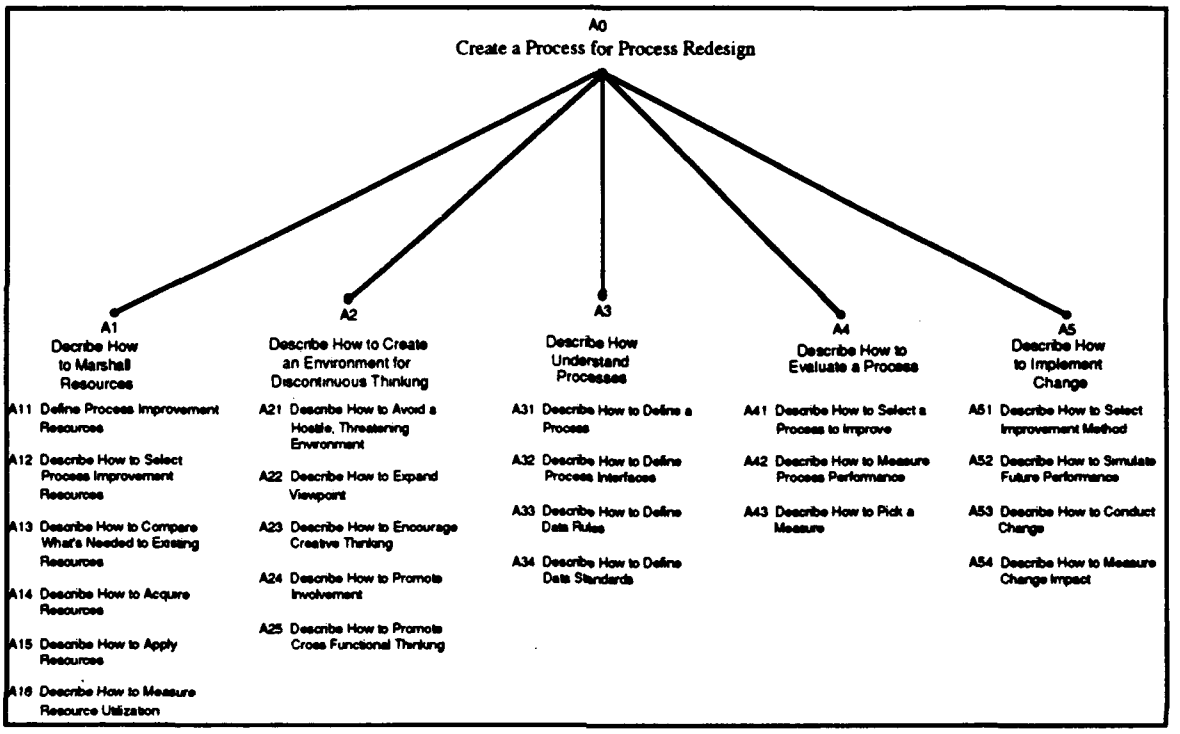



Figure (3) [REAP Report, 1992]

The following activity descriptions from the model could be compared to chapters and sub-chapter titles in a future handbook on how to improve processes.

(A1) The Describe How to Marshall Resources process use REAP's knowledge, experience, and other necessary resources to develop a framework for assembling and organizing the resources necessary to initiate and accomplish process redesign. These resources include, but are not limited to people, funds, seminars, technology, and ideas. A functional manager responsible for bringing about process redesign will be unable to model or portray existing AS-IS processes if he does not understand how to gather the resources to undertake the project. The

extent of this knowledge will affect the amount of resources that can be brought to bear in the effort to understand process change.

Included in the Describe How to Marshall Resources activity are the following sub-activities:

(A11) The Define Process Improvement Resources process describes how to determine what resources are available to accomplish process redesign.

(A12) The Describe How to Select Process Improvement Resources process describes how to choose those resources appropriate for the given redesign process.

(A13) The Describe How to Compare What's Needed to Existing Resources process describes how to evaluate what resources are lacking, if any. For example, inventories of skills, knowledge, and experience (both needed and available) must be taken and compared to identify deficiencies. Specific tools for evaluating these resources and converting one resource to another must be addressed.

(A14) The Describe How to Acquire Resources process describes how to obtain or appropriate resources which are lacking.

(A15) The Describe How to Apply Resources process describes how to put to use the resources which are necessary for process redesign.

(A16) The Describe How to Measure Resource Utilization process describes how to evaluate resources for bringing about the desired process redesign.

(A2) A functional manager responsible for bringing about process redesign may not be able to execute the process if he or she cannot assemble a

team with the requisite group diversity, temperament and social skills to deal with redesign issues with a broad commitment to action. The (A2) Describe How to Create an Environment for Discontinuous Thinking process uses REAP's knowledge and experience of encouraging creative thinking to explain to a functional manager how to overcome that deficiency through training or facilitation and the use of technology.

Included in the Create an Environment for Discontinuous Thinking activity are the following sub-activities:

(A21) The Describe How to Avoid a Threatening, Hostile Environment process explains both how to initiate and sustain an environment that facilitates the open exchange of ideas.

(A22) The Describe How to Expand Viewpoint process explains how to facilitate the understanding and adoption of new perspectives by those individuals participating in the process improvement process.

(A23) The Describe How to Encourage Creative Thinking process explains how to facilitate innovative solutions among the individuals participating in the process improvement process.

(A24) The Describe How to Promote Involvement process explains how to engender active participation in the individuals participating in the process improvement process.

(A25) The Describe How to Promote Cross Functional Thinking process explains how to facilitate positive interaction across areas of responsibility, e.g., including extending process analysis to process interfaces.

(A3) The Describe How to Understand AS-IS Processes uses REAP's knowledge and experience of portraying an existing work process using methods and processes to render them understandable and accessible by functional managers contemplating the redesign of their business operations.

Included in the Describe How to Understand AS-IS Processes activity are the following sub-activities:

(A31) The Describe How to Define a Process describes how to model and portray an activity accurately as it exists now. This process includes the work of measuring the value added by activities and identifying deficiencies in a process.

(A32) The Describe How to Define Process Interfaces process describes how to define the interfaces between the activities that are being modeled and portrayed and those tangential, peripheral activities with which the modeled activities exchange inputs, constraints, outputs or mechanisms. This process includes an examination of relationships between activities that are gathered under activity context descriptions at a higher level of abstraction during a modeling project.

(A33) The Describe How to Define Data Rules process describes how to define rules for data meaning and usage in the databases that support existing activities.

(A34) The Describe How to Define Data Standards process describes how to define standards for data elements, including storage, format, and media.

(A4) The Describe How to Evaluate a Process uses REAP's knowledge and experience to provide an explanation of means by which a process can be measured and judged. The extent of this comprehension will affect the level of understanding of the selection of criteria and methods employed in business process evaluation.

Included in the Describe How to Evaluate a Process activity are the following sub-activities:

(A41) The Describe How to Select a Process to Improve process provides a description of procedures involved in discerning which processes will have a positive impact if improved.

(A42) The Describe How to Measure Process Performance provides a description of the methods and instruments used to measure various process efficiencies, such as activity based costing, quality function deployment, benchmarking, and activity based analysis.

(A43) The Describe How to Pick a Measure process describes the various metrics and why they are used to assess corresponding processes.

(A5) The Describe How to Implement Change process uses the REAP experience base, its understanding of change doctrine and long range DoD strategy to describe to functional DoD managers of all levels how to implement change. The metrics developed from this process are used to improve REAP's process for improving the DoD Process Improvement Process (PIP).

Included in the Describe How to Implement Change activity are the following sub-activities:

(A51) The Describe How to Select Improvement Method process uses REAP's understanding of improvement methods and the DoD environment to produce a guide for selecting a method and improving a process. It helps the manager evaluate characteristics of the process change environment surrounding the process and selects an appropriate method for implementing the change.

(A52) The Describe How to Simulate Future Performance process uses REAP's understanding of enterprise modeling and simulation methods to produce a guide for DoD managers wishing to simulate the effects of changes to processes and how those changes affect an organization, the changed processes, and other processes in an organization.

(A53) The Describe How to Conduct Change process uses REAP's understanding of change methods to produce a guide for DoD managers planning or conducting a change to a process. It includes organizational, personnel, tasking, information, and resourcing guidelines for particular change characteristics.

(A54) The Describe How to Measure Change Impact process uses REAP's understanding of change methods to produce a guide for DoD managers planning to measure the effects of a process change. It includes candidate measurable characteristics and provides mechanisms for measurements. It also includes information about when and where to take the measurements,

who should take the measurements, and what to do with the measurements. It includes information on testing and validating measurements and methods to improve the measurement process.

Most of the IDEF exercise was spent deliberating the major activities that were required to complete a successful process redesign. Each of the five major activities and their subactivities were finally agreed upon and were evaluated countless times to ensure their accuracy.

# VI. OBSERVATIONS AND RECOMMENDATIONS REGARDING THE PROCESS IMPROVEMENT PROCESS AND IDEF

The REAP team raised several issues after the seminar that should be addressed at subsequent IDEF exercises as well as by managers who are about to undertake the process improvement process.

## A. ENCOURAGING RESULTS

The results of the first IDEF conference are indeed encouraging. The REAP team is convinced that the process of process improvement has been modeled accurately using IDEF and can be described in a handbook for functional managers. IDEF0, despite its difficulties as an exercise, proved to be a useful tool for focusing the communications and flow of contributions among redesign team members. IDEF0 provides a common language and needed structure which is absent in free-format techniques such as brainstorming.

## B. TOP LEVEL MANAGEMENT COMMITMENT

If top level management commitment is missing when initiating process evaluation, then middle managers will have an almost impossible task at hand. An observation made by the consultants is that functional managers and military commands are not likely to incur the opportunity costs of nominating their best staff members for participation in a process redesign effort. Indeed, to minimize opportunity costs, they are likely to nominate their least capable personnel. To the extent that this inclination is exercised, the quality and impact of a recommended redesign are likely to be less than what the CIM initiatives require or envision. This problem needs to be addressed to find ways to induce functional managers and commands to nominate their most qualified staff members for participation in

process redesigns. The Navy Total Quality Leadership (TQL) program has appeared to overcome this problem by requiring the highest ranking personnel (Admirals and Captains) to attend TQL seminars prior to tasking the troops. The highest ranking personnel may not be the most appropriate to attend an IDEF exercise, but an attempt should be made to ascertain the most qualified personnel and use them in the IDEF exercises.

Because managers may be uniformed about (1) the technique of modeling a process, (2) the crucial nature of process redesign in the CIM scheme or (3) what CIM itself is all about, the REAP team recommends that the CIM office produce a twenty-minute videocassette that addresses the gaps in what functional managers are likely to know about CIM or PIP. REAP does not believe that manuals, guides, lectures or seminars will suffice.

## C. STAFFING THE IDEF TEAM

In addition to committing the best people to attend an IDEF exercise, what other criteria should be addressed to ensure success? Are executives, managers, workers, complete outsiders, or any combination of the above particularly desired on the IDEF team? An individual's experience and viewpoint may have a profound affect on the outcome of the seminar. A person who works closely with a process may know its inherent strengths and weaknesses better than an executive who reads an occasional report produced during that process. However, the executive who reads the occasional report may know more about the strategic directions of the company and how the process being evaluated relates to other processes within the company. The worker may only be an expert within his own niche.

Even an individual's personality may be considered as to whether he has the appropriate temperament for progressing through a seminar. Tests exist, their

usefulness somewhat debatable, that may be used to determine a candidates IDEF reliability. Some personalities are ill-suited to the level of detail and frequent tedium of the modeling process. Others seem quite at ease with these aspects of the modeling process. Ill-suited personalities undermine the productivity and effectiveness of IDEF teams. A review of the literature of the social psychology of small group effectiveness to determine what is already known about this issue and a set of experiments testing the composition of modeling teams of various personality mixes should be conducted as soon as possible.

## D. INCENTIVES FOR FUNCTIONAL MANAGERS TO REDESIGN PROCESSES

Assuming that functional managers and commanders are overburdened with responsibilities, *ad hoc* taskings, mandated stand-downs, and nagging urgencies, they will naturally try to reduce the time and attention costs for redesign efforts needed to satisfy the CIM requirement. If a manager cannot readily see the value of a particular program they most likely will not give the program their premium effort. The issues are:

(1) What incentives exist or ought to exist for them to produce any redesign effort beyond the minimum?

(2) How can the CIM office mount a leadership effort that emulates the success of TQL?

## E. WEAKNESSES OF IDEF

Is IDEF indeed the invincible tool for process improvement? IDEF does have its weaknesses. The linearity of the IDEF process may lead to inefficient use of time. Consensus is often difficult to achieve and the entire process may come to a screeching halt because several members cannot reach an agreement on a minor issue. In the PIP model, each activity's relationship to one another gave cause for

concern. The enhanced knowledge and experience (output) gained while creating each activity was considered a control (limiting factor) on creating each of the other activities. These outputs and controls may be seen in Figure (2). It could also be considered a mechanism because it supports creating other activities. Although of minimal importance to the overall model, deliberation of how this knowledge and experience affected other activities consumed excessive time. Unfortunately the facilitators allowed the REAP team to debate this issue long past its useful completion. IDEF exercise teams must take care not to allow minor issues to undermine successful completion of their objectives. In any group situation, the facilitator must keep the group focused on important issues and not allow the group to go off on a tangent for any length of time.

Group consensus certainly does not guarantee accuracy and often group members resort to decision making by hierarchy and job title (who has the authority to decide this?) rather than reaching a true consensus among themselves. This is an artifact of their normal everyday decision making. Nonetheless it erodes the potential of IDEF and other tools to usefully model a process. Further study needs to be conducted on existing literature on small group processes to reveal what is known about this tendency and what can be done to overcome it. This issue is a key element in the A2 activity in our PIP model (Create an Environment for Discontinuous Thinking).

Furthermore, there are many other stand-alone techniques that a manager may use, such as benchmarking, to assist in evaluating and changing his processes. IDEF is time and resource exhausting.

## F. MODELING THE "AS-IS" VERSUS NOT MODELING THE "AS-IS"

Does analyzing the "as-is" doom the IDEF methodology to rebuild a weak process with some minor refinements? Evaluating the "as-is" certainly may lead to

biases as the team considers the way the process is currently being done. A group of independent consultants or even employees completely unfamiliar with the current process could conceivably build a better process from the ground up with no biases based on the past. For example, a group of engineering graduates are hired by a company who manufactures steel. This company has been producing steel for over fifty years in an obsolete factory. The company hires the engineering graduates to design a new factory with no knowledge of how the steel is currently being produced. They create a design that is state-of-the-art technology that is far more effective than anything the long-term company engineers could dream of. The opposite situation could happen in an environment where corporate knowledge is more important in the design of the process. Whether or not to evaluate the "as-is" process is indeed an important consideration before embarking on an IDEF seminar. If the personnel involved are already familiar with the current process, then evaluating the "as-is" process will most likely be beneficial because their experiences and biases will be inherent in their opinions on how to redesign the process. Another possibility exists to do both an IDEF with the "as-is" analysis and one without the "as-is" analysis. This concept is obviously more expensive than just doing it one way or the other. However, having two viable models to redesign a process should be better than one if a manager can harvest the strengths and eliminate the weaknesses from both models.

## G. SUBSEQUENT REAP TEAM IDEF EXERCISES

The next REAP team report should carefully consider the transition from the "as-is" to the "what-if." Cost-benefit analysis will be paramount in confining "pie-in-the-sky" ideas from being implemented before there actual benefits are evaluated.

While the REAP team strongly believes that it has come up with a framework for PIP that is both comprehensive and correct, the team recommends that the CIM office sponsor further refinement of the model. The REAP team at the Naval Postgraduate School (NPS) is already directing thesis studies that will detail activities A2 (Create an Environment for Discontinuous Thinking), A3 (Design the Process), and A4 (Implement the Change) with elements on the "how's" of their subactivities.

## H. POPULATING THE REAP DATABASE

The PIP model that has emerged relies heavily on the existence of a REAP database to support redesign teams with examples of other successful redesigns in similar endeavors. The prototype database is concurrently being developed by another member of the REAP team. As presently envisioned, the REAP database architecture would be institutionalized as a database in the CIM office where it would be maintained and populated with data entries. Feasible methodologies by which to populate the database should be devised including establishing quality standards for admitting a reference as a record entry. Software lifecycle maintenance and database editing must also be considered.

## I. CONCLUDING REMARKS

The REAP team is convinced it has created a model that is comprehensive and accurate. Expansion of this model down to its data element level will be the subject of follow-on study and IDEF exercises. Eventually a handbook for functional managers will be written that will explain each of the activities and the various options available for the manager to employ during process redesign.

# APPENDIX A

**Corporate Information Management**
**Process for Process Redesign**
**IDEF Modeling Findings and Recommendations**
**March 1992 REAP Report**

# Corporate Information Management
# Process for Process Redesign
# IDEF Modeling Findings and Recommendations

**March 1992**


Redesign Experts and Practices (REAP)

Convened in Monterey, California
21 - 25 March 1992

# Table of Contents

# Executive Summary

Two things happened at the end of the 1980s that had profound implications for information technology in the Department of Defense (DOD): (1) Congress became displeased with DOD management of information technology and (2) the end of the Cold War started the down-sizing of the defense establishment.

In July, 1989, the House Armed Services Committee responded to GAO reports of mismanagement of automated data processing in DOD by suggesting that funding would no longer be forthcoming for DOD investments in information technology until the department devised a unified, non-duplicative, comprehensive strategy for its information technology (IT). DOD was spending nine billion dollars annually on IT resources. In response to Congressional criticism, the Secretary of Defense appointed a Deputy Secretary (DSD) from the private sector to manage the DOD comptroller office, which included the office of DOD information resources management (IRM). The DSD brought with him a corporate information management (CIM) strategy that was being implemented by his former employer. That company devised CIM to bring information resources together across divisional boundaries.

In November, 1989, a CIM office was created under the DOD deputy comptroller for IRM. She appointed a director of CIM who began implementing the DSD's recipe for unifying

and standardizing information resources. The emphasis was on unified and standardized. The IT strategies to be devised by CIM were to be conceived at the DOD level rather than being an amalgam of the parochial interests and historically-evolved systems of the individual services and agencies.

For FY 91 funding, the CIM office requested $200 million for its operating budget. In October, 1990 the Senate took one billion dollars out of the IT request in the Defense Appropriations Bill and gave it to the CIM office for operations and to begin implementation of CIM initiatives. The bulk of this billion dollars would be returned to the services and agencies from which it was taken, but only if the systems they sought to fund met CIM standards. The message from Capitol Hill was that CIM was a positive response to Congressional concerns and that it was being rewarded with a grant of veto power over investments in IT by the services and agencies. An added message was that, from then on, proposals for IT must possess the capability for DOD-wide integration and standardization.

In December, 1990, the Secretary of Defense moved the CIM office from the comptroller office and placed it within the domain of the Assistant Secretary of Defense for command, control, communications and intelligence (ASD[$C^3$I]). The IRM director became the Deputy Assistant Secretary for information systems. The Defense Communications Agency was selected as the action agency to embody and carry out the CIM program. It was renamed the Defense Information Systems Agency.

In January, 1991 the ASD($C^3I$) created the position of Director of Defense Information (DDI) as a leadership locus for IT across DOD. An IT executive from industry of national repute was appointed to the post early in 1991. Within six months of his appointment, the DDI, who was the author of books on information payoff and business unit practices, began to expand the CIM concept to encompass business process redesign. The message from the DDI's office was that if DOD was going to be smaller it was also going to work smarter. Rather than making across-the-board cuts in information systems, the DDI sought to squeeze non-value-added elements out of business processes. Only after a business process had been redesigned down to its value-added activities would it be considered for automation.

In April, 1991, a member of the Naval Postgraduate School (NPS) department of administrative sciences visited the DDI to explore possibilities for CIM-funded research into information systems. The DDI proposed that NPS could assist his office by undertaking research related to the implementation of business process redesign in DOD. He funded a research project to be undertaken in FY 92.

In February, 1992, a special assistant to the DDI, formerly a successful practitioner of business process redesign with the Army Corps of Engineers, met with NPS representatives in Monterey to finalize taskings for the research project. An agreement was reached in which a NPS faculty-student

research team would model the "how" of business process redesign using the IDEF modeling tool. The resultant model of the modeling process would be incorporated into a guide book on process redesign for DOD functional managers. At the end of March, 1992, the NPS research team, joined by the NPS Dean of Computer and Information Services, participated in a five-day IDEF modeling workshop in Monterey conducted by representatives of D. Appleton Company, Inc.

## Mission

The Redesign Experts and Practices (REAP) Team received its detailed charter to produce a quality model of the Process Improvement Process (PIP) using IDEF0 modeling techniques.

1. To model the "how" of business process redesign steps, creating a model of the redesign process model itself that can be used in the handbook on business process redesign for functional managers. This model is to be constructed using IDEF techniques by 10 May 92.

2. To develop a data structure (business rules), from general to specific aspects of an organization, of what functional managers can realistically expect to do. The structure is to take the form of an entity-relation diagram. This is expected to be a long-term project.

Estimated completion date: unknown.

3. To develop an inventory of alternative resources and inputs to be used by redesign teams to assist them in breaking the crust of customs and convention in business processes. The means by which redesign teams can identify and discover these resources will be a database. The scope, configuration, design, architecture, ownership, and maintenance of this database are issues to be addressed during IDEF modeling. A prototype of this database has an expected completion date of 1 September 1992.

4. To demonstrate the capability of redesign business processes through an integrating, comprehensive case study of applied redesign to a single business system, i.e., civilian payroll. Expected completion date is 1 December 1992.

5. To prepare a final report that will include the deliverables described in tasks 1-4 as well as suggested follow-on reports.

## Workshop Scope

The scope for this workshop is limited to number (1) from above: to provide the REAP with an orientation in IDEF0 activity modeling and Activity Based Costing (ABC). The model and initial performance metrics will be documented in the PIP plan that is the primary deliverable for the workshop.

## Daily Schedule

Day 1: Kickoff and IDEF0 orientation. Establishment of workshop mission, scope, and objectives. Workshop expectations set.

Days 2/3: Development of high-level IDEF0 Model. ABC orientation.

Day 4: Identification of major activities and primary outputs for application of ABC techniques to follow on projects. Preparation of PIP plan and workshop report begun.

Day 5: Completion of model documentation and workshop report. Reviewed issues and recommended actions.

The REAP continued to display diversity and full participation throughout the five days. It is expected that the group will continue to develop its model, but the group may change its personnel somewhat upon completion of the original activity from 21-25 March 1992.

## Findings

The model was created and then refined many times through the course of the week. As the root node was decomposed it became obvious that the immediate branch nodes would include activities that REAP could not explore thoroughly during the five day constraint.

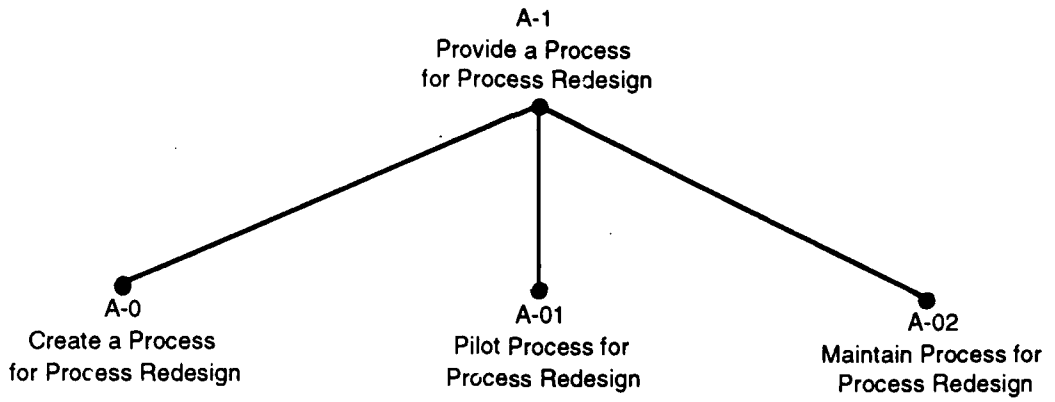



*Figure 1: Context for REAP Modeling Effort*

The "Create a Process for Process Redesign" activity was developed and stabilized down two levels. The "Pilot Process for Process Redesign" activity will test the process redesign model by applying the output to an actual single business system. The "Maintain Process for Process for Process Redesign" activity will include the long-term update and refinements of the model using feedback from the users and will most likely by handled by the CIM office.

One of the criticisms of REAP is that it did not spend time creating any data models or business rules. The counter-argument to this criticism is that these rules will be inherent in

lower levels of the model when they are detailed.

ABC was not discussed due to time constraints.

The answer to the original research question (can the process improvement model be modeled?) was answered positively. The model is being built successfully and its completion will include a viable working handbook on specifically how to improve processes in one's functional area.

IDEF is a useful tool to model the process improvement process. It is not without its limitations, however.

IDEF modeling is manpower intensive, difficult to set consistent policy, and requires long-term commitment to attain a complete model of any complex process.

## Recommendation

The REAP Team recommends that the Office of the Director of Defense Information develop a maintenance module for the process redesign process. The model should include a business rule model.

## REAP Team Profile

Barry Frew, Dean of Computer and Information Services

Kenneth Euske, Associate Professor of Accounting

William Haga, Adjunct Professor of Management Information Systems

Jeff Nevels, LCDR, SC, USN, Instructor of Accounting

Scott White, LCDR, USN, Aviator

Diane Bizzell, LT, USN, General Unrestricted Line

William Kotheimer, LT, USN, Naval Intelligence

Gene Honbo, D. Appleton Company, Inc.

Eric Bails, D. Appleton Company, Inc.

# PIP Process Model

## Approach to Process Modeling

This workshop was conducted as a standard engagement offered by D. Appleton Company to provide modeling support to business process improvement efforts under the DOD CIM umbrella. A description of the standard engagement appears below.

**CIM Business Process Improvement Workshops**

Scoping Workshop (one week) - This workshop is designed to provide DOD functional executives and managers with an understanding of the business process improvement objectives associated with the CIM initiative. The participants will receive an orientation in the IDEF0 activity modeling used to develop the foundation for developing a process for business process improvement. The workshop team will build a high level IDEF0 model to reflect the processes that improve business processes. The workshop team will use the model as the foundation for developing a preliminary Process Improvement Process (PIP) Plan. The model and initial performance metrics will be documented in the Business Process Improvement Plan that is the primary deliverable for the workshop. The report will present recommendations for specific follow-on projects and implementation actions.

*Figure 2: Description of CIM Business Process Improvement Scoping Workshop*

Details of the workshop implementation for this engagement are provided in the Executive Summary.

*Group Accumulation Technique*

In the group accumulation process, the facilitator begins by reviewing the objectives of the session. A session objective might be to develop a program mission statement (i.e., articulate program goals). It might be to identify the critical success factors required for attacking identified problems. It might be to identify considerations to be incorporated in the definition of an ICOM.

In the example of an order processing situation, the facilitator might start the group accumulation by asking, "Management and staff have complained that there is too much paperwork involved in serving our customers. Also, order clerks can't get the information they need fast enough to respond efficiently to customers. Our objective for this session is to identify the critical success factors that are required to solve these problem."

At this point, each participant is asked to record several ideas on a piece of paper. Normally five to ten minutes is allocated for the completion of this step.

Participants are told that the papers will not be collected, since they are merely for recording ideas that may be contributed later in the meeting. Participants may or may not share all of their recorded ideas with the group.

The facilitator asks participants to follow these instructions:

- Refrain from talking to one another about the ideas they are recording
- Write down anything that comes to mind, and write it as clearly as possible.

When participants are through recording their ideas, the facilitator begins the group accumulation, which involves the steps that follow.

1. Each participant, in turn, submits one idea to the group.
2. The facilitator records each submitted idea on a flipchart, but s/he does not repeat an idea that has already been mentioned. Complicated ideas should be subdivided into simpler ideas. Ideas should be limited to one or two lines on the flipchart. As flipchart pages become full, they should be hung on the wall so they are visible to the entire group.
3. As each idea is listed on the flipchart, the facilitator makes sure that everyone understands the item listed (participants can ask for clarification at any point in the process). The submitter is asked to clarify any questions about a specific idea.

4. The facilitator then asks if anyone objects to an idea or challenges it as inappropriate.

5. If an idea is challenged, the scribe places brackets around the item on the flipchart. The challenge is not discussed by the group at this time.

6. When everyone in the group has contributed one idea, the facilitator begins the process again by asking each participant for an additional idea. If a participant does not wish to make a contribution, s/he simply says, "Pass."

7. Each member of the group must pass in turn. When the entire group passes three times in succession, the group accumulation process is completed.

8. If any member of the group makes a new contribution before three complete group passes, the three passes rule goes into effect once again. This rule ensures that group members can contribute as many ideas as they wish.

Generally, the process requires participants to make efficient use of the allotted time. If the facilitator notices that time is running short, participants should be encouraged to finish submitting ideas. Throughout the group accumulation process, it is the facilitator's role to see that a steady pace is maintained.

After all ideas have been recorded and understood by the team, the next step is to clear the challenges by removing the brackets from challenged ideas. This procedure will indicate which ideas fit into the pattern and which are irrelevant. Ideas should be synthesized and collapsed into categories.

Then, the person who challenges an idea is asked to explain to the group why s/he objects to the item. After this explanation is given, the person who contributed the idea is asked if it should be deleted or saved. If the challenger can't express persuasive reasons why the idea should be deleted, and the submitter can't decide what to do, then the fate of the idea is decided by a majority vote of the group.

After all bracketed items have been resolved, the data discovery process has been completed, and the session is over. The result is a list of ideas that need to be explored more thoroughly in other information-gathering or modeling activities.

The discarded ideas should be noted and kept as a separate list for possible future use. An idea that seems far-fetched now may be useful in the future.

## Objectives and Critical Success Factors

*Objectives*

The REAP Team used the Group Accumulation Technique to establish the objectives for the process model resulting from the Scoping Workshop. Throughout the five days, the team

revisited these objectives to ensure that the model adequately addressed these concerns.

Objectives are defined as specific targets which are intended to be reached at a given point in time. An objective is an operational transformation of one or more goals. Objectives are measurable, quantifiable, controllable, and transformable. Objectives must also be congruent with other objectives.

The objectives are presented in no particular order.

1. The PIP should be as concise as possible

2. The PIP will focus on its implementation, so that financial or functional managers know what to do next.

3. The PIP will be described in a manner similar to the way functional managers talk about their work.

4. The PIP will be described such that implementers will see their own process when implementing the PIP

5. The PIP will be described clearly, so it is as easily understandable as possible.

*Critical Success Factors*

The REAP team used the set of group-accumulated objectives as candidate for critical success factors.

Critical success factors are defined as the limited number of areas in which satisfactory results will ensure successful performance for the functional managers. Critical success factors are the few key areas in which "things must go right" for PIP to succeed and for the managers' own objectives to be attained. Since they are a subset of PIP objectives, the project critical success factors are measurable, quantifiable, controllable, and transformable.

The REAP Team achieved consensus deriving the following critical success factors from the set of objectives.

1. The PIP must be applicable to manufacturing and service operations.

2. The PIP will be presented as a "cookbook" guide with an explanation of the underlying theory

3. The PIP will make process improvement clear and accessible to functional managers
4. The PIP will help to identify meaningless activities

5. The PIP will be operational

6. The PIP will be detailed enough to be implement able

7. The PIP will be easily modifiable

8. The PIP will either identify improvement methods or a method for identifying improvement methods.

9. The PIP will be generic enough to be applicable across different levels of management

10. The PIP will help identify value-added activities

11. The deliverable will completely describe the PIP

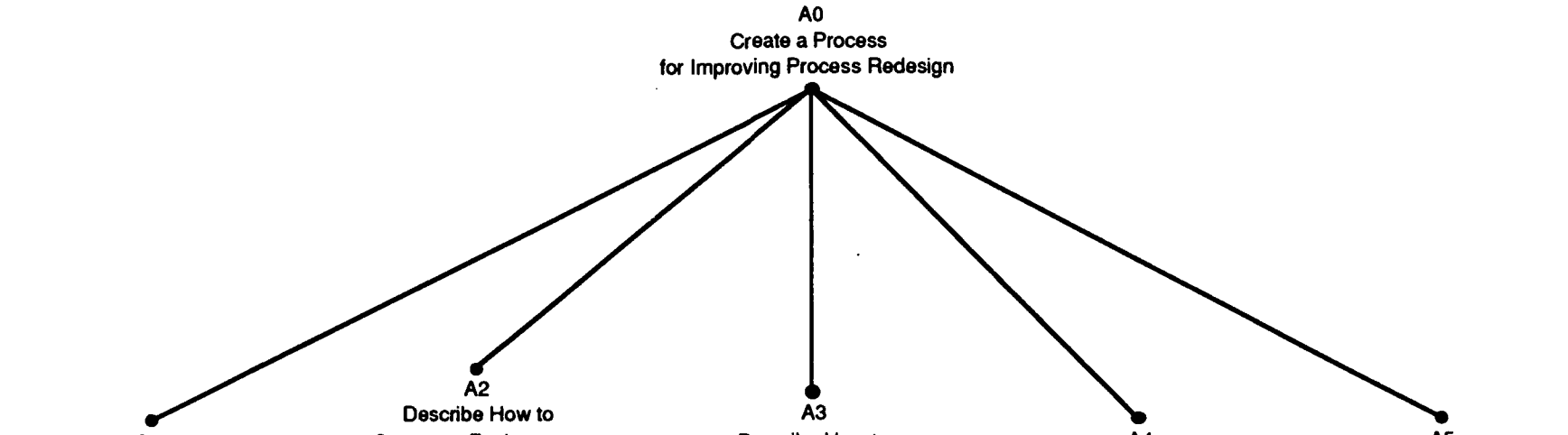
12. The PIP will provide functional managers with a way to envision alternatives to the current process and will make the paradigm shift obvious

13. The existing process must be accurately defined in PIP.

## Process Model Diagrams

The next few pages feature IDEF0 (process) model diagrams of the process to create the Process for Process Redesign. The node tree shows all activities within the scope of "Create a Process for Process Redesign." The Context Diagram depicts high level inputs, controls, outputs, and mechanisms for this process. The A0 Decomposition Diagram shows how high-level activities in "Create a Process for Process Redesign" relate to one another and produce and exchange information about process redesign in the DOD environment.

For a primer on reading IDEF0 models, please refer to the appendix "Process Model Reader's Guide" immediately following this section.




A11 Define Process Improvement Resources

A12 Describe How to Select Process Improvement Resources

A13 Describe How to Compare What's Needed to Existing Resources

A14 Describe How to Acquire Resources

A15 Describe How to Apply Resources

A16 Describe How to Measure Resource Utilization

A21 Describe How to Avoid a Hostile, Threatening Environment

A22 Describe How to Expand Viewpoint

A23 Describe How to Encourage Creative Thinking

A24 Describe How to Promote Involvement

A25 Describe How to Promote Cross Functional Thinking

A31 Describe How to Define a Process

A32 Describe How to Define Process Interfaces

A33 Describe How to Define Data Rules

A34 Describe How to Define Data Standards

A41 Describe How to Select a Process to Improve

A42 Describe How to Measure Process Performance

A43 Describe How to Pick a Measure

A51 Describe How to Select Improvement Method

A52 Describe How to Simulate Future Performance

A53 Describe How to Conduct Change

A54 Describe How to Measure Change Impact

| USED AT: | AUTHOR: Redesign Experts and Practices (REAP) | DATE: 3/21/91 | | WORKING | READER DATE | CONTEXT: |
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| | PROJECT: DoD Process Improvement Process | REV: 1.3 | | DRAFT | | |
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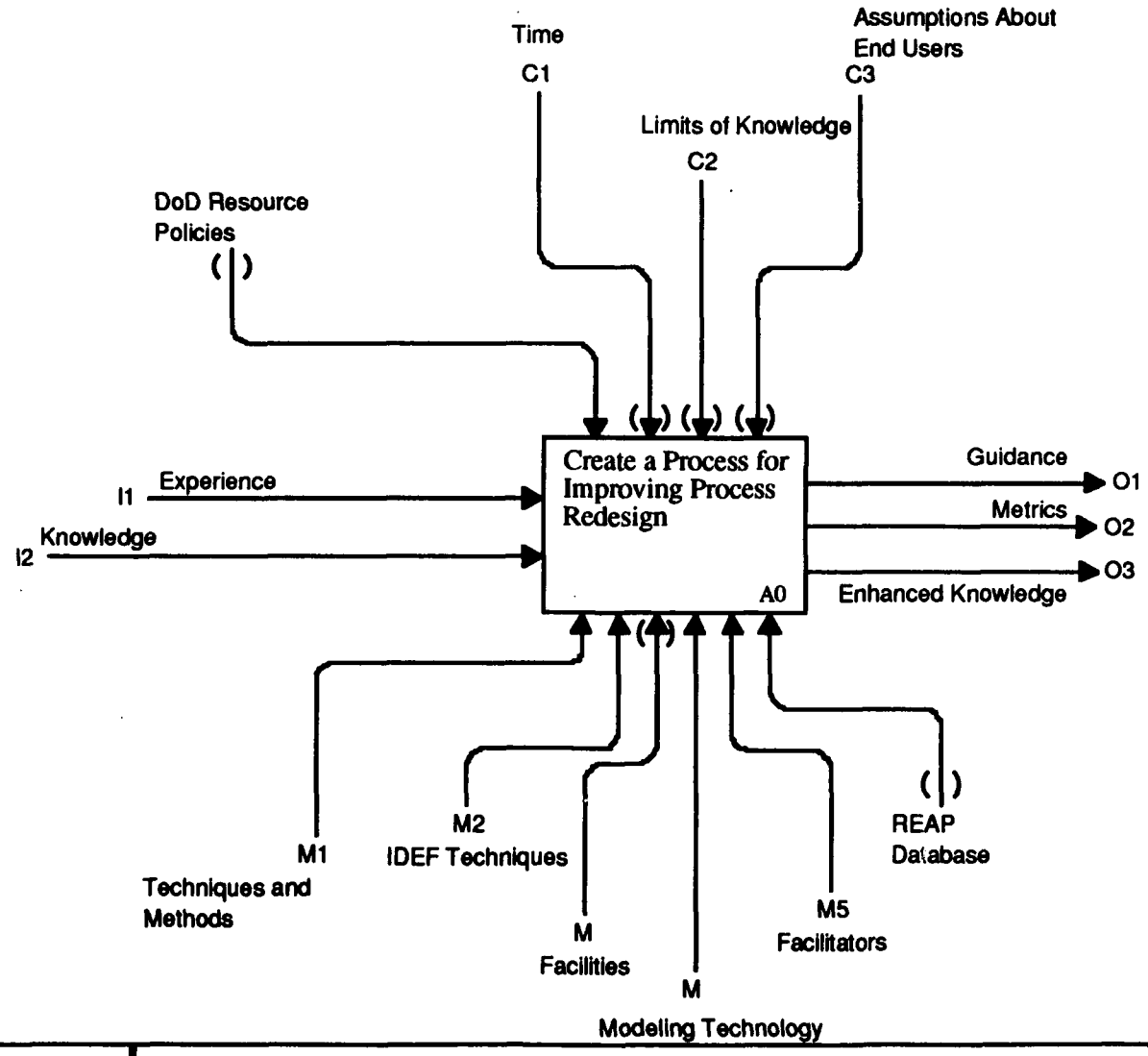


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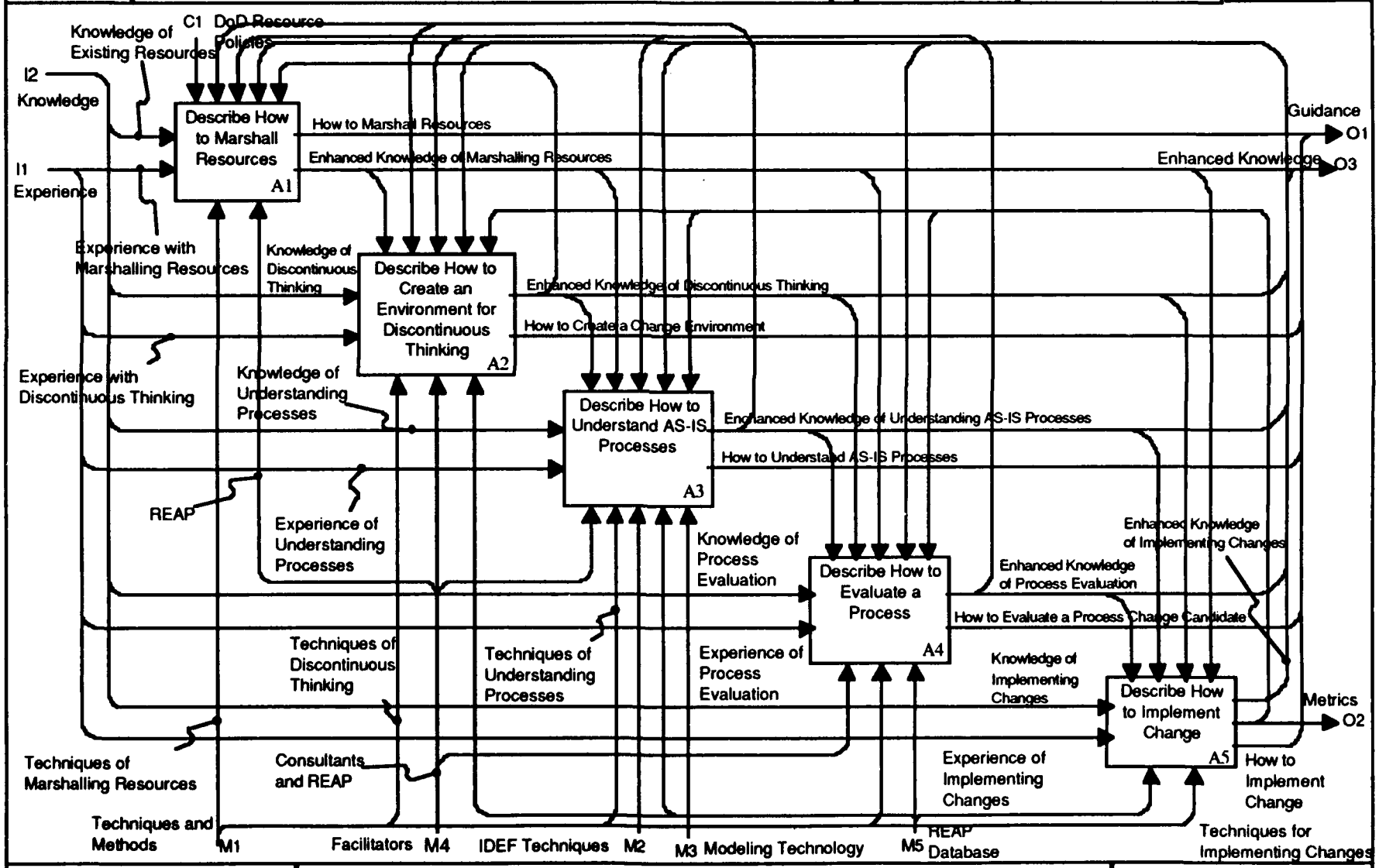



| NODE: A0 | TITLE: Create a Process for Process Redesign | NUMBER: Figure (2) REAP Repost, 1992] |
|---|---|---|

| Objective | A1 Describe How to Marshall Resources | A2 Describe How to Create an Environment for Discontinuous Thinking | A3 Describe How to Understand AS-IS Processes | A4 Describe How to Evaluate a Process | A5 Describe How to Implement Change |
|---|---|---|---|---|---|
| The PIP must be applicable to manufacturing and service operations. | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP should be as concise as possible | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will be presented as a "cookbook" guide with an explanation of the underlying theory | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will make process improvement clear and accessible to functional managers | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will help to identify meaningless activities | | | ✔ | ✔ | |
| The PIP will be operational | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will be detailed enough to be implementable | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will be easily modifiable | ✔ | ✔ | ✔ | ✔ | ✔ |

| Objective | A1 Describe How to Marshall Resources | A2 Describe How to Create an Environment for Discontinuous Thinking | A3 Describe How to Understand AS-IS Processes | A4 Describe How to Evaluate a Process | A5 Describe How to Implement Change |
|---|---|---|---|---|---|
| The PIP will focus on its implementation, so that financial or functional managers know what to do next. | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will either identify improvement methods or a method for identifying improvement methods. | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will be generic enough to be applicable across different levels of management | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will be described in a manner similar to the way functional managers talk about their work. | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will be described such that implementers will see their own process when implementing the PIP | | | | | ✔ |
| The PIP will help identify value-added activities | | ✔ | ✔ | ✔ | |

| Objective | A1 Describe How to Marshall Resources | A2 Describe How to Create an Environment for Discontinuous Thinking | A3 Describe How to Understand AS-IS Processes | A4 Describe How to Evaluate a Process | A5 Describe How to Implement Change |
|---|---|---|---|---|---|
| The deliverable will completely describe the PIP | ✔ | ✔ | ✔ | ✔ | ✔ |
| The PIP will provide functional managers with a way to envision alternatives to the current process and will make the paradigm shift obvious | | ✔ | | ✔ | ✔ |
| The PIP will be described clearly, so it is as easily understandable as possible. | ✔ | ✔ | ✔ | ✔ | ✔ |
| The existing process must be accurately defined in PIP | | | ✔ | | |

## IDEF0 Model Glossary

The definitions for the activities and ICOMs appearing in the PIP model appear below. This glossary is an integral part of the activity model and workshop deliverable. These definitions should be read closely, for they give greater depth and meaning to the diagrams just presented.

*Activities*

**A0 Create a Process for Process Redesign**
This process uses REAP's knowledge, experience, and other necessary resources to develop process redesign implementation guidance for DOD functional managers. It also results in enhanced knowledge of process redesign, DOD resource policies, assumptions about DOD functional managers, and the limits of REAP's knowledge base pose constraints on this activity.

**A1 Describe How to Marshall Resources**
This process uses REAP's knowledge, experience, and other necessary resources to develop a framework for assembling and organizing the resources necessary to initiate and accomplish process reengineering. These resources include, but are not limited to, people, funds, seminars, technology, and ideas.

A functional manager responsible for bringing about process redesign will be unable to model or portray existing AS-IS processes if s/he does not understand how to gather the resources to undertake the project. The extent of this knowledge will affect the amount of resources that can be brought to bear in the effort to understand process change.

These resources include, but are not limited to, people, funds, seminars, technology, and ideas. The mechanisms to assist in this process are REAP and techniques for marshalling resources.

**A11 Define Process Improvement Resources**
This process describes how to determine what resources are available to accomplish process redesign.

**A12 Describe How to Select Process Improvement Resources**
This process describes how to choose those resources appropriate for the given redesign process.

**A13 Describe How to Compare What's Needed to Existing Resources**
This process describes how to evaluate what resources are lacking, if any. For example, inventories of skills, knowledge, and experience (both needed and available) must be taken and compared to identify deficiencies. Specific tools for evaluating these resources and converting one resource to another must be addressed.

**A14 Describe How to Acquire Resources**
This process describes how to obtain or appropriate resources which are lacking.

**A15 Describe How to Apply Resources**
This process describes how to put to use the resources which are necessary for process redesign.

**A16 Describe How to Measure Resource Utilization**
This process describes how to evaluate resources for bringing about the desired process redesign.

**A2 Describe How to Create an Environment for Discontinuous Thinking**
A functional manager responsible for bringing about process redesign may not be able to execute the process if he or she cannot assemble a team with the requisite group diversity, frame of mind and social skills to deal with redesign issues with an open mind and with a commitment to action. This process uses REAP's knowledge and experience of encouraging creative thinking to explain to a functional manager how to overcome that deficiency through training or facilitation and the use of technology.

**A21 Describe How to Avoid a Threatening, Hostile Environment**
This process explains both how to initiate and sustain an environment that facilitates the open exchange of ideas.

**A22 Describe How to Expand Viewpoint**
This process explains how to facilitate the understanding and adoption of new perspectives by those individuals participating in the process improvement process.

**A23 Describe How to Encourage Creative Thinking**
This process explains how to facilitate innovative solutions among the individuals participating in the process improvement process. One technique for facilitating the innovative solutions is to first define the complete redesign team, then include an individual who is a supplier to the process and an individual who is a customer of the process.

**A24 Describe How to Promote Involvement**
This process explains how to engender active participation in the individuals participating in the process improvement process.

**A25 Describe How to Promote Cross Functional Thinking**
This process explains how to facilitate positive interaction across areas of responsibility, e.g., including extending process analysis to process interfaces.

**A3 Describe How to Understand AS-IS Processes**
This process uses REAP's knowledge and experience of portraying an existing work process using methods and processes to render them understandable and accessible by functional managers contemplating the redesign of their business operations.

**A31 Describe How to Define a Process**
This process describes how to model and portray an activity accurately as it exists now. This process includes the work of measuring the value added by activities and identifying deficiencies in a process.

**A32 Describe How to Define Process Interfaces**
This process describes how to define the interfaces between the activities that are being modeled and portrayed and those tangential, peripheral activities with which the modeled activities exchange inputs, constraints, outputs or mechanisms. This process includes an examination of relationships between activities that are gathered under activity context descriptions at a higher level of abstraction during a modeling project.

**A33 Describe How to Define Data Rules**
This process describes how to define rules for data meaning and usage in the databases that support existing activities that are being portrayed and modeled.

**A34 Describe How to Define Data Standards**
This process describes how to define standards for data elements, including storage, format, and media.

**A4 Describe How to Evaluate a Process**
This process uses REAP's knowledge and experience to provide an explanation of means by which a process can be measured and judged. The extent of this comprehension will affect the level of understanding of the selection of criteria and methods employed in business process evaluation.

**A41 Describe How to Select a Process to Improve**
This process provides a description of procedures involved in discerning which processes will have a positive impact if improved.

**A42 Describe How to Measure Process Performance**
This process provides a description of the methods and instruments used to measure various process efficiencies, such as activity based costing, quality function deployment, benchmarking, and activity based analysis.

**A43 Describe How to Pick a Measure**
This process describes the various metrics and why they are used to assess corresponding processes.

**A5 Describe How to Implement Change**
This process uses the REAP experience base, its understanding of change doctrine and long range DOD strategy to describe to functional DOD managers of all levels how to implement change. The metrics developed from this process are used to improve REAP's process for improving the DOD Process Improvement Process (PIP).

**A51 Describe How to Conduct Change**
This process uses REAP's understanding of change disciplines and the DOD environment to produce a guide for conducting or planning a change. It addresses the risks, timing and resource requirements, and benefits associated with a particular strategy and helps a manager select a method with acceptable risk characteristics.

**A52 Describe How to Select Improvement Method**
This process uses REAP's understanding of improvement disciplines and the DOD environment to produce a guide for selecting a method and improving a process. It helps the manager evaluate characteristics of the process change and the environment surrounding the process. This process also selects an appropriate method for implementing the change.

**A53 Describe How to Simulate Future Performance**

This process uses REAP's understanding of enterprise modeling and simulation disciplines to produce a guide for DOD managers wishing to simulate the effects of changes to processes and how those changes affect an organization, the changed processes, and other processes in an organization.

**A54 Describe How to Conduct Change**

This process uses REAP's understanding of change methods to produce a guide for DOD managers planning or conducting a change to a process. It includes organizational, personnel, tasking, information, and resourcing guidelines for particular change characteristics.

**A55 Describe How to Measure Change Impact**

This process uses REAP's understanding of change methods to produce a guide for DOD managers planning to measure the effects of a process change. It includes candidate measurable characteristics for process change and provides mechanisms for measurements. It also includes information about when and where to take the measurements, who should take the measurements, and what to do with the measurements. It includes information on testing and validating measurements and methods to improve the measurement process.

*ICOMs*

**Assumptions About Ends Users**
Assumptions include such facts as a user's level in organization, education, bureaucratic experience, capacity, length of tenure, organizational environment, and ability to think discontinuously.

**Consultants**
Specialists in the field of process evaluation hired to transfer their expertise on business process evaluation.

**DOD Resource Policies**
The statutes, regulations, procedures, customs, and policies governing appropriation and allocation of resources. This includes, but is not limited to, public law, the DOD budget process, Federal Acquisition Regulation (FAR), and Managing to Payroll (MTP) procedures.

**Enhanced Knowledge**
The internal body of knowledge of an environment which has expanded as a result of completing a process within PIP. This heightened awareness serves to influence all other activities.

**Enhanced Knowledge of Discontinuous Thinking Environments**
This knowledge is expanded as a result of completing the process of describing how to create an environment for discontinuous thinking. This heightened awareness serves to influence all other activities.

**Enhanced Knowledge of Implementing Changes**

This knowledge is expanded as a result of completing the process of describing how to implement changes. This heightened awareness serves to influence all other activities.

**Enhanced Knowledge of Marshaling Resources**

This knowledge is expanded as a result of completing the process of describing how to marshall resources. This heightened awareness serves to influence all other activities.

**Enhanced Knowledge of Process Evaluation**

This knowledge is expanded as a result of completing the process of describing how to evaluate processes. This heightened awareness serves to influence all other activities.

**Enhanced Knowledge of Understanding AS-IS Processes**

This knowledge is expanded as a result of completing the process of describing how to understand AS-IS processes. This heightened awareness serves to influence all other activities.

**Experience**

REAP's active participation in events and activities that have lead to the creation of environments that facilitate discontinuous thinking, including practical knowledge based on personal involvement and observation, which is inherently biased.

**Experience in Process Evaluation**
Memories and biases concerning methodology, tools, and techniques of business process evaluation based on previous involvement with process evaluation projects.

**Experience of Implementing Changes**
Memories and biases concerning methodology, tools, and techniques of business process evaluation based on previous involvement with change implementation.

**Experience with Discontinuous Thinking**
Memories and biases concerning methodology, tools, and techniques of business process evaluation based on previous involvement with methods to promote discontinuous thinking.

**Experience with Marshaling Resources**
Memories and biases concerning methodology, tools, and techniques of business process evaluation based on previous involvement with marshalling resources.

**Experience with Understanding Processes**
Experiences, anecdotes, insights, judgments, biases and lore about ways to understand and model existing systems that exists in the minds of practicing managers, facilitators, consultants, subject matter experts and others who constitute a functional redesign team or are engaged to support one.

**Facilitators**

CIM assumes that functional managers facing process redesign have no background in its methods, or techniques. To start a redesign project and shepherd it through to completion requires the help of people who are skilled and experienced in process redesign. They are the redesign process facilitators. They may be found within CIM, DOD or in private consulting firms.

**Facilities**

Physical sites include offices and conference rooms equipped with presentation media, desktop publishing equipment, and analytical tools.

**How to Create a Change Environment**

This is a set of ideas, tools, and techniques that explain to those involved in process redesign the necessary and possibly sufficient conditions for an innovation to occur. This set of ideas encourages commitment to action by functional managers.

**How to Evaluate a Process Change Candidate**

A description of the principles, methods, tools, and techniques used to measure and judge business processes and an understanding of when and how to use them.

**How to Implement Change**

A set of documents describing the implementation of process improvement within the DOD environment. Included are case studies, charts, tables, theories, practical application examples, description of risks, critical success factors, reference models, methods, training and education requirements, and best practices.

**How to Marshall Resources**

The description of the ideas, tools, and techniques that explain to the manager of the process redesign how to acquire the necessary and sufficient tangible and intangible sources of support for the purpose of redesigning a process.

**How to Understand AS-IS Process**

A document that describes the methods and techniques for modeling existing business activities.

**How to Understand Existing Processes**

A description of the principles, methods, and tools used to understand business processes.

**IDEF Techniques**

IDEF (ICAM DEFinition language) is a family of modeling techniques that are easily understood by managers and developers of information systems. IDEF0 (IDEF zero) models processes.

**Knowledge**
REAP's awareness and comprehension of techniques, processes, and activities that facilitate the creation of environments conducive to discontinuous thinking. This awareness is learned through training and intellectual investigation rather than practical experience.

**Knowledge of Discontinuous Thinking**
Prior understanding of the methods available to expand the viewpoints of a redesign team.

**Knowledge of Existing Resources**
The current awareness of resources available to those involved in the process improvement process (PIP).

**Knowledge of Marshaling Resources**
Practical knowledge of marshaling resources to support an event or process.

**Knowledge of Process Evaluation**
Any prior understanding of the principles, methods, and practices used to measure and judge business processes gained through the study of business process evaluation.

**Knowledge of Understanding Processes**
Written, documented lore about ways to understand and model existing systems that exists in books, reports, academic literature, conference papers and business and trade periodicals.

**Limits of Knowledge**

The parameters of REAP's knowledge base that constrains the development of PIP.

**Metrics**

Units, standards and criteria involved in the process of measurement. In PIP, measurement of both qualitative and quantitative aspects of a process are included.

**Modeling Technology**

The primary technology employed in describing existing business processes is the software that models the IDEF techniques.

**REAP**

Those individuals, organizations, and conventions facilitating the process improvement process. Up to the publication date of this model, REAP (Redesign Experts and Practices) consisted of the accumulated knowledge, bias, energy, insight, and analytical skills of a diverse group including three NPS graduate students, three NPS faculty members, an NPS dean, and two D. Appleton Company facilitators.

**REAP Database**

The REAP database contains the following resources to assist functional management redesign teams:

1. Lists of names and contact points for experts and

facilitators in activity redesign methods and techniques.

2. Lists and brief descriptions of methods and techniques for modeling, portraying and analyzing existing business processes.

3. Lists of activities in DOD and firms in the private sector that have already experienced process redesign and offer contact points willing to share their experience with you.

4. Lists of business process metrics, i.e., what measures are best employed to evaluate certain processes.

**Techniques and Methods**

Examples of techniques and methods include a set of exercises, readings, lectures, audio-visual media and other devices that are available to the team and its facilitators to reach a commitment to action by the team members.

**Techniques for Implementing Change**

Methods, procedures and conventions used to change business processes.

**Techniques for Marshaling Resources**

Generally accepted DOD procedures and practices for acquiring resources.

**Techniques for Understanding Processes**

Methods for bringing about discontinuous thinking among the members of a functional redesign team in order to examine and describe their activities in a useful, accurate portrayal unencumbered by suboptimal biases or departmental politics.

**Techniques of Discontinuous Thinking**

Techniques for use with individuals involved in process redesign, some examples are

- Framing and reframing exercises
- Use of creative thinking exercises
- Developing multiple interpretation exercises
- Escaping from dominant ideas exercises
- A checklist on how to kill creativity
- Readings and discussion of groupthink
- Readings and discussion of unconscious aspects of organizations
- Readings and discussion of how organizations can obstruct learning
- Readings and discussion of conflicting messages sent by organizations.

**Time**

Deadlines on the execution of each process in PIP.

# Process Model Reader's Guide

## Overview

The purpose of this paper is to provide guidelines for reading and understanding IDEF0 Activity Models. It is not intended to be an instructional manual in the techniques of building such models. Rather, it is intended to specify the basic components of an Activity Model and their interpretation.

The use of IDEF0 is supported by software that maintains, analyzes, and cross-references models. D. Appleton Company has developed a computer processable language, called Activity Modeling Language (AML), which can be used to define IDEF0 models for computer processing.

An IDEF0 Activity Model may be defined as a graphic portrayal of the processes within an organization. That is, the model depicts the specific steps, operations, and data elements that are needed to perform an activity. It is important to understand that the model does not represent a "time-flow;" that is, it does not define a sequential time-constrained set of tasks, but rather the logical interdependency of various types of activities.

## Definition of Activity

An activity is a named process, function, or task that has one or more occurrences over time and produces recognizable results.

## Uses of the Activity Model

One of the most important uses of the model is to define the scope of a project. It may be developed from the viewpoint of the functional group performing the activity - what the system will do, from the viewpoint of the designer - how the system will be built, or from the viewpoint of the operator - how the system will be maintained. The model may represent as broad or as narrow a viewpoint as is required and may be refined further and further into more detail. If several viewpoints are needed, separate models are developed for each one.

Another use of the Activity Model is for "data discovery and validation" since the model shows the relationship between an activity and the information that is used to perform the activity. Data elements can be extracted from the model and can be used to specify transactions which may, in turn, eventually be used to automate the process. After these data elements are documented in a data model, the activity model can be referenced for validation purposes.

Documentation of the "as-is" environment is another important use of the Activity Model because the model is similar to a "snapshot" of an organization's activities at a particular moment in time. It can, therefore, be useful for documenting how an organization really functions. The model can be used to describe operations, processes and procedures, interactions, interfaces, directions, etc., in the existing environment. The Activity Model, which reflects the "as-is" environment, is also useful in problem identification.

The "to-be" environment can also be documented through development of an

Activity Model, showing proposed changes to the processes, procedures, mechanisms, etc.

The remainder of this paper will address Activity Models primarily as a means of data discovery and validation, which can form the basis for development of an IDEF1X semantic data model.

## Components of an Activity Model

The result of applying the IDEF0 activity modeling technique is an understanding of the activities in the environment and their use of information or materials.

- These are typically represented by three different types of activity diagrams:
  - Node trees, which graphically portray activities in a hierarchical format.
  - Context diagrams, which illustrate individual activities and their inputs, controls, outputs, and mechanisms, in terms of either information or materials.
  - Decomposition diagrams, which represent a refined definition of an activity by showing its lower-level activities and the interrelationships of inputs, controls, outputs, and mechanisms.
- An Activity Model also includes a glossary that defines the terms, or labels, used on the diagrams.

- The model also includes explanatory text in paragraph form that describes an entire diagram, including what goes on in each activity and how activities in the diagram interact.

## Activities: A Building Block of the Activity Model

In an IDEF0 modeling diagram, an activity is represented graphically by a rectangular box. Each activity box is labeled using an active verb or verb phrase.

Any complex activity can be broken down into smaller, more detailed activities. The process of breaking down an activity into subactivities is called decomposition. Activity modeling uses functional decomposition's as the foundations for model refinement and validation.

## ICOMs: Another Building Block

Often information or materials produced in one activity are used in others. These ICOMs or "activity relationships" are represented by arrows interconnecting the activity boxes and are named with a noun or noun phrase.

The term "ICOM" is the acronym of the four possible roles relative to an activity:

- Input - data or material used to produce the output of an activity
- Control - data that constrain an activity. Controls regulate the transformation of inputs into outputs
- Output - data or materials produced by or resulting from the activity

- Mechanism - usually people, machines, or existing systems that perform or provide energy to the activity

The particular role of an ICOM is identified by the position of its arrow in relation to the activity box, proceeding clockwise around the four sides of the activity box. Refer to the representation of an activity illustrated in Figure 3.

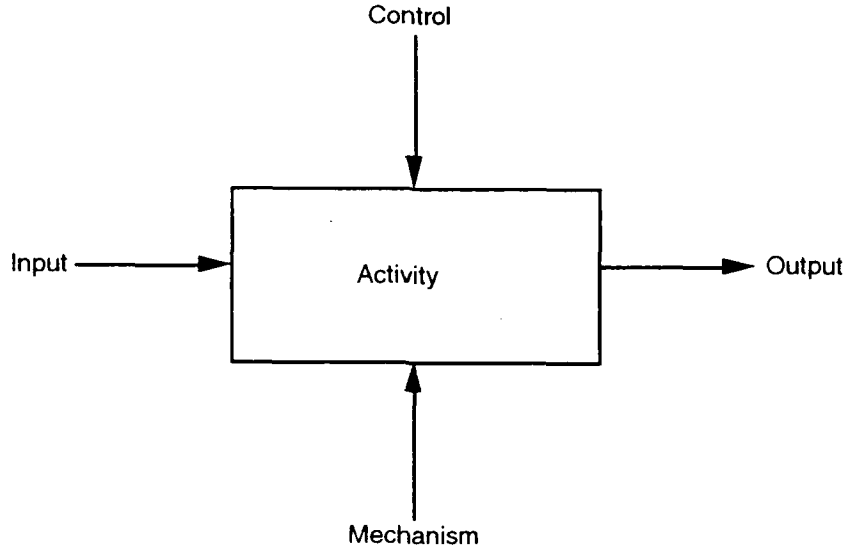



*Figure 3. IDEF0 Graphical Syntax*

## Activity Node Trees

At times, it is useful to identify a number of activities of interest and their potential decomposition relationships before diagramming them and identifying their associated ICOMs. In these cases, activities can be displayed on a single structured diagram for easy reference, using a graphic convention that resembles a tree. Consequently, it is referred to as a "node tree." A node tree is illustrated in Figure 4.

Each node, or dot, on the tree represents an activity. Each arc, or line, from one activity to

the next lower level subactivity represents a decomposition relationship. Node trees do not depict ICOMs.

All activities in a node tree must be given an activity name and be numbered. Each decomposition of an activity assumes the number identity of the parent activity and adds an additional decimal-separated integer indicating its relative position to its peers.

## Context Diagram

A context diagram shows only one activity and its ICOMs. A context diagram is always prepared for the top-most activity in a node tree, but it can also be prepared for any other activity. The number of a context diagram is the same as that of the activity it shows. Its name consists of the phrase "context for" followed by the name of the activity. The number and name appear at the bottom of the diagram. Figure 5 illustrates a context diagram.

## Decomposition Diagrams

Each activity on a diagram may be described in more detail (i.e., decomposed) on a separate, lower-level diagram. This lower-level diagram is used to show the subactivities which, together, are represented by the parent activity box.

The number of a decomposition diagram is the same as the number of the parent activity, whose decomposition is shown. The A0 decomposition diagram, for example, shows the decomposition for the A0 activity. The diagram depicts the subactivities A1, A2, A3, etc., which define the overall A0 activity. A decomposition diagram is illustrated in Figure

6. The A2 decomposition diagram would show the decomposition for the A2 activity. It would illustrate activities A2.1., A2.2, A2.3, etc. The name of a decomposition diagram begins with the words "Decomposition of," followed by the name of the parent activity. If a diagram replaces a previous diagram in a model, it keeps the same node identification, but it must be updated with the appropriate revision identification.

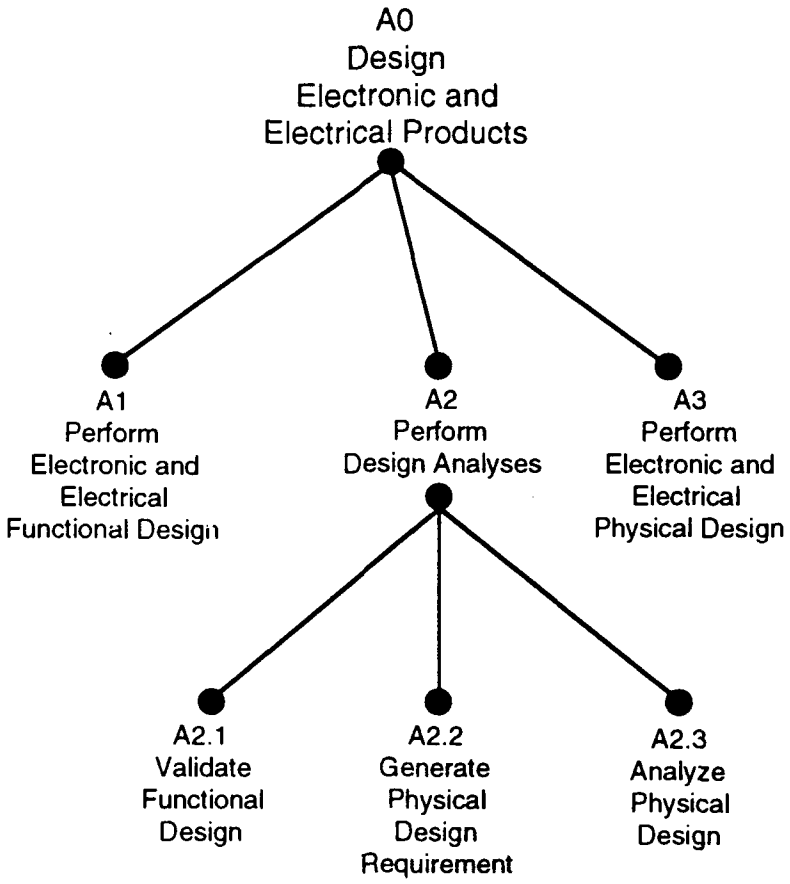
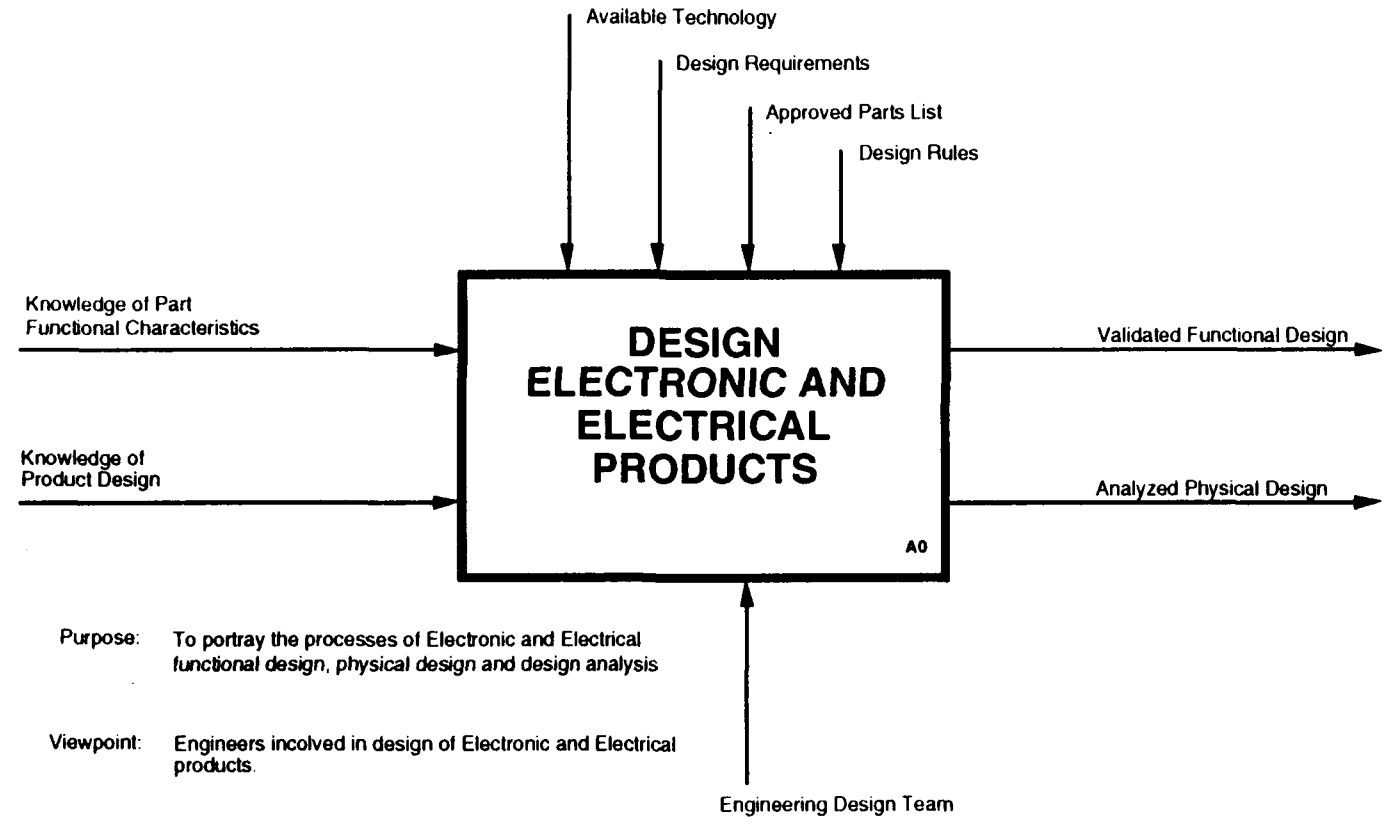



*Figure 4: Activity Node Tree*

| USED AT: | AUTHOR: ROGER W. GALE | DATE: 20 April 1987 | X | WORKING | READER | DATE | CONTEXT: |
|---|---|---|---|---|---|---|---|
| | PROJECT: IEEE/PDES | REV: | | DRAFT | | | |
| | NOTES: 1 2 3 4 5 6 7 8 9 10 | | | RECOMMENDED | | | |
| | | | | PUBLICATION | | | |




| NODE: A-0 | TITLE: Context of Design Electronic and Electrical Products | NUMBER: |
|---|---|---|

*Figure 5: Context Diagram*

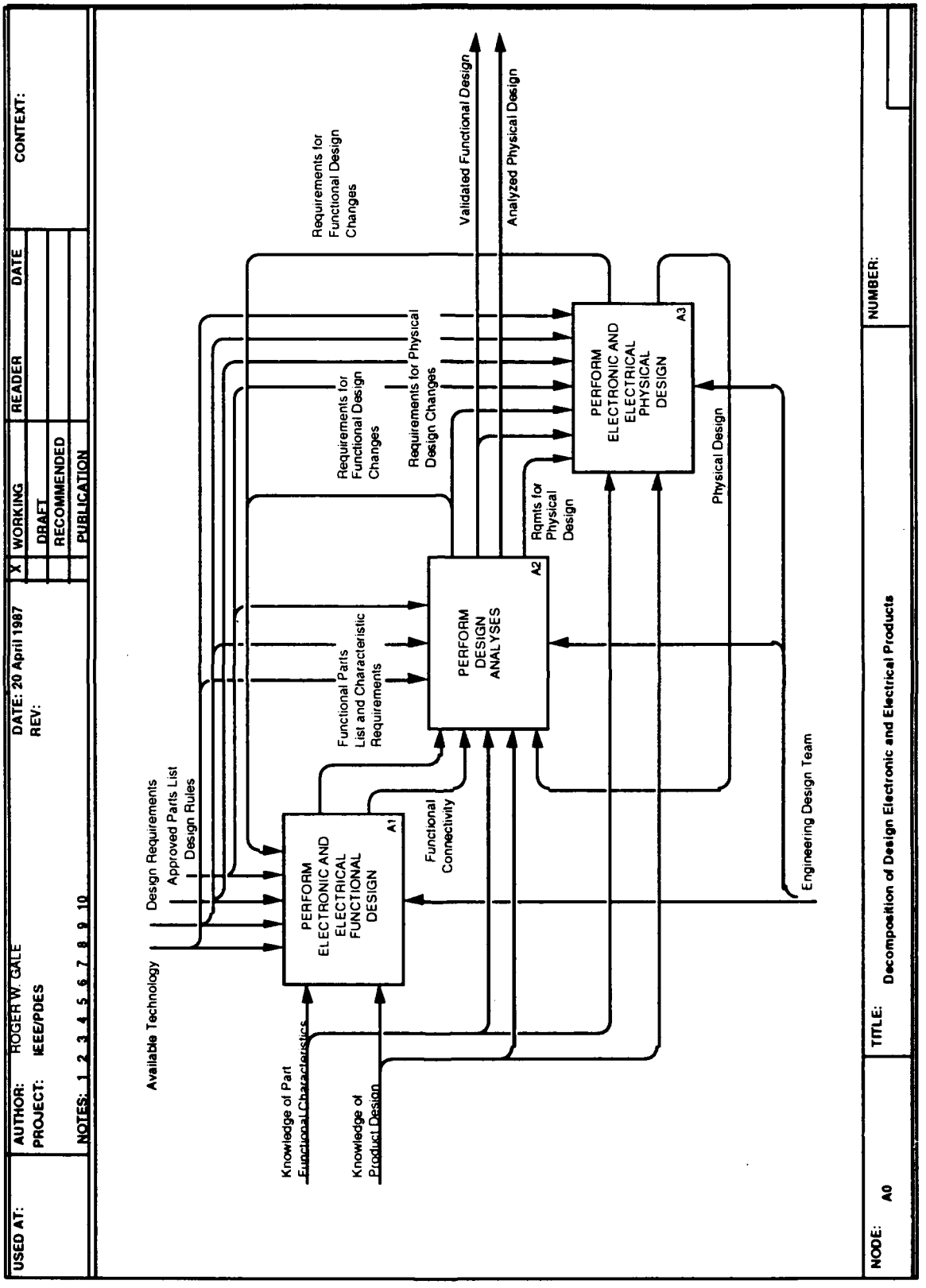



*Figure 6: Decomposition Diagram*

## Model Glossary

The glossary provides definitions of the activities and ICOMs that appear on the Activity Diagram. These are definitions that have been developed and agreed upon by the modeling team during the process of building the activity model. Developing the glossary also provides the model builders with a good cross-check to ensure that all activities and ICOMs are appropriately identified and clearly defined.

## Narrative Text

This is the English language version of the pictorial diagram or view. It is narrative textual information that uses declarative statements to describe what is happening in each activity box in the diagram, including interaction between activities. It includes the object of each activity and a description of the tasks (decomposition) that are performed to complete the activity.

Often there is also included a statement that discusses the scope, objectives, and viewpoint of the activity model.

## Conclusion

While this write-up has not gone into the more sophisticated features of activity models, e.g., feedback loops, pipelines, tunneling, paths, ICOM traceability, and supplemental views, it should present a framework of understanding for reading such models.

The IDEF0 activity modeling technique is a simple but rigorous technique that facilitates communication about how an organization functions in either its current or proposed future environment. The diagrams can be understood easily by both business professionals and data processing professionals and can be used to discuss complex processes.

The IDEF0 activity modeling technique provides an opportunity for involvement and consensus among diverse members of an organization as they define a common view of their environment and a strategy for integration.

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