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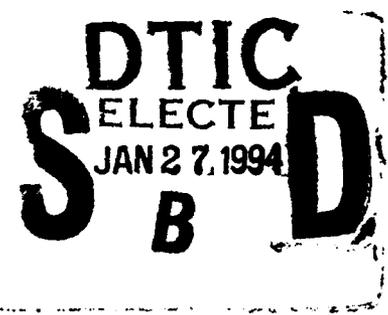
THESIS

BUSINESS PROCESS REDESIGN:
DESIGN THE IMPROVED PROCESS

by

Jerry L. Warwick

September, 1993

Thesis Advisor: William J. Haga

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94-02780

94 1 26 200

REPORT DOCUMENTATION PAGE

1a Report Security Classification Unclassified		1b Restrictive Markings			
2a Security Classification Authority		3 Distribution/Availability of Report			
2b Declassification/Downgrading Schedule		Approved for public release, distribution is unlimited			
4 Performing Organization Report Number(s)		5 Monitoring Organization Report Number(s)			
6a Name of Performing Organization Naval Postgraduate School	6b Office Symbol *(if applicable)* 37	7a Name of Monitoring Organization Naval Postgraduate School			
6c Address *(city, state, and ZIP code)* Monterey CA 93943-5000		7b Address *(city, state, and ZIP code)* Monterey CA 93943-5000			
8a Name of Funding/Sponsoring Organization	6b Office Symbol *(if applicable)*	9 Procurement Instrument Identification Number			
Address *(city, state, and ZIP code)*		10 Source of Funding Numbers			
		Program Element No	Project No	Task No	Work Unit Accession No

11 Title *(include security classification)* Business Process Redesign: Design the Improved Process

12 Personal Author(s) Jerry L. Warwick

13a Type of Report Master's Thesis	13b Time Covered From To	14 Date of Report *(year, month, day)* 1993 September	15 Page Count 155

16 Supplementary Notation The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17 Cosati Codes			18 Subject Terms *(continue on reverse if necessary and identify by block number)*
Field	Group	Subgroup	Identify Customer Needs; Incremental Process Improvement; Radical Business Process Redesign or Reengineering; IDEF0

19 Abstract *(continue on reverse if necessary and identify by block number)*

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20 Distribution/Availability of Abstract xx unclassified/unlimited __ same as report __ DTIC users	21 Abstract Security Classification Unclassified	
22a Name of Responsible Individual William J. Haga	22b Telephone *(include Area Code)* (408) 646-3094	22c Office Symbol AS/HG

DD FORM 1473,84 MAR   83 APR edition may be used until exhausted   security classification of this page
                                        All other editions are obsolete   Unclassified

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Business Process Redesign: Design the Improved Process

by

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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September 1993
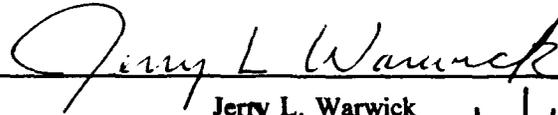
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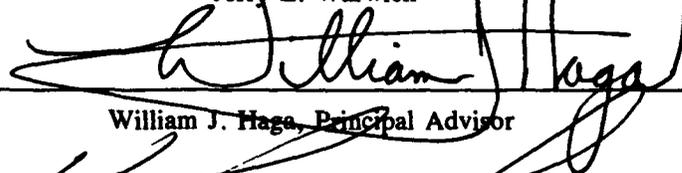
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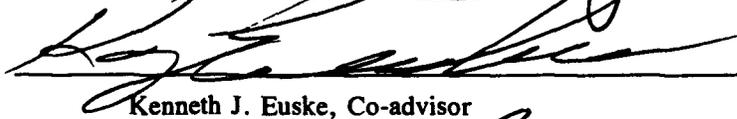
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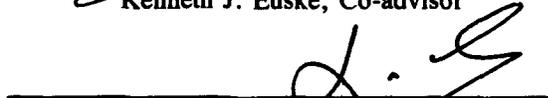
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ABSTRACT

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The business activity model was constructed by a faculty/student team in August of 1992, in support of DoD's Corporate Information Management (CIM) initiative. This team used an Integrated Definitions Language (IDEF0) supported software tool (Design/IDEF by Meta Software of Cambridge, Massachusetts) to construct their model.

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ACKNOWLEDGEMENT

This thesis is dedicated to my parents, Eunice Driggers Warwick and John Hugh Warwick, SFC, USA-RET. Their love and support remain an inspiration to me throughout my naval career.

I would like to acknowledge those professors that have been an inspiration to me during my course of study at the Naval Postgraduate School. These educators exuded enthusiasm and conveyed knowledge so intensely that students could not help but learn. The following is a list of these highly respected professors:

James C. Emery	Douglas Moses
Kenneth J. Euske	Patrick J. Parker
William J. Haga	Myung W. Suh

Finally, my most sincere appreciation is extended to my wife, Gloria. She has provided me with a constant source of patience and encouragement. Without her support, little would have been accomplished.

I. INTRODUCTION

A. BACKGROUND

Faced with a need to maintain a strong military with fewer resources, the Department of Defense (DoD) launched its Corporate Information Management (CIM) initiative in 1989 to streamline operations and manage information resources more effectively [U.S. General Accounting Office, 1992]. For the CIM initiative to be considered a success, CIM must achieve a promised $2.2 billion in net savings between 1991 and 1995 [U.S. General Accounting Office, 1989]. As a part of its savings program, the CIM office will not approve a major system purchase unless a system applies to processes that have been satisfactorily evaluated and redesigned [White, 1992]. CIM's reasoning is that automating without redesign often results in automation of an inferior process. Therefore, managers should automate only well-designed, value-added business processes [White, 1992].

Modeling is used to evaluate and redesign processes. In order to gain an understanding of what is required to successfully redesign any process so that effective redesign

can be promoted throughout DoD, the CIM office sought to model the process of improving business processes [REAP, 1992].

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 (Integrated Computer Aided Manufacturing Definitions Language) methodology. Many DoD organizations are currently using the IDEF methodology to model their business processes including such organizations as the Army Corps of Engineers [White, 1992]. REAP's March exercise resulted in a model of what a redesign team should do, but not how to do it [White, 1992].

In August, 1992, a second REAP exercise was conducted to (1) build on the March redesign model and (2) concentrate on how a functional manager should approach redesign. This thesis uses the results of the second exercise (a model of what was termed the Process Improvement Process (PIP)) to explore how one part of the PIP, designing the improved process, can be accomplished.

B. HISTORY OF CORPORATE INFORMATION MANAGEMENT (CIM)

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 of Defense (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 (CIM) strategy that was being implemented by his former employer. That corporation wrestled with information system problems familiar to DoD watchers: divisional parochialism, divisional rivalry, not-invented-here syndrome, duplication, obsolesence, data incompatibilities and attachments to computer architectures that were more theological than technical. The company had devised CIM to bring information resources together across divisional boundaries [Haga, 1992].

In November 1989, DoD created a CIM office under the deputy comptroller for IRM. She appointed a director of CIM who began implementing the DSD's CIM recipe for standardizing information resources. The emphasis was on unification and standardization. The strategies were to be devised at the DoD level rather than being an amalgam of the parochial interests and historically evolved systems of the individual services and agencies [Haga, 1992].

For FY 91, the CIM office requested $200 million for its operating budget. Instead of granting this request, Con-

gress took one billion dollars out of the IT budget in the Defense Appropriations Bill and gave it to the CIM office. The bulk of this billion dollars would be returned to the services only if the systems they sought to fund met CIM standards. As a result, CIM was given virtual veto power over investments in IT by the services and other federal agencies. The message to federal agencies was clear. Any new proposal for IT acquisition had to possess the capability for DoD-wide standardization [White, 1992].

In December 1990, the Secretary of Defense moved the CIM office out of the comptroller office and placed it under the Assistant Secretary of Defense for Command, Control, Communications and Intelligence (ASD[C3I]). Under this arrangement, the Defense Communications Agency was renamed the Defense Information Systems Agency and was tasked with carrying out the CIM program [White, 1992]. Additionally, the IRM director became the Deputy Assistant Secretary for Information Systems.

In January 1991, the ASD (C3I) created the position of Director of Defense Information (DDI) to manage IT DoD-wide. An IT executive, the former Chief Information Officer for Xerox, was appointed to the post early in 1991. Within six months of his appointment, the DDI began to expand the CIM concept to encompass business process redesign. The DDI said that if DoD was going to be smaller, it had to work smarter. Rather than make across-the-board cuts in informa-

tion systems, the DDI sought to squeeze non-value-added elements out of business processes. Only after a process had been redesigned down to its value-added activities would it be considered for automation [White, 1992].

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 [REAP, 1992].

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 [REAP, 1992].

At the end of March 1992, the NPS faculty-student research team, joined by the NPS Dean of Information Systems, participated in a five-day IDEF modeling exercise in Monterey conducted by the D. Appleton Company, Incorporated. During the course of that exercise, this group named itself

the Redesign Experts And Practices (REAP) team. The exercise identified five activities that constitute the process of process improvement from the team's perspective as providers of support to functional managers:

1. Describe how to marshall resources for a redesign effort.

2. Describe how to create an environment for discontinuous thinking.

3. Describe how to understand AS-IS process.

4. Describe how to evaluate a process.

5. Describe how to implement changes proposed by a redesign team [REAP, 1992].

In April 1992, the results of this exercise, including the IDEF model of these five activities and their interconnections were forwarded to the DDI's special assistant for business process redesign. The response from that office was that the March exercise, although ostensibly aimed at dealing with the "hows" of business process improvement had dealt only with a set of "whats." Without the "hows," there was little guidance or instruction to offer to functional managers embarking upon a process redesign. The special assistant tasked the REAP team to undertake a specification of the "hows," again employing the IDEF modeling tool [REAP, 1992].

On August 28, 1992, the REAP team convened near Carmel, California to undertake its second five-day IDEF exercise, again with facilitation provided by D. Appleton Company. The perspective in this workshop was to shift from that of the REAP team to that of a functional manager facing the prospect of redesigning a business process. Moreover, the aim of this exercise was to set the stage for describing the "hows" of undertaking process redesign [REAP, 1992].

II. THE PROCESS IMPROVEMENT PROCESS (PIP)

A. IDEF METHODOLOGY

The REAP team chose the IDEF modeling tool to create a model of the PIP. IDEF was chosen primarily because it is the same tool that functional DoD managers will use to model their own processes. In general, IDEF works by uncovering all relevant factors influencing or coming from a process and categorizing them as either an input, output, control, or mechanism (ICOM) [White, 1992].

1. Defining a Process

A process is an activity that occurs over time and transforms inputs (information or materials) into recognizable outputs. The term process is synonymous with activity, task, and function in the IDEF methodology. Each process is constrained by controls and carried out by mechanisms. A process can be broadly or narrowly defined depending on the level of detail required. For example, a process can be as large as a process for constructing a skyscraper, or as small as a process for riveting steel beams. More broadly defined processes are placed at higher levels and narrowly defined ones at lower levels in the IDEF hierarchy [White, 1992].

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2. IDEF Methodology Evolution

Developed by the Air Force in the 1970's to increase manufacturing productivity, IDEF evolved from the Integrated Computer-Aided Manufacturing (ICAM) Program. From this program a need arose to define procedures for developing models to display business activities, and the rules associated with their data structures. IDEF was chosen to fulfil those needs [White, 1992].

IDEF has two components. IDEF0 defines overall business activities and relationships. IDEF1X defines actual business rules applying to the lowest level activities [White, 1992].

3. Modeling Process

A modeling process begins with a group exercise led by an expert IDEF facilitator. The facilitator explains how the modeling process works and then asks group members what objectives they have for the exercise. The group then decides which of these objectives are critical to its success.

Modeling occurs from the top down. First the broader overall process is modeled using node trees (a hierarchical view of the upper level activities). Sub-processes existing within a node are then identified using context

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diagrams, which show a single process and its ICOM's.
Finally, decomposition diagrams are used to show an entire
level of sub-activities of the parent with ICOM's. With
each model is a glossary that defines all terms used.

The Process Model Readers Guide provided in Appendix
A (used with permission of D. Appleton Company, Inc.) ex-
plains the basic tools and methodology used in IDEF model-
ing.

B. MISSION AND SCOPE

The charter of the Redesign Experts and Practices (REAP)
team was to produce a quality model of the Process Improve-
ment Process (PIP) using IDEF0 modeling techniques.

Using the outline of redesign "whats" developed in
March, the August PIP was to detail the "how" of business
process redesign. REAP's objective was to produce a model
of the redesign process model that can be used in a handbook
on business process redesign for functional managers.

The project's scope is within the domain of the DoD
functional manager, who is defined as a manager responsible
for any organizational activity or business process that is
subject to redesign. A so-called functional manager could
be, for these purposes, a program manager, a line operations
manager or someone who, in DoD convention, is known as a
"functional manager" by virtue of his or her control of such

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activities as military payroll, medical services or civilian personnel administration [REAP, 1992].

C. PIP RESULTS

During the March exercise, the REAP team sought to fully understand the IDEF model. The team questioned assumptions and basic definitions of the IDEF model. Although this produced a useful learning experience, appropriate in a graduate school setting, the critical approach was not conducive to producing a useful IDEF model [Euske, 1993].

The REAP team during the August exercise accepted the definitions and assumptions of the IDEF model [Euske, 1993]. As a result of the change in approach, the REAP team believes its model of the PIP is:

1. Comprehensive in including all of the activities that a redesign team must consider if it is to be successful.
2. Realistic in developing ICOM relationships between activities and sub-activities.
3. A useful, insightful framework upon which CIM can build guidance and training of redesign teams throughout DoD [REAP, 1992].

The REAP team identified the following four major activities for effective process redesign (See the A0 level decomposition diagram contained in Appendix B):

1. Activity A1: Marshall resources.

2. Activity A2: Create an environment for discontinuous thinking.

3. Activity A3: Design the improved process.

4. Activity A4: Implement changes.

The following sub-activities of activity A3, which were to be explored in chapters three through seven, were described by the REAP team. An IDEF model for each activity, A1 through A4, is contained in Appendix C.

(A3) This activity was to model both the ideal (TO-BE) and AS-IS processes. It was then to evaluate and compare the two models by means of various economic analysis as well as testing and validation techniques. After all relevant variables have been carefully considered, recommendations are made as to which process is most suited at satisfying the customer and supplier needs.

Included in the "design the improved process" process are the following sub-activities:

(A3.1) This activity derives detailed descriptions/ definitions of each customer/ supplier requirement.

(A3.2) Through means of rationalizing and prioritizing the list of customer needs identified in A3.1, this activity generates a list of feasible customer needs.

(A3.3) Based on the output of activity A3.2, this activity models the TO-BE process.

(A3.4) By means of a process modeling technique (e.g., IDEF0), this activity reflects the current state of the AS-IS process problem identification. It is here where redundant, inefficient, and other non-value activities will be identified.

(A3.5) Through various economic analysis as well as testing and validation techniques, this activity compares the AS-IS process to the TO-BE process. After all relevant variables have been carefully weighted, recommendations are made as to which process should be implemented.

Since the convening of the REAP conference, research conducted by the author of this thesis has caused the author to conclude that a logical model of the AS-IS process is needed before designing the TO-BE process. A logical model examines what tasks are accomplished by an activity or process. This model is normally derived prior to the physical model which unlike the logical model addresses how the process accomplishes its tasks. Researchers like DeMarco [1979], Hammer and Champy [1993], and Camp [1989] all subscribe to this prerequisite. Because of this relationship, modeling the AS-IS activity will be examined prior to modeling the TO-BE activity. The REAP team was concerned that designing the TO-BE model with the knowledge of the AS-IS model might stifle the creativity of a design team. The author submits that as long as one looks at the logical process and not the physical description of the AS-IS

process (only view the whats of the process and not the hows of the process), the creativity of the design team will not be stifled in any way [Whitten, Bentley and Barlow, 1989].

This concludes the relationship between the two activities. For the most part these two activities will be treated by the author as two separate and distinct activities. "Modeling the AS-IS process" activity will be viewed as a methodology for practicing incremental business process improvement, while the activity "Identify How to Meet Customer and Supplier Needs" will now be viewed as methodology for practicing Business Process Redesign (BPR). This is the methodology practiced by the functional manager prior to winning approval from CIM for automating a process.

Business process improvement is what is needed when a business falls, for example, ten percent short of where its profits should be, its costs are ten percent too high, its quality ten percent too low or its customer service needs a ten percent boost. Anything from circling the wagons to establishing incremental quality programs, can dig a company out of ten percent hole [Hammer and Champy, 1993]. These methodologies will be discussed in the activity "Model the AS-IS Process."

In the activity "Identify How to Meet Customer and Supplier Needs", the discussion will center upon BPR. BPR is not incremental improvement at all. It is not about fixing a process. It is about reinvention, not about im-

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proving existing processes. Nor is BPR the same as quality improvement, total quality leadership (TQL), or any other manifestation of the contemporary quality movement. These quality programs do share a number of common themes with BPR. Both movements recognize the importance of processes, and therefore begin with the needs and desires of the customer. However, the two programs also differ fundamentally. Quality programs work within a framework of existing processes and seek to improve/enhance them through continuous incremental improvement. The aim seems to be to do what we are already doing, only better. In contrast, BPR seeks breakthroughs, not by enhancing existing processes, but by discarding them and replacing them with entirely new ones [Hammer and Champy, 1993].

In light of the minor modifications stated above, this thesis now serves two purposes for the functional manager. It will aid the functional manager in conducting business process improvement when incremental improvement is desired as well as conducting BPR when more radical and dramatic improvement is required.

Since the author now intends to treat each of the two activities as essentially mutually exclusive events, activity (A3.5) "Determine Recommended Change" now becomes non-applicable. The recommendations which would have become an output of activity (A3.5) will now become a product of the two previous activities.

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III. ACTIVITY (A31) IDENTIFY CUSTOMER NEEDS

Growing each day is the realization by more and more
businesses that under an effective quality improvement
program, customer satisfaction drives all business processes
[Freedman, 1992]. American businesses are only now begin-
ning to practice what their Japanese counterparts have
practiced and benefited from for many years, continuous
quality improvement. Most Japanese companies have fully
committed themselves to satisfying their customer needs
every time, not just most of the time. They consider every-
one in the system, both inside and outside their companies,
to be essential partners in meeting their objectives
[Bowles, 1992].

Everyone in a process chain is, in effect, a supplier
and a customer of someone else in the chain. Therefore,
everyone is relentless in their efforts to acquire a thor-
ough understanding of all their business processes, so they
know precisely what they must demand from their suppliers
and with what they must provide to their customers. Whether
a manager is in the private or public sector, the way in
which one gains the confidence of one's customers is to
provide them with only quality products which meet their
needs in every way. In addition to improving customer

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service, producing quality products and services will ultimately provide an advantage over competitors by reducing costs and increasing productivity [Freedman 1992]. Global business leaders recognize that there is no substitute for quality as the foundation of their success and that by building customer information into the design of every product and service, these leaders capture current global market segments for their goods and services [Bowles,1992].

A. SURVEY RESEARCH

1. Survey History

Surveys are quite similar to censuses, differing primarily in that a survey usually examines a sample of a population, while a census typically examines an entire population. Population is defined as a collection of all individuals, items, or data under consideration in a statistical study. Survey research dates back as early as ancient Egyptian Civilization when censuses were considered useful by rulers to collect empirical data describing their subjects [Babbie,1973].

Use of survey research for political functions is ever present today with continuation of political polls conducted on behalf of candidates. One of the first political uses of the survey appeared in 1880. A German political sociologist mailed questionnaires to some 25,000 French

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workers to determine the extent of their opinions about exploitation by their employers. This survey researcher was Karl Marx [Babbie, 1973].

2. Typical Survey Components

Before continuing, it is appropriate to briefly describe components of a typical survey. Assume that a functional manager is interested in determining certain attitudes among his customers. A sample of customers would be selected from the total customer population. A question-naire is constructed to solicit information relevant to attitudinal attributes in which the functional manager is interested. Questionnaires would then be administered to a sample of customers, either by face-to-face personal inter-views or in a self-administered format, possibly even con-ducted via the mail. Responses provided by each customer are then grouped into standardized categories that can be easily recorded in a quantitative manner (referred to as coding). The standardized responses from all customers are then subjected to an aggregate analysis to determine de-scriptions of customers in the sample and to provide corre-lations among different responses. The conclusions reached by the analysis are then generalized to the population from which the sample was chosen, which in this instance was the entire customer clientele [Babbie, 1973].

3. Why Surveys?

Why should managers sample (survey)? Most functional managers realize that two obvious advantages to surveying is time and money savings [Nadler, 1977]. Considering only costs of interviews, at X dollars per interview, it becomes evident that it is less expensive to interview twenty customers rather than an entire customer population of 2,000 for example. Babbie [1973] points out that sampling often makes a data collection project possible, whereas a more costly means of data collection may rule out a study altogether.

Regardless of costs savings, many functional managers may no doubt remain uncomfortable about sampling [Babbie, 1973]. Babbie [1973] states that because it is clearly possible for a sample to misrepresent the population from which it is drawn, there is an inevitable danger to a researcher who uses sampling methods.

4. Types of Data

The survey research format generates numerous types of data. Some kinds of data are considered to be "facts", that is data that a respondent believes to be the truth and an interviewer generally accepts as the truth [Babbie, 1973]. Demographic data (e.g.; sex, age, race, and so forth) fall into this category.

There are instances when a respondent is asked to report information which he accepts as the truth, however a researcher does not necessarily accept as such. For example, a respondent may be asked whether there is life after death. By answering "yes" or "no", a respondent indicates what he or she believes to be the truth. A researcher, however, regards the response only as a description of a respondent and not as an answer to the question of whether there is life after death [Babbie, 1973].

Babbie [1973] indicates there are other cases where a researcher asks a respondent to provide information that both the researcher and respondent recognize as subjective attitudes. A researcher may ask a respondent whether he feels that President Clinton has done a good job during the first three months of his administration. Both the researcher and the respondent understand that in answering this question, the respondent is offering an opinion and not a fact [Babbie, 1973].

Respondents may be asked to report on their past behavior. Do they attend church? For whom did they vote for in the last election? These type questions are subject to recall and honesty. A respondent may not remember for whom one voted in the 1956 presidential election or may not want to admit voting for a particular candidate if the action was perceived to be socially unacceptable [Babbie, 1973].

Survey research may also examine future behavior. Who will you vote for in the upcoming election? As you might expect, measures of prospective behavior are less reliable than measures of past behavior in most cases [Babbie, 1973]. Although past behavior data are subject to recall and honesty, future behavior is subject to both honesty and a multitude of other variables that have the potential to change between now and the occurrence of the event in question [Babbie, 1973]. Keep in mind that Haga [1992] suggests that neither past or future behavior can be assessed by surveys; only attitudes can be assessed.

5. Levels of Measurement

Now I will look at four levels of measurement that are typically encountered when measuring survey data: nominal, ordinal, interval, and ratio. Nominal measurements distinguish categories that comprise a given variable. Sex would be one example of a nominal variable comprised of categories male and female. Other examples might include religious preference, political affiliation, occupation, or place of residence [Davis and Cosenza, 1985]. Categories which make up a nominal variable are mutually exclusive, but bear no other relationships to one another. One will find that other levels of measurement reflect additional relationships between categories which comprise the specific variable [Babbie, 1973].

Ordinal measurements reflect a rank-order among categories comprising a variable. Probably the best example of this variable is social class which might comprise the categories: lower class, middle class, and upper class. Other examples could include religiosity, dedication, prejudice, and so forth. Ordinal measurements provide information on whether a respondent possesses more or less of a characteristic (variable), but not how much more or less [Davis and Cosenza, 1985].

Interval measurements, like ordinal measurements, also use numbers to describe conditions, but these numbers have more meaning in that distances on a scale between points define how much more or less is possessed of the characteristic in question. An example of interval level measurement is the Fahrenheit thermometer. If one was to measure his or her temperature, one would find that the distance between 92 degrees and 94 degrees to be exactly equal in magnitude to the distance between 98 and 100 degrees. This will normally not be the case with ordinal measurements. A respondent who measures a 5 on a Likert-type ordinal scale (1-5) measuring loyalty, will not necessarily surpass the individual measuring 4 to the same degree as the individual measuring 3 surpasses 2 [Babbie, 1973].

Ratio measurements comprise all the same characteristics of interval measurements, but have the additional characteristic of a true zero. For example, because there

is not a true zero on the Fahrenheit scale, 40 degrees is not twice as warm as 20 degrees. However, because there is a true zero present on the Kelvin scale 40 degrees would be twice as warm as 20 degrees. In the context of social research age is another example of ratio measurement. Someone 40 years-old is four times the age of a 10-year-old [Davis and Cosenza, 1985].

While studying analysis techniques, a functional manager will find that various analytical techniques may require specific levels of measurement. For a specific analysis, some levels of measurement may be more appropriate than others; while still others cannot be used at all [Babbie, 1973].

For further research on levels of measurement, the author recommends Euske [1984], Churchman and Ratoosh [1962], and Stevens [1946].

6. Guide to Question Asking

The central thesis behind maximizing the validity of survey data obtained by a question-asking process is that wording is the crucial element. In the past, researchers have thought that formulation of a questionnaire to be the easiest part of a survey design process, and thus, too little time was spent on it [Sudman and Bradburn, 1982].

It should go without saying that questionnaire items should be clear and unambiguous; however, broad pro-

liferation of unclear and ambiguous questions comprised by surveys, requires that this subject be further examined.

Babbie [1973] argues that survey data are frequently created and not simply collected. Researchers need to be aware of how a specific wording of a particular question would affect resulting data. Most researchers would recognize the likely effect of the question that begins "Don't you agree with the President in the belief that...". It is probable that no reputable researcher would use such a question to obtain data; however, there are cases where a biasing effect of items and terms is far subtler than this example suggests.

The following is an example which illustrates how a questionnaire writer can cause response bias by the conscious or unconscious wording of a question:

Korean War

　1. Do you think the United States made a mistake in deciding to defend Korea, or not [Gallup, 1951]?

　2. Do you think the United States was right or wrong in sending American troops to stop the Communist invasion of South Korea　[National Opinion Research Center, January 1951]?

In response to the first question, the government received only a 38% approval rating. However by adding the

words "communist invasion" to the second question, the government received a 55% approval rating. It is clear in this example that a researcher can invite response bias by suggesting that the defense of Korea was motivated by a desire to eliminate communism [Babbie, 1973].

Whether designing questions for an interview or a questionnaire (self-administered interview), there are also social aspects to consider. Sudman and Bradburn [1982] suggests that a major motivation for respondents of inter-views is an opportunity to talk about a variety of topics with an empathetic listener. An interviewer already has the advantage in that most people tend to enjoy this experience.

However, unlike witnesses that have been subpoenaed to court, respondents of surveys are under no compulsion to participate. They must be encouraged to participate by holding their interest throughout a survey. With the excep-tion of paid respondents, typically respondents have nothing to gain in an interview except possibly some measure of psychic gratification [Sudman and Bradburn, 1982]. This gratification can be provided by an opportunity to state their opinions or relate their experiences to a sympathetic and nonjudgemental listener, a chance to contribute to public or scientific knowledge, or even a positive feeling that they have helped an interviewer [Sudman, Bradburn, 1982]. For this reason, Haga [1992] warns that the respon-dent may be compelled to pass a "test", be a "good" respon-

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dent, or even "be pleasant to a stranger." It would be prudent for the researcher to be alert in recognizing this displayed behavior.

The subject of social desirability bias is a significant problem in survey research. Many survey questions are related to desirable and undesirable behavior or attitudes. Respondents are torn between wanting to report accurately as good respondents and appearing to be good people in the eyes of the interviewer [Sudman and Bradburn, 1982].

Sudman and Bradburn [1982] suggest that the most direct and probably most common questions asked of respondents relate to their behavior. It is difficult for a novice researcher to understand that there could be a problem with a question such as "Do you own or rent your home?" Nevertheless, such questions are not as simple and direct as they might first appear. Clearly, it is more difficult to ask questions about a crime committed than what brand VCR a customer might prefer. However, questions about owning your home, what brand VCR you own, or whether you jog can be threatening. Respondents may find themselves asking "Should I be jogging?" The current social or medical thought may be that one should jog and therefore, the respondent may be inclined to answer positively, when in fact, the respondent is a couch potato. This phenomena which finds the respondent asking "How should I answer to pass the test" or "What

is the correct answer to this question" is one cause for Haga [1992] to suggest that surveys only measure attitudes and not behavior.

Sudman and Bradburn [1982] suggest that when asking questions concerning socially desirable as well as undesirable behavior, such as income, intellectual reading, exercise, voting, drinking, gun ownership and drug-use to mention just a few, specific ordering and wording of questions becomes very important. Their checklist of major points to examine as well as a full chapter on how to ask questions dealing with social behavior is left to the reader should this be the method of choice for data collection [Sudman and Bradburn 1982].

Even those questions that are considered not to be threatening, possess much potential for returning erroneous data. The most serious problem with non-threatening behavioral questions is that human memory is fallible and depends on the length and recency of the time period in question. Ways have been developed for reducing but not eliminating the memory error problem. An advantage to non-threatening questions, unlike threatening questions, is that wording does not seem to be particularly significant except as it might influence memory [Sudman and Bradburn 1982].

Sudman and Bradburn [1982], Babbie [1973], Hyman [1975], and Nadler [1977] are all excellent sources for

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advice on how-to strategies for reducing memory error. A few of these techniques will be mentioned here while others will be left to the reader.

When asking a closed question about behavior, make sure that all reasonable alternative answers are included. Omitted alternatives and answers lumped into an "Other" category will be under-reported.

Aided-recall procedures may be helpful if a major problem is under-reporting of behavior. In its most general sense, an aided-recall procedure is one that provides one or more memory cues to the respondent as part of the question. Rather than ask "What is your favorite television program?" the question might focus on a list of twelve programs from which to choose. Similarly, a respondent may be shown a list of books or magazines and asked which from the list he or she had read in the last month. Increasing the length of the question by adding memory cues may improve the quality of reporting. Do not assume the shorter, the better.

As one might imagine, it has been demonstrated that aided-recall procedures produce higher levels of reported behavior than unaided procedures do, since they can help respondents remember events that would otherwise be forgotten [Sudman and Bradburn, 1982]. However, certain precautions must be taken when aided-recall is used. Most importantly, the list of examples provided must be as exhaustive

as possible. As already mentioned, responses placed in the category "Other" will tend to under-report data on those related behaviors.

Another problem with aided-recall results from lists that are too long. Imagine a respondent who is presented a list of fifty choices of behavior, none of which the respondent has done. A respondent is likely to feel threatened even though the topic is considered to be non-threatening. Typically a respondent will feel that the interviewer expects an answer and is likely to deliberately fib or subconsciously misremember a date when the individual was involved in one of the behaviors [Sudman and Bradburn, 1982].

Caution is recommended when deriving your lists of behaviors. If your questions concern media, products, and organizations, lists are almost certainly available from published directories. For behaviors where outside lists are not available, data from previous studies may provide information about what behaviors to place on your lists. The time period of a question should be related to the significance of the topic. Periods of a year or longer may be used for high saliency topics, such as the purchase of a car, the birth of a child, the beginning of a job, or a serious accident. Periods of a month or less should be used for items with low saliency, such as purchases of clothing and minor household appliances.

Use words that virtually all respondents will understand. Do not use special terms unless all members of the sample will be expected to know them or the term is explained in the question. Unfamiliar terms can cause a respondent to offer erroneous data if the individual answers the question at all.

Sudman and Bradburn [1982] offer some basic suggestions to the beginning survey researcher. Too often questionnaire writers are so caught up in the excitement of question writing that they jump rapidly into writing questions before they were able to formulate the goals of the research and understand the research questions. To develop a good questionnaire, observe the following rules:

1. Restrain the impulse to write specific questions until you have thought through your research questions.

2. Write down your research questions and keep them handy when you are working on the questionnaire.

3. Every time you write a question, ask yourself "Why do I want to know this?" Answer it in terms of the way it will help you to answer your research question.

Sudman and Bradburn [1982] further indicate that one might want to seek out earlier researchers who have done

similar research to see what questions they have asked and to what degree specific questions were successful.

7. Choosing a Survey Type

There are essentially two types of surveys: the questionnaire and the interview. When choosing between these two methods, it is important that a functional manager remain focused on the purposes and objectives of the research as well as advantages and disadvantages of each method. The discussion on advantages and disadvantages that follows is taken from Nadler [1977].

a. *The Questionnaire*

Questionnaires are essentially self-administered interviews. A set of questions are given to a respondent in printed form. A respondent reads the questions and answers, either by writing in an answer or choosing from alternative predetermined responses. The major difference between the questionnaire and the interview is that the questionnaire is self-administered and that it generally tends to make use of fixed responses rather than open-ended responses to questions.

(1) Advantages

1. Questionnaires can be administered to more than one person at a time and the quick turnaround time makes them easy to use with large samples of people.

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2. Data are easily quantified since a respondent does one's own coding. The numerical data can be summarized, aggregated, and subjected to statistical analysis with little or no coding, interpretation, or preparation.

3. Once a questionnaire is developed, the cost of administering it can be as little as one fifth that of the cost of an interview.

(2) *Disadvantages*

1. Not adaptive: Questionnaires may present questions to a respondent that he or she cannot or will not answer, while they disregard areas where the respondent may have a rich store of information.

2. Non-empathic: Questionnaires are incapable of communicating to a respondent that a researcher understands the problems that a customer is encountering with a product or service. This empathy frequently pays high dividends in that a respondent feels more willing to open up and disclose valuable data. Because interviewers are able to convey empathy toward respondents, respondents sense that the researcher understands their problems and are thus more likely to disclose significant information.

3. Fixed response questionnaires present problems in terms of interpretation and analysis. The value of a response may have little meaning when you are only work-

ing with fixed responses. The true meaning may not be conveyed when checking a specific answer on a scale. If for example, a respondent checks #3 when the selections are based on a scale of 1-5, does a response of #3 equate to the interviewers perception of #3 or the perception of other respondents in the interview? The bottom line is that nobody really knows how to accurately assign a value to that response. Secondly, since the data are inherently limited in terms of interpretation, their ease of quantification can lead one to interpretations that may not be valid.

4. Researchers, such as Haga [1992], submit that rather than collecting data on behavior, questionnaires instead collect data on attitudes about a behavior.

b. *The Interview*

An obvious, direct and sensible way to collect information about a customer is to simply ask them in a one-on-one interview format. Many customers are ready and sometimes even eager to share their perceptions, evaluations, and feelings about your product or service. You simply have to ask them questions--that is by interviewing.

(3) Advantages

1. Adaptive: As an interviewer proceeds with an inter-
view, one can modify the questions, choose an area to
probe, or make other changes to adapt the interview to
the situation. Thus, an interview allows collection on a
wide range of subjects, with an interviewer having the
ability to change the interview to emphasize those sub-
jects about which a respondent seems to have abundant
information or professional expertise.

2. Rich data: Open-ended interviews are a potentially
rich source of data. Responses may contain detailed
information about causes as well as symptoms. The
respondent can explain why one is satisfied or dissatis-
fied as opposed to only how satisfied or dissatisfied one
is, for example.

3. Empathic: By communicating to a respondent that one
understands the problems that a customer is encountering
with the product or service, an interviewer conveys
empathy to the respondent (customer). Empathy often
results in a respondent opening up to disclose valuable
data.

4. Builds rapport: Given a skilled interviewer, the
whole process of interviewing builds harmony with custom-
ers.

(4) Disadvantages

1. Interviews can be as much as five times more expensive than costs of questionnaires.

2. Time-consuming: Because interviewing is time intensive and because coding and interpretation of open-end responses are more difficult than fixed responses of the questionnaire, the turnaround time, from the beginning of the i terviews to the delivery of feedback, can be considerable.

3. Requires skilled interviewer: In order to build rapport, be empathic, and be aware of and control the interviewer-based biases, it is essential to have skilled interviewers. This may result in higher costs from hiring additional personnel or paying for additional training.

Now that a functional manager has chosen one's method of survey, I will discuss a few techniques in employing the survey.

8. Data Collection Techniques

The following discussion on data collection techniques is taken from Babbie [1973].

a. *Questionnaire*

Having constructed a questionnaire which is appropriate to a functional manager's research, the func-

tional manager's staff must now distribute the sample to all respondents.

While a mail survey is the typical form for distributing a self-administered survey, there are additional methods a functional manager might want to consider. A survey of a group of employees gathered together at some common place might facilitate the timely return of questionnaires. Although timely, Euske [1993] cautions the researcher to guard against what could be a biased group.

Home delivery and the mail can be used in combination as well. In several parts of the country, the census was conducted in this manner where it was delivered by mail and then collected in person by a census enumerator who checked questionnaires for completeness.

The basic method of data collection via the mail has been transmission of a questionnaire, accompanied by a letter of explanation and instructions, and a return envelope. A respondent then completes a questionnaire returning it to the office of the functional manager, using an envelope provided for that purpose. As questionnaires are returned through a mailing system, the research staff should begin careful recording of methodological data. One tool in this activity is a return rate graph. Day one, denoting the mailing of the survey should be indicated on the graph; every day thereafter, the number of surveys should be logged on the graph. This provides a research staff with a certain

amount of gratification in observed results; but even more importantly, it is a guide to when follow-up mailings should be conducted.

Also, as questionnaires are returned, each should be opened, perused, and assigned an identification number. These numbers should be assigned serially as the questionnaires are returned, even if other identification numbers have already been assigned. This system can have important advantages.

An example might be if a military command or governmental agency were attempting to implement Total Quality Leadership and were conducting a survey of employees to determine if the environment was conducive to implementation. An attribute a researcher may be concerned with is how employees feel about job security. If sometime after an original mail-out, a rumor were to be circulated that the base the command or agency was located on was going to be closed, it may be advantageous to know if specific questionnaires were returned before or after this rumor surfaced.

Literature on follow-up mailings suggests that these mailings are effective for increasing return rates in mail surveys. In general, the longer potential respondents delay in replying, the less likely they are to do so at all. It has been demonstrated that properly timed follow-up mailings, provide stimuli for responding.

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The Survey Research Office at the University of Hawaii conducts frequent surveys and has been able to refine the follow-up procedure considerably. It found, that indeed, a consistent pattern of returns has been found, which appears to transcend difference of survey content, quality of questionnaire, and other questionnaire attributes. Within two weeks after an original mailing, approximately forty percent of the questionnaires are returned; within two weeks after a first follow-up, an additional twenty percent are received, and within two weeks after a final follow-up, an additional ten percent are received.

Follow-up mailings may be conducted in many ways. A common method is just a simple letter encouraging respondents to participate. It is proven, however, that a more effective format is simply to mail a new copy of the survey with a follow-up letter. If potential respondents have not returned their surveys within two weeks of the original mailing, it is doubtful that they still have the original survey, and a method which provides them a second survey, provides the researcher with a higher probability of having a questionnaire returned. While it is true that this method will no doubt increase the probability of a returned questionnaire, Euske [1993] points out that great caution should be taken to preserve anonymity.

A question that researchers ask themselves concerns the acceptable percentage return rate that should be

achieved in a mail survey. It is important to note that inferential statistics used in analysis of data collected in surveys assume that one has a 100 percent return rate. Since this almost never occurs, response bias becomes a topic of great concern. Response bias in this context merely means that one is basing one's analysis of the data on an assumption of a 100 percent response rate from a carefully selected sample of the population, when in fact, one may receive responses from only a portion of the sample which may have the effect of skewing the data.

If a high response rate is received, there is less chance of significant response bias than if a low rate is received. However, what is a high rate of response? Babbie [1973] offers some rules of thumb for determining what is good enough for response rates. First of all, researchers must subtract the number of questionnaires that were never delivered from the number that were mailed in the original mailing. Now divide the number of ones returned by the number in the original mailing. If a response rate of fifty percent is received, this is considered adequate for analysis reporting. A sixty percent return rate is considered good, and a seventy percent return rate is considered very good.

It should be obvious at this point that the many biases and other points discussed earlier in this chapter

should be considered so as to facilitate the highest possible return rate.

b. *Interviews*

As was noted in an earlier section, there are many advantages to having a questionnaire administered by an interviewer rather than by a respondent as in a self-administered questionnaire. For example, interview surveys typically experience much higher response rates than a typical self-administered questionnaire. This rate can be as high as eighty to eighty-five percent which is the rate which federally funded surveys often require. It would appear that a respondent is less likely to turn down an interviewer standing on one's doorstep than one is to throw away a questionnaire received in the mail.

Within the scope of a questionnaire, presence of an interviewer can decrease the number of "do not know" and "no" answers [Babbie, 1973]. If minimizing of such answers is important to a researcher, an interviewer can be instructed to probe for answers.

Finally, interviewers can provide clarification for confusing items in the questionnaire. If a respondent clearly misunderstands the intent of a question, mere clarification on the part of the interviewer can provide increased question response rate as well as increased correctness of the responses.

While there are many advantages for having inter-
viewers administer the questionnaire, there are many general
rules that need to be adhered to so not to inject biases
into the data collection process. I will address just a few
of these.

While nobody is completely neutral, interviewers
must strive to remain as neutral a medium as possible
through which questions and answers are transmitted. If an
interviewer allows one's opinion to be conveyed to a respon-
dent about the topic being discussed, it is likely that one
may cause the respondent to agree with the interviewer's
point of view. Results of the survey may suggest that the
population in question agrees with the interviewers point of
view, when it actually agrees with the counterpoint of a
two-sided issue.

An interviewer should dress in a fashion fairly
similar to that of people one is interviewing. However, by
no means should one dress poorly. A poorly dressed inter-
viewer will not receive credibility from any respondent
[Haga, 1993]. To the extent dress of the interviewer is
different from the respondent's, cleanliness and proper
grooming should make up for it. While cleanliness and good
grooming may not be acceptable to 100 percent of a popula-
tion, it is definitely the norm, and most likely to be
accepted by a majority of respondents being interviewed.

An interviewer's demeanor should be pleasant. Because an interviewer will be prying, to some degree, into the lives and attitudes of respondents, the interviewer should make an attempt to appear to be genuinely interested without appearing to be prying.

It is imperative that an interviewer be familiar with a client's questionnaire. If an interviewer is unfamiliar with the questionnaire, the study suffers, and the burden shifts to the respondent. The study no longer possesses those advantages over the self-administered questionnaire.

While being able to clarify specific questions on a survey, it remains important to initially convey each question to respondents in the exact words of the questionnaire's author. As I explained earlier, the wording of a question is extremely significant. Much time and effort have gone into the construction of each question to ensure with as much confidence as possible, that most if not all potential for response biases have been removed from each question.

Responses should be recorded by an interviewer exactly as they are stated in replies by respondents. It is important that no attempt is made to summarize, paraphrase, or correct bad grammar. This is especially important since a researcher may not know how responses will be coded prior to processing. In fact a researcher may not know the coding

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scheme until after one has read a hundred or so responses. For example, in a survey conducted concerning a traffic situation, one respondent may indicate that the number of cars on a highway is too high and consequently something should be done to reduce this number. Another respondent may reply that a need for more roads are required to alleviate this problem. An untrained interviewer may record both answers as "congested traffic" when there were obviously two different answers.

There will be times when a respondent's reply will be incoherent and the interviewer interprets the respondent's reply by his or her tone and mannerisms. The interviewer should still record the answer exactly as given by the respondent and then offer a summary of the interviewer's perceptions as comments. In general, it would be helpful for the interviewer to offer comments explaining aspects of the responses not given in recorded responses, such as the respondent's uncertainty, anger, embarrassment, and other emotional traits. However, in every case, the exact response should also be recorded.

The specific number of interviewers needed to conduct a survey is determined by (1) the number of interviews to be conducted, (2) the average time required for each interview, (3) the period of time allotted to the entire interviewing operation, and (4) the number of qualified interviewers available.

Babbie [1973] suggests recruiting and training twice the required number of interviewers. During the course of training, many prospective interviewers will drop out voluntarily or be attrited. Babbie [1973] further suggests that it is better to begin an interviewing process with a few good (qualified) interviewers than a lot of bad ones. Typically, an interviewing staff is terminated in a staggered fashion near the end of the operation, with the best interviewers being asked to remain on board for the wrap-up.

Often times, the scope of a survey will require more than one supervisor. While one person may be responsible for the entire operation, the individual may be assisted by a supervisory staff. As a general rule of thumb, Babbie [1973] suggests that one supervisor per every ten interviewers should suffice. An individual assigned as overall in charge, should not be assigned any interviewers to supervise. This person will have enough work handling logistics, coordinating with a project director, possibly recruiting other interviewers, and supervising the supervisors.

Babbie [1973] suggests that procedures should be established concerning regular reporting of interviewers to their supervisor. Perhaps the best procedure is to establish a regular interval to meet, possibly a weekly appointment. At the meeting an interviewer could check in with

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data from the completed interviews, discuss them with the supervisor, and receive a new set of assignments.

Supervisors needs to peruse interviews looking for incomplete answers, obvious errors, illegible responses, or anything else which causes questionnaires or open-ended responses to be difficult to use and interpret. Supervisors should also examine the data for anything that might suggest an interviewer does not understand the survey or some part of it. Each error by an interviewer needs to be disclosed and discussed with that interviewer so that the same mistakes are not repeated [Babbie, 1973].

There will be times that respondents will not be receptive to an interviewer. Even with a scheduled appointment, an interviewer might arrive at an inopportune time and be turned down. Appearance or demeanor of an interviewer may cause a respondent to refuse an interview. Interviewers need to be trained not to force respondents to cooperate; it may be possible for an interviewer to phone a respondent and reschedule an appointment. Some interviewers will be more successful at gaining the cooperation of respondents and establishing a good rapport immediately. These interviewers will become identifiable quickly and should be considered to specialize in difficult respondents [Babbie, 1973].

Finally, all or a large portion of the interviews should be verified [Babbie, 1973]. This verification may

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take on many forms. As a minimum, an interviewer's supervisor should call the respondent on the phone, identify himself, and verify that the interview was indeed conducted. In a more rigorous verification, a supervisor may re-ask a key question or two from the survey. However, when this approach is used, care should be taken not to be too extensive as it takes up a supervisor's time, further inconveniences a respondent, and may even give a respondent cause to worry about the confidentiality of the survey [Babbie, 1973].

B. FOCUS GROUP RESEARCH

1. Overview

A focus group is a planned and moderated group discussion designed to obtain information on a specific area of interest in an environment where disclosures are encouraged. Typically groups are composed of seven to ten people who have some homogeneous characteristic that will allow meaningful data collection for a particular topic. Data gathered are of a qualitative nature and can offer rich insights. As ideas and perceptions are shared, synergism provides results not obtainable from other research methods [Stewart and Shamdasani, 1990].

The moderator/ facilitator creates a permissive environment that nurtures different perceptions and points of view within a group, without pressuring participants to

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vote, plan, or come to any consensus. The group is conducted several times with similar types of participants to identify trends and patterns in perceptions. Careful and systematic analysis of discussions provide clues and insights as to how a product, service, or opportunity is perceived [Krueger, 1988].

Use of focus groups can be traced to work done as early as the 1930's [Krueger, 1988]. They were born out of necessity as social scientists began investigating values of nondirective individual interviewing as an improved source of information. Many doubts existed among the scientific community about accuracy of traditional information gathering techniques, specifically an excessive influence of an interviewer and limitations of predetermined, closed-ended questions. As a result social scientists began considering strategies whereby a researcher would take on a less directive and dominating role and respondents would be able to comment on those areas they deemed most important. In effect, the emphasis of nondirective interviewing was to shift attention from an interviewer to a respondent [Krueger, 1988].

During World War II, increased attention was placed on focused interviewing in groups, primarily as a means of increasing military morale. After the war, Merton applied the focus group technique while analyzing training and morale films for the Research Branch of the United States

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Army Information and Education Division. He along with Fiske and Kendall, published papers and books on the technique used [Krueger, 1988].

Since that time, focus groups have taken on many different forms and do not follow all procedures as they were earlier defined. For example, they have been extensively used in market research to enable sellers to understand the thinking process of consumers. Today, they are again becoming increasingly popular as an important tool for researchers in the social sciences [Stewart and Shamdasani, 1990].

2. Use as a Research Tool

The following are common uses where focus groups have been particularly useful:

- Obtaining general background information about a topic
- Generating hypothesis for further research
- Stimulating new ideas
- Diagnosing the potential problems with a particular area
- Generating impressions of the topic being researched
- Learning how respondents talk about the phenomena of interest
- Triangulate previous results
- Assessing needs
- Developing plans
- Recruiting new clientele
- Determining customer decision processes

• Testing new programs and ideas

• Improving existing new programs, products, and services

• Generating information for constructing questionnaires

[Stewart and Shamdasani, 1990 and Krueger, 1988]

3. Advantages and Limitations

Like choosing any research collection method, it is important for a functional manager to compare advantages and limitations to ensure the proper collection technique is being used.

a. Advantages

1. Focus groups provide data more quickly and cheaply than most other data collection techniques. In emergency situations, skilled moderators have been able to conduct three to four discussions, analyze results, and prepare a report in less than a week. When compared to other means of obtaining information about behaviors and attitudes, the focus group has a considerable advantage.

2. Focus groups place people in natural, real-life situations as opposed to controlled experimental situations typical of quantitative studies. Also, the one-on-one interviews are not able to capture the dynamic nature of this group interaction. Inhibitions often are relaxed in group situations, and the more natural environment prompts increased candor by respondents.

3. Focus groups allow a researcher to interact with a group and pursue follow-up questions and interpret nuances such as tone of voice that may add meaning to a response. This flexibility to explore unanticipated issues is not possible within a more structured questioning sequences typical of mail-out surveys.

4. The open response format of focus groups provides data in respondents' own words.

5. The results of focus groups are easy to understand. This is in direct contrast to studies that rely on complex statistical analysis.

6. Focus groups enable a researcher to increase the sample size of qualitative studies. Qualitative studies typically have limited sample sizes due to the time and cost constraints of individual interviewing. Focus groups enable the researcher to increase the sample size without dramatic increases in time required of an interviewer.

7. Finally, focus group discussions have high face validity. The technique is easily understood and results seem believable to those using the information. Results are not presented in complicated statistical charts but rather in lay terminology embellished with quotations from group participants [Stewart and Shamdasani, 1990 and Krueger, 1988].

"In essence, the strengths of focus groups come from a
compromise between the strengths found in other qualita-
tive methods. Like participant observation, they allow
access to a process that qualitative researchers are
often centrally interested in: interaction. Like in-
depth interviewing, they allow access to the content
that one is often interested in: the attitudes and
experiences of our informants. As a compromise, focus
groups are neither as strong as participant observation
on the naturalistic observation of interaction, nor as
strong as interviewing on the direct probing of infor-
mant knowledge, but they do a better job of combining
these two goals than either of the other two techniques.
We believe this is a useful combination, and one which,
for some types of research questions, may represent
the best of both worlds" [Krueger, 1988].

b. Limitations

All techniques for gathering information have
limitations, and focus group discussions are no exception.
It is important for a functional manager to be aware of
these limitations in deciding whether to use this technique.
Many of the limitations are simply the negative effects of
advantages previously discussed and include:

1. Interaction of the respondents with the researcher
and one another can be influenced by intentional or

unintentional moderator bias and group discussion could reflect the opinion of a dominate or influential group member.

2. A researcher has less control in the group interview as compared to the individual interview. The sharing of group control results in some inefficiencies such as detours in the discussion, and the raising of irrelevant issues, thus requiring the interviewer to keep the discussion focused.

3. Although data are easier to understand, it is more difficult to analyze than data collected from surveys. Comments must be interpreted within the context. Care is needed to avoid jumping to premature conclusions. Occasionally, participants will modify or even reverse their positions after interacting with others.

4. Groups can vary considerably. Each focus group tends to possess unique characteristics. One group may be lethargic while the next group may be enthusiastic. Because of these differences in groups, it is recommended to include enough groups to balance idiosyncrasies of individual sessions.

5. The discussion must be conducted in an environment conducive to relaxed conversation. These factors can present logistical problems and may require incentives to participate.

6. Often times, more credibility may be given to focus group results than those of a statistical survey because of actual "live" interaction with the respondents. This may not always be warranted.

7. Focus group research requires carefully trained interviewers. At times, an untrained moderator can achieve remarkable results, but it is far better to influence the odds of success by using skilled interviewers. The open-ended questioning technique, the use of techniques like pausing for reflection and further probing of specific subjects, as well as knowledge of when to move on to another topic require a degree of expertise not typically possessed by the untrained interviewer [Krueger, 1988 and Stewart and Shamdasani, 1990].

4. Focus Group Preparation

It is essential for a focus group moderator and a functional manager to be clear as to exactly what are the goals and objectives of a proposed focus group. Before doing anything, a moderator should determine from a functional manager what the manager knows and what one thinks one wants to know. Higginbotham and Cox [1979] describe the process of the interviewer hunting for answers in a focus group, as a hound following a scent. If an interviewer does not recognize the wisp on an answer, a trail that might

provide rich data may never be taken [Higginbotham and Cox, 1979].

When recruiting members of a focus group, it is usually important to solicit homogeneity within the group. Often homogeneity is desirable with respect to social class and family life cycle. Consumers occupying different areas of the life cycle require different needs to be met. Also, when different social classes are mixed, the more literate and articulate middle-class respondents may suppress the participation of the lower-class interviewees who might feel as though they are unlearned [Higginbotham and Cox, 1979].

It has been found that seven to ten respondents is about the ideal size of a focus group. Very small groups lose the mutual stimulation among respondents that make a group environment unique. By contrast, when groups are too large, they are difficult to manage, and in very large groups, less aggressive but potentially valuable respondents hesitate to speak. It may be a good idea to over-recruit. Focus groups require an appearance by designated individuals in a specific place at a designated time. When sickness, bad weather or family emergencies arise, it would be prudent to have alternates on stand-by [Higginbotham and Cox, 1979].

By questionnaire or even traditional interview standards, the number of focus groups in a typical study is small. From the initial interview, on even a totally unfamiliar topic, the interviewer invariably learns a great

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deal. The second interview produces more data, but not much of it is new. Normally by the third session and certainly by the fourth, one will experience diminishing marginal returns and it will become obvious that little would be gained by continuing [Higginbotham and Cox, 1979].

5. The Discussion

It is best that a moderator guide a discussion, keeping it within the realm of the subject, but not frequently participate in it oneself. When a moderator can provoke a group member to ask a question of the group, the moderator can avoid asking the question. The rationale for encouraging spontaneous interchange among group members is that this type of discussion may produce important data that might not have been obtainable from direct questioning [Higginbotham and Cox, 1979].

It often makes a difference where respondents sit in relationship to the moderator. Members who sit across from the moderator (within eye contact) often participate more frequently; while those individuals sitting to the right or left of the moderator, participate less often. Therefore, it is helpful to sit the least talkative individual across from the moderator and the most talkative members to the right and left [Higginbotham and Cox, 1979]. Haga [1993] suggests that in the event a moderator has not sized up the personali _3 of group members prior to a discussion,

a roving moderator may be used to facilitate soliciting opinions from all group members.

A moderator's opening remarks define the ground rules and set the tone for a focus group. These opening comments serve several purposes. Firstly, it provides respondents with some idea of the scope of the discussion as well as the topics to be covered. The topics also suggest the boundaries of discussion [Higginbotham and Cox, 1979].

Remarks about video recording serve to explain the recording in a routine way so not to bring special attention to the recording and cause initial nervousness within the group. These remarks also set the stage for a moderator to request various members to speak up or discontinue simultaneous conversations when required [Higginbotham and Cox, 1979].

Comments about radio and television are helpful because several of the participants will have seen commercials which center around group discussions and think that the focus group may be a part of one of these commercials. Inform the group members up front that a commercial is not being made. If they assume a commercial is in the making, the participants may tend to be self-conscious and non-productive [Higginbotham and Cox, 1979].

The tactic of going around a room to have everyone introduce themselves and discuss their families breaks the ice. First it allows each participant, up front, the oppor-

tunity to talk about something on which they are an expert. At this specific moment, a particular respondent knows more about a subject than any other member of the group. This discussion also allows the moderator to ask probing questions, such as "any grandchildren yet?" "you said your husband was a gardener; what kind of plant food does he recommend?" This sets the stage for probing questions, the moderator may have during later discussion [Higginbotham and Cox, 1979].

The moderator's concern about being receptive to negative comments needs to be reinforced. In a friendly atmosphere, respondents will hesitate to be frank and critical unless this is demonstrated. Obviously, a moderator must not only express interest in negative comments, but must also demonstrate sincerity [Higginbotham and Cox, 1979].

Pacing a focus group discussion is equally important. It is much like taking an essay examination. The moderator must rank the various topics and allot the proper amount of time to each topic. A moderator must therefore pace the session so that a fascinating subject does not crowd out other topics to be covered near the end of a discussion [Higginbotham and Cox, 1979].

Balanced participation among members of a group must be maintained. This may mean that a moderator may need to ask directed questions to those members who tend to be

quiet or are hesitant about expressing their opinions. The moderator may find that one needs to suppress those members who desire to be center stage. One way to do this may be to solicit comments by going one-by-one around the table. Another time, the moderator may just want to ask, "Does anyone else have an opinion?" If the center-stage type develops into a pest, more drastic measures may be required, such as appearing bored, avoiding eye contact or even looking up at the ceiling [Higginbotham and Cox, 1979].

In summary, a focus group can be defined as a carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, nonthreatening environment. It is conducted with approximately seven to ten participants by a skilled interviewer. The discussion is relaxed, comfortable, and often enjoyable for participates as they share their ideas and perceptions. Group members influence each other by responding to ideas and comments in the discussion [Krueger, 1988].

While Higginbotham and Cox [1979], Krueger [1988] and Stewart and Shamdasani [1990] describe the procedures of how to prepare for, conduct, and analyze the data from focus groups in great detail, this author prefers the version by Krueger [1988]. For those functional managers who prefer the abbreviated version, direct your reading first to Higginbotham and Cox [1979].

C. QUALITY FUNCTION DEPLOYMENT RESEARCH (QFD)

1. QFD History

Quality function deployment is a system which allows all employees of an organization as well as customers to participate in the design of new products. Although this system seemed to have had its beginnings in Japan sometime in the early 1950s, its first big breakthrough was in 1972. The Kobe shipyard in Japan began using a matrix that placed customer demands on the vertical axis and methods by which these demands would be met on the horizontal axis. During the 1970s and 1980s, the Japanese developed many more matrices and today there are over thirty popular matrices that facilitate assurance that a product and process are designed right the first time [King, 1987].

2. Key Elements of QFD

One of the key elements of QFD, is acquiring a better understanding of what a customer desires. QFD defines these needs in a series of charts called the Quality Tables [King, 1987].

King [1987] suggests that there are basically three classes of customer desires. They are:

- Specifications
- Expected Qualities
- Exciting Qualities

Specifications are those desires that the customer conveys to the producer (functional manager) that he or she desires and then the producer meets those desires.

Expected qualities are those that are not conveyed by the customer but are expected by the customer nonetheless. For example, consumers of automobiles expect that they are buying a safe vehicle. While a great percentage of customers shopping for a car do not emphasize safety as a customer requirement, safety is in fact an expected quality. Expected quality demands are not really "satisfiers." If customers do not receive characteristics like safety, they are unhappy; but if they do receive them, they are not particularly pleased; they are merely getting what they expected [King, 1987].

Exciting qualities are those that consist of new ideas generated by the company providing a product or service to a customer. A customer did not expect or demand these qualities by the supplier but since they are improvements, the customer likes them [King, 1987].

Before QFD, customer requirements were solicited by means of surveys and focus groups. In addition to these methods, further information about customer needs were determined through means such as analyzing other competitor's products, complaint reports from governmental agencies, lawsuits, what employees hear from their neighbors, and information presented to the organization's sales force,

to mention just a few. Still other information is derived from professional sources such as trade shows, product conventions, trade journals, academic programs, and current suppliers [Bossert, 1991].

QFD provides an access to this information by placing it in a structure such as a matrix. The research team then has a means by which to determine not only what the customer wants, but also what the customer wants but is not expressing [Bossert, 1991].

Now that I have discussed the various types of surveys and techniques with which to employ these surveys, a functional manager should be able to digest the information covered in this section and determine which method best applies in deriving customers' needs. The choice of data collection methods is an important one; and all advantages and limitations of each method should be weighted against one another to determine which is best for each functional manager's specific application. While one cannot avoid making choices among these methods, the use of multiple methods might help to triangulate data and thus discard that data that are distorted or biased. Upon determining the needs of the customers, the functional manager is invited to continue to the next chapter where I discuss those methods to evaluate the needs of the customer.

IV. ACTIVITY (A32) EVALUATE CUSTOMER AND SUPPLIER NEEDS

A functional manager should now compile a list of customer needs. This list of attributes will serve as an aid to redesigning the process as well as a measurement of performance. With this information, a functional manager will be able to satisfy those customer requirements that are deemed most important and feasible. This list will also serve as a starting point from which to determine the business process most suited to satisfy those requirements.

Because most evaluation techniques considered here will center upon group consensus, it is important that good listening skills be applied by each group member. Consensus requires understanding basic issues, causes, and solutions. It requires each group member to keep open ears and an open mind. Without good listeners on a team, an entire process breaks down and creates mediocre status quo solutions and plans [Brassard, 1989].

It is not enough to have good listening skills; each group member must value (not simply tolerate) different perceptions of others. Brassard [1989] points out that despite "participative management" being in vogue today and organizations emphasizing teamwork, many managers are still "going through the motions" when it comes to valuing opin-

ions and perceptions of others. They realize they should seek input, encourage differences of opinion, and get as many views of a situation as possible, but being the "Lone Ranger" is easier and more fun. If functional managers are going to redesign the best possible business process, valuing knowledge of all group members will be required.

A. NOMINAL GROUP TECHNIQUE

One method to evaluate/rank customer needs is described by Brightman and Verhoeven [1986] as the "nominal group technique". The nominal group technique attempts to give everyone an equal voice in solution selection (in this case, attribute selection). In doing so, it leads to commitment to working on a problem (redesigning the business process) [GOAL/QPC, 1988]. Each person's ideas are assured of a fair appraisal by separating a process of idea generation from critical analysis. Haga [1992] states that this separation is so critical that separate groups should brainstorm and criticize iteratively. In the first phase of this technique, each member silently generates and records an alternative (in this case, a customer need), avoiding discussion in order to prevent self-censorship. Next, each member presents one alternative with supporting arguments. Critical comments are not voiced at this time. Once all members have voiced their opinions, interactive discussion can take place. During this period, a group leader should explore

differences in initial arguments while ensuring that ideas are not forgotten or ignored. Finally, if a consensus has not been reached, each person silently and independently ranks the remaining options and votes are tallied by the leader [Brightman and Verhoeven, 1986].

B. DECISION MATRIX

The decision matrix is an evaluation tool, useful for assessing the relative impact of a problem or a potential solution. When used to compare potential solutions, it provides insights about relative effectiveness and suggests areas where information is insufficient to make comparisons [AT&T, 1988].

Florida Power and Light Company [1987] recommends conducting a decision matrix as follows:

1. List alternatives: (customer requirements to satisfy).

2. Brainstorm selection criteria: For example, consider cost of implementation, required resources and commitments, cost of unmet expectations.

3. Rate each alternative on a scale of 1 (low) to 5 (high) for each criteria.

4. Determine overall priority by combining ratings of all criteria for each alternative.

C. MULTIVOTING

Florida Power and Light Company [1988] defines multivoting as a series of votes to assign priorities and reduce a list to a manageable few items (usually three to five).

The procedure is as follows:

1. Take a first vote: Each person votes for as many items as desired, but only once per item.

2. Circle the items receiving a relatively higher number of votes than the other items.

3. Take a second vote: Each person votes for a number of items equal to one-half the total number of circled items, again only once per item. (Example: If six items received a relatively large number of votes during the first vote, then each person gets to vote three times during the second vote).

4. Repeat steps 2 and 3 until the list is reduced down to a feasible list/ number of customer requirements.

D. ELECTRONIC VOTING TECHNOLOGY

Nunamaker [1992] suggests that traditional voting usually happens at the end of a discussion, to close and decide a matter once and for all. Electronic voting, however, tends to inspire a vote early, vote often approach. Because it is so fast, teams use it to measure consensus and focus subsequent discussion, rather than close debate.

Electronic polling can sometimes facilitate decisions that are too painful to arrive at using traditional methods. Nunamaker [1992] offers the example of the corporation which chose an electronic polling system to aid in choosing how best to downsize. In many previous meetings, the possibility of eliminating a large but ineffective division was raised but was set aside for fear of offending the division's head, who was a personable and effective lobbyist for his employees.

Although the division was generally unproductive, no one wanted to hurt the manager's feelings by pushing to have it eliminated. Instead, using traditional voting methods, the group consensus indicated that across-the-board cuts should be implemented. Everyone would bleed a little, sacrificing some efficiency in the interest of harmony.

When the electronic votes were tallied, however, it was clear to all involved that the most sensible and most widely supported alternative was to eliminate the ineffective division. In doing so, the organization did not have to make potentially crippling cuts to the mission-critical functions, and at the same time it distributed responsibility for the decision among the participants.

Although teams may save time and money with electronic voting, it would be a mistake to view that as the technology's main advantage. Enhanced understanding of the

issues and of the workshop and the workgroup itself remain the clearest and most sustainable advantages of electronic polling [Nunamaker, 1992].

An example of an electronic polling tool is VisionQuest by Collaborative Technologies. VisionQuest permits participants to shuffle the order of items on a list to create a ranked ballot, or to assign numeric weight to each item on a list. For example, a survey can ask group members to rate the importance/feasibility of a list of customer requirements.

Through VisionQuest's "filtering and prioritization of possibilities" mode, the system can conduct such exercises as:

1. Ranking: Individuals assign a rank to each alternative in order of importance and feasibility. VisionQuest computes the average rank and displays results in order of group preference.

2. Rating: Groups rate each alternative using a predefined numeric scale. VisionQuest computes the group averages and displays the results. Ratings tend to quantify the strength of opinion, revealing significant differences in individual preferences.

3. Subgroup Selection: Each person in the group selects a specified number of alternatives. VisionQuest computes the number of times each alternative was selected, revealing the group's top priorities.

4. Scoring: Participants rate alternatives using multiple criteria that can be assigned weighting factors. Vision-Quest calculates and displays a group's preference by total score.

5. Voting: Participants may make Yes, No, or Abstain votes on a list of ideas.

While VisionQuest is aimed at real-time meeting support, it can be used over a period of time, with participants adding opinions or prioritizing at their convenience. [Nuna-maker, 1992] Other electronic polling software include such systems as Group Matrix, OptionFinder, and SmartChoice. See appendix D for a list of companies which provide these systems.

E. PAIRED COMPARISONS

The paired comparison method of a measurement of atti-tudes, also known as the "Law of Comparative Judgement" has also been used to rank the order of a set of attributes [Thurstone and Chave, 1966]. Using this method, one submits all the stimuli (customer requirement attributes), in pairs to all group members for judgement. Each one of the attrib-utes is submitted to every group member in combination with every other attribute in the entire series. For example two attributes would be given to each subject with the request that one indicate which of them is more favorable/feasible

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to provide the customer in the improved product/service. When each group member has rendered judgement on this pair of attributes, a proportion of the members who prefer *a* over *b* can be derived [Thurstone and Chave, 1966].

This scenario can of course be done, but the task can become practically prohibitive in two ways. In the first place group members would become fatigued or bored if they had to make this type of judgement for tens, hundreds, or even thousands of pairs of attributes, each requiring careful reading and consideration [McGuire and Davison, 1991].

Secondly, statistical labor required to determine scale-values would also be prohibitive. Statistical applications will be left to the reader, however suffice it to say, the longer a list of attributes the more complex the statistical analysis will become [Restle and Greeno, 1970].

When a number of attributes are small, from ten to even forty, paired comparisons are not fatiguing and statistics not laborious and the method of paired comparisons can be readily applied. This will be the case for most functional managers attempting to determine which customer requirements to incorporate into the redesigned process. However, keep in mind that once a list of attributes reaches 100, the fatigue and statistical calculations might exceed a threshold that would allow the paired comparison method to be productive [Thurstone and Chave, 1966].

V. ACTIVITY (A33) MODEL THE AS-IS PROCESS

Now that a functional manager has compiled the list of customer and supplier requirements, the manager must now model the process in order to fully understand it. Then a functional manager should subject the process to activity based costing, process data analysis, and simulation in order to ensure an effective and efficient process. In effect, conduct business process improvement.

A. DATA COLLECTION

To facilitate the modeling procedure, the design team will need to collect data which describes the physical structure of the as-is process. Those data collection methods used in support of customer requirements discussed in chapter three are valid in this activity. The only difference is that instead of collecting data about the needs of one's customers, the individual is now collecting data from process owners and team members about activities within their processes.

Most methods that are used to gather data in organizations assume that data have not already been collected and thus must be obtained either by asking organizational members or by observation of events as they occur. Nadler

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[1977] points out, that in fact, organizations do an immense amount of data collection during the normal course of activities, and therefore they contain huge "data banks," waiting to be used by a redesign team. These data are normally referred to as secondary data, since they are collected from secondary sources instead of respondents.

In organizations, perhaps the richest source of secondary data is archives, that is, the various documents, records, and written material in the possession of an organization [Nadler, 1977]. Mentioning a few common kinds of data should present a picture of the scope and potential usefulness of these archives. Many organizations keep detailed records of certain kinds of behavior including records of absenteeism, lateness, turnover, accidents, grievances, etc. A more relevant kind of data collected is performance of work units. In particular, data about productivity, reject rates, repairs, costs, complaints, etc. All these data provide information about the performance of a process and can be valuable to a redesign team [Nadler, 1977.

B. MODELING TECHNIQUES

1. IDEF0

Described in Chapter II and Appendix A, IDEF0 is one available modeling technique. Vogel [1993] states that IDEF0 graphically walks the functional manager down a hier-

archical peeling of an onion in studying the present AS-IS environment. Vogel [1993] further states that CIM mandated the use of the IDEF0 modeling technique as opposed to other modeling techniques based on the following concepts:

1. One cannot solve a problem if one does not define and document the problem.

2. Problems should be analyzed in a modular, hierarchical, and structured top-down method.

3. IDEF0 depicts redundant activities, interrelationships among the activities, and how the activities fit into a hierarchical structure.

4. IDEF0 supports disciplined, coordinated teamwork and consensus.

5. IDEF0 is structured and rigorous.

6. IDEF0 follows the principle of gradual exposition of detail.

The benefits of IDEF0 are as follows:

1.   Provides an understanding of the As-Is environment.

2.   Provides a means for communicating and presenting results.

3.   Establishes a forum and a structure for interviewing people.

4.   Identifies opportunities for improvements.

5. Identifies and categorizes information entities which form the foundation for data modeling.

6. Reveals redundant processes.

7. Documents the AS-IS process for baseline evaluation and further analysis.

8. Begins a roadmap from the AS-IS process to the improved process.

In addition to the above benefits, the author found software which supported IDEF0 extremely user friendly. Using Meta Software's "Design IDEF", the author was able to create the diagram shown in Appendix E in about an hour. Although the author used IDEF0 software provided by Meta Software, other IDEF0 supported software may be as user friendly. A list of vendors which support IDEF0 is provided in Appendix F.

2. Other Modeling Techniques

While other modeling techniques do exist, IDEF is considered far superior by the DoD for reasons already stated. While other modeling techniques such as Data Flow Diagrams (DFD) and Entity Relationship Diagrams (ERD) serve their purposes, they do not have an ability to display and communicate those mechanisms and controls that play significant roles in business processes.

For purposes of Chapter VI where we will discuss business process redesign (BPR), it is beneficial to say a few words about DFDs. DFDs were derived through Structured Analysis, also called Structured Systems Analysis. Two of its most renown advocates are Tom DeMarco and Ed Yourdon. The future redesign specification evolves from a series of flow models. As already noted, one of DFDs disadvantages is that DFDs do not explicitly show control of a flow through a process. DFDs only display flow of data, storage of data, and the activities that respond to and change data within a process [Whitten, Bentley and Barlow, 1989]. DFDs will differ in respect to whether they model the current system or the system to be built and whether they model the imple-mentation details of the system (the so-called physical system) or the essence of the system (the so-called logical system) [Whitten, Bentley and Barlow, 1989]. The concept of the logical system, sometimes called an essential system, is crucial to Structured Analysis and BPR. It addresses the problem of damaging creativity of a redesign team by prema-turely thinking about a new system (process) in terms of how it should it work (called the physical process). Structured Analysis requires an analyst to define what the process should achieve before determining how the process should achieve those objectives. Advocates of this theory insist that by reducing a process to its logical essence, the following benefits will be realized:

1. The analyst more accurately defines end-user require-
ments by not prematurely worrying about technology.

2. The analyst is more inclined to conceive more creative
alternative solutions that are based on the existing
system. [Whitten, Bentley, and Barlow, 1989]

C. ACTIVITY BASED COSTING

One method used to streamline and improve business
processes is that of Activity Based Costing (ABC). ABC is
not a new concept. ABC helps ensure that the accounting
system appropriately models the physical process. Activi-
ties are the building blocks of business processes. For
this reason, it is essential to understand business activi-
ties in order to implement business process improvement. ABC
organizes financial information so that it can be used for
decision making by a non-accounting oriented functional
manager. ABC shows them what they do with their money.
This ability to match costs with activities and outputs of
those activities quickly indicates where improvement is
needed. ABC can help functional managers determine the
value of, or need for, each activity. In turn, these deter-
minations can be used to rank various activities of a busi-
ness process for improvements [Moravec and Yoemans, 1992].

Through the use of IDEF0 based ABC, functional managers
can define activities and their relationships and determine

the relationship of costs based on or associated with those activities and transactions. Activities can be stratified by their total costs, their unit costs, and their cost drivers. Using ABC, activities can be distinguished as either primary or secondary, essential or non-essential. Primary activities can be further classified as either value added or non-value added, enabling functional managers to use different actions to simultaneously attack waste and improve performance [Moravec and Yoemans, 1992].

Brimson [1991] provides an excellent blow-by-blow how-to on the procedure for determining activity costs. The details will be left to the reader while the steps are as follows:

- Select cost basis
- Trace resources
- Determine activity performance measurement
- Select activity measure
- Allocate secondary activities
- Calculate cost per activity

D. PERFORMANCE MEASUREMENT

Another technique (method) often used for process improvement is that of analyzing business process data through performance measurement. This methodology encourages the functional manager to question, probe, and revisit one's decisions while asking the questions:

1. Why do I measure?

2. What do I measure?

3. How do I make sense of the measures to understand, control, and improve my process?

The following discussion on process performance measurement is taken from AT&T [1990].

> The widespread application of process data
> analysis (Statistical Quality Control (SQC))
> techniques to business operations is rela-
> tively new. SQC has a successful and distin-
> guished history in manufacturing. For de-
> cades, factories have plotted process data on
> control charts to monitor, troubleshoot, and
> improve manufacturing performance. Is it
> safe to assume that these proven strategies
> will work on business as well as manufactur-
> ing processes? Can you assume that these
> same techniques can help you manage and im-
> prove your process?

To analyze a process, it must be repeatable and measur-
able. A process is repeatable if it recurs over time. The
cycle of the process may be as short as minutes or as long
as years, requiring obviously different types of strategies
to define and measure the two very different processes.
However both extremes produce data, and that data can be
analyzed to reveal useful information.

In determining how to measure one's process, it is necessary to decide what factors will be measured. A functional manager should be looking for internal measurements that act as surrogates for customer satisfaction. This is no easy task. One needs to ask questions like:

- What are my customers looking for?
- How are they judging my product or service?

Once these questions are answered, one must translate the answers into characteristics of your process that the functional manger can measure.

In general, the customer has three measures of satisfaction:

1. Quality: How well does the product or service meet the need?

2. Timeliness: Was the product or service there when it was needed?

3. Cost: Is the product or service worth what it costs?

At this point, the author refers the reader back to activities (A31) and (A32). The reader has undoubtedly recognized that what has been discussed thus far in process data analysis was completed in the activities "Identify the Customer Needs" and "Evaluate Customer Needs". None-the-less it is important to periodically remind ourselves as functional managers, that customer satisfaction drives efficient and effective business processes.

Once the functional manager has determined the types of measurement which will be used in a process, one will need to use one's intuition, instinct, and experience in selecting how to use this data. However before the functional manager can anticipate how to use data generated by a process, one must first understand the concept of control.

Measurements taken from a repeatable process form a pattern that reveals a variability and central tendency of the process. One can expect that measurements taken from the same process will fit this same predictable pattern. When they don't, something may be out of control.

When one controls a process measure, one monitors it over time, looking for changes to the predictable pattern. When the pattern changes, something is affecting or influencing a process. If a functional manager has collected the right data, data analysis can find the reason for a change. In the context of process data analysis, control means identifying and eliminating detrimental change. It requires that a functional manager know what to expect (the predicted pattern), understand what one gets (the pattern of the data), and act on the difference (understand and eliminate whatever is degrading the process).

So let us now put it all together for the functional manager. How can the data that has been so thoughtfully identified and collected by a functional manager and staff

help one understand, control, and manage a process in ways that matter to customers of the process?

The control chart is one way to present such data. The control chart tests one's process data against the laws of variability and predictability to reveal information. Because it tests the stability of one's process, one can use the control chart to decide:

- Can the process meet customer needs? (Process Capability)
- Has something changed? (Process Control)
- How can we do better? (Process Improvement)

In prefacing the discussion of the control chart, the author invites the reader to recall basic statistics. All repeatable events in nature fluctuate within certain limits. One can see this variability almost everywhere. Let's say that each morning one steps on a scale. Even though your diet has not changed, your weight will vary by as much as a pound or two from day to day. However, unless one diets or binges, one can expect a scale to read, on average, a certain weight. If one plotted a daily weigh-in, a pattern would most certainly emerge. When one collects data that shows the natural fluctuation of any process, that data tends to form a pattern, known as its frequency distribution.

Patterns or distributions are important because they are clues to the stability of a process. Natural patterns

formed by repeatable events tend to mirror theoretical patterns or distributions. These theoretical distributions, when expressed mathematically, allow the functional manger to apply the laws of probability to predict how a process should behave. With the help of statistics, one can calculate an average (central tendency) and statistical limits (variability) of a theoretical distribution within which one's process should fluctuate. A control chart is a graphical picture of these calculations. It uses the formula of a theoretical distribution to test the stability of one's process against its statistical limits. When the data collected by a functional manager does not fit a predicted pattern, one can be reasonably assured that something unusual is going on, something deserving attention and action.

It is a safe bet that most functional managers are familiar with or at sometime have been exposed to one theoretical distribution: the normal curve. Using a normal curve distribution, a functional manager can assume that all measurements of one's process should fall within plus or minus three standard deviations from the mean or central tendency. A mean is commonly calculated as the sum of all measurements divided by the number of measurements taken. The standard deviation expresses the dispersion of the measurements relative to the predicted overall mean (average) of the population of measurements. With this understanding one is ready for the control chart.

No doubt the reader will come across many types of control charts. However, Figure 1 depicts the elements common to all control charts.

The points on the chart labeled by the number (1) are the process response data. They can be individual measure-
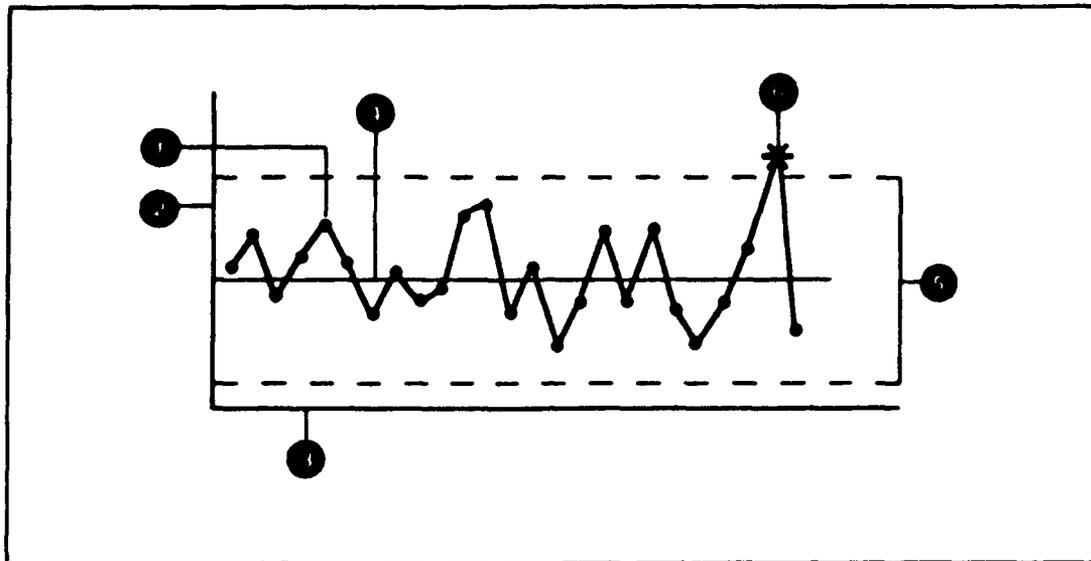
Figure 1. Control Chart

ments or the average of several measurements. The vertical or Y-axis is the unit of measurement of the response and is labeled by the number (2). The horizontal or X-axis on any control chart represents time and is indicated by the number (3). Number (4) is the centerline which represents the mean (average) of all data plotted on the chart, the overall mean. Number (5) is the upper control limit (often referred to as the UCL) and a lower control limit (LCL). They are shown as the dashed lines above and below the centerline. The con-

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trol limits represent three standard deviations from a centerline or mean. Although control limits on charts estimate three standard deviations from the mean, different charts use different formulas for estimating standard deviation. Finally, the point labeled by number (6) flags an out-of-control point, a point that, based on the laws of probability, would not be likely to occur when the process is operating under a stable system on chance causes. In this case, the point is flagged because it falls outside of three standard deviations from the mean.

What a functional manager can learn from a control chart comes from an analysis of data, some number of measurements or observations taken from a process. Those measurements or observations represent a sample of the overall population. The population encompasses all possible measurements or observations of a given process characteristic that could be made if a process continued to operate indefinitely. A sample is some number of measurements or observations taken at a given time to represent a population.

A pattern of points on a control chart will reveal useful insight into one's process. Remember, a control chart is based on a theoretical distribution. As long as one's process is operating under a stable system of chance causes, one can expect that the pattern of points will reveal the underlying characteristics (central tendency and spread) of this distribution.

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The centerline represents the overall mean of a measurement or counts being plotted. Because a mean expresses central tendency, most of the points should occur near the centerline.

Few points should occur near the control limits. The control limits delineate the boundaries of natural variability of a process. Under a normal distribution, only 4.27 percent of measurements fall between two and three standard deviations.

Rarely will a point fall beyond the control limits. An occurrence of a point outside three standard deviations limit is highly improbable. If the underlying distribution is normal, for example, the probability of a point occurring outside three standard deviations limits is twenty-seven chances in 10,000 occurrences.

Points should appear as a random distribution on the control chart. The points are plotted over time. If a process is operating under a stable system of chance causes, the variability of a process should appear random, without cycles or trends.

A control chart flags points as "out-of-control" when a pattern violates the expected pattern. For example, the probability of two out of three points occurring near a limit is so small that one can assume something unnatural is occurring. One can assume the process is out of control.

Control charts aid a functional manager in conducting process capability studies, conduct process control, and process improvement. Process capability is a description of the performance of a process when nothing unpredictable is occurring. It is an expression of the variability and central tendency of a process when it is operating under a "stable system of chance causes." Process capability studies are important because each out-of-control point on a control chart can represent an obstacle to customer satisfaction that a functional manager can identify and eliminate. In the course of a study, one is actually investigating and solving process problems. One is learning the cause-and-effect relationships at work in one's process.

One may learn that bringing one's process under control requires fundamental changes, even redesigning and implementing a new process that eliminates or tolerates the sources of variability now at work. Redesign will be discussed at greater length in Chapter VI.

Since we have already discussed control to some degree, the author will now attempt to clarify the difference between process improvement and control for the reader. When one takes corrective action during routine process control, is not one practicing process improvement? Is not one making things better? Process control, which is what one is practicing in this case, is the maintenance of a process within it natural limits. A process can be under control

and still not meet the needs of one's customers. In these cases, the natural level of the process is not adequate to meet business needs. To achieve and maintain competitive advantage, a functional manager must attain new levels of process performance. Process improvement is an activity to attain new, better levels of performance in a stable process. When one improves one's process, one brings about beneficial change in a process.

A control chart often reveals opportunities for improvement. One can investigate points on downward trends to discover the reasons for better performance. One can then incorporate the root cause of these better performers as a permanent part of one's process. Likewise, upward trends may initiate the identification of factors causing the system to exceed expectations. If the investigations result in the implementation of changes to the system, new process capability studies are useful to quantify the changes. In either case, the control chart can then be used to hold the gains. Use the new control limits for routine monitoring to ensure that the changes/improvements one has made are maintained.

E. COMPUTER SIMULATION

As discussed in the previous section, data or points on a control chart must be collected so that a control chart can offer a functional manager valuable information about

the performance of one's process. A functional manager may elect to collect this data through normal observation of a process. However, when it is economically essential to measure the performance of a proposed improved process prior to its implementation or when a functional manager needs to speed up a process so that a process can be assessed over a long period of time, computer simulation may be in order.

Computer simulation is a method that can be used to study the performance of a process. This technique often conducts experiments such as "what if" with the aid of a computer. First, one must develop a model which simulates the real-world process [Anderson, Sweeney and Williams, 1991]. Once the simulated model has been designed, one should go to great lengths to ensure the design properly emulates the real-world process. It is imperative that this take place in order to collect accurate data of one's process. One source for a how-to on validation of simulation models, is Turban [1990].

Once the model is validated, the functional manager should run a series of computer runs. The characteristics that are observed in the model can then be used to make inferences about the real system. One tool the functional manager may use to evaluate the data derived from one's simulation is the control chart discussed earlier and shown in Figure 1.

VI. ACTIVITY (A34) IDENTIFY HOW TO MEET CUSTOMER AND SUPPLIER NEEDS

In this chapter, methodologies of Business Process Redesign (BPR) will be discussed. The greater part of this discussion is taken from the exellent work of Hammer and Champy [1993]. BPR involves redesigning work processes to take advantage of two demographic and technological changes that have emerged since the advent of Scientific Management. First, the economy now contains many well educated people that are knowledgeable and experienced enough to complete the work they have always performed, and make decisions formerly reserved for supervisors and managers. Second, technology now makes it possible for pieces of information and even entire documents to be in many places at once, allowing different work that uses the same information to proceed ahead simultaneously [Schnitt, 1991].

Hammer and Champy [1993] suggest that functional managers *not confuse BPR with incremental business process im-*provement. BPR is not about fixing anything; BPR means starting all over again, starting from scratch. BPR means putting aside most of the wisdom of the past two hundred years of industrial management. It means forgetting how

work was done in the age of the mass market and deciding how it can best be done now. BPR means asking oneself, "if I were re-creating a business process today, given what I know and given current technology, what would it look like?" With BPR, old job titles and old organizational structures such as departments, divisions, and groups, cease to matter. What matters in BPR is how one wants to organize work today, given the demands of today's markets and the power of today's technologies. How people and companies did things yesterday doesn't matter to a business reengineer.

Hammer and Champy [1993] state that at the heart of BPR is discontinuous thinking, identifying and abandoning outdated rules and fundamental assumptions that underlie current business operations. Every company abounds with implicit rules left over from earlier times. These rules are based on assumptions about technology, people, and organizational goals that no longer hold. Unless companies change these rules, any reorganizations one creates will continue to be ineffective and inefficient. For a excellent preparation in discontinuous thinking, read Young and Haga [1993].

For conversational purposes, it is fine to say that BPR is the going back to the beginning and inventing a better way of doing work, starting from scratch. However, there is not much a functional manager can do with this definition. A more workable definition of BPR is that BPR is the fundamental rethinking and radical redesign of business processes

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to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed [Hammer and Champy, 1993]. The functional manager will find that most if not all attributes discovered in activities (A31) and (A32) falls within the realm of one of these categories.

The definition for BPR contains four key words. The first key word is "fundamental." In conducting BPR, managers must ask the most basic questions about their processes and how they operate: Why do we do what we do, and why do we do it the way we do it? Asking these fundamental questions, forces a redesign team to examine old rules and assumptions that underlie the way processes have operated in the past. Often, these rules turn out to be obsolete, erroneous, or inappropriate [Hammer and Champy, 1993].

BPR begins with no assumptions and no givens; in fact, organizations that undertake reengineering must guard against the assumptions that most processes already have embedded in them. To ask "How can we perform customer credit checks more efficiently?" assumes that customer credit must be checked. In some instances, the cost of checking may, in fact, exceed the bad-debt losses that checking avoids. BPR first determines what a process must do, then how to do it. BPR takes nothing for granted. It ignores what is and concentrates on what should be [Hammer and Champy, 1993].

The key word "radical" represents getting to the root of things, not making superficial changes or tinkering with what is already in place, but throwing away the old. In BPR, radical redesign means disregarding all existing structures and procedures and inventing completely new ways of accomplishing work. BPR is about business reinvention, not business improvement, business enhancement, or business modification [Hammer and Champy, 1993].

The key word "dramatic" suggests that BPR is not about making marginal or incremental improvements but about achieving quantum leaps in performance. If a company falls ten percent short of where it should be, if its costs come in ten percent too high, if its quality is ten percent too low, if its customer service performance needs a ten percent boost, that company may not need BPR. It is entirely possible that this company needs more conventional methods, from circling the wagons to establishing incremental quality programs [Hammer and Champy, 1993]. A functional manager that finds oneself in this described predicament may want to review chapter five in which the author discusses incremental business process improvement.

Although the key word "process" is the most important word within the definition of BPR, it is probably the one that will give a functional manager the greatest difficulty. Most managers are not process-oriented; they tend to

focus on tasks, on jobs, on structures, but not on processes [Hammer and Champy, 1993].

Hammer and Champy [1993] define a business process as a collection of activities that takes one or more kinds of input and creates an output that is of value to a customer. In other words, delivery of the ordered goods to customer's hands is the value that a process creates.

Receiving an order form, retrieving goods from a ware-house, and so forth of a major mail-order catalog business, managers tend to lose sight of a larger objective, which is to get the goods into the hands of a customer who ordered them. The individual tasks within this process are important, but none of them matters to a customer if an overall process does not work, that is, if a process does not deliver the goods.

A. RE-EXAMINING BUSINESS PROCESSES

Hopefully by now, the author has made the case that a reengineered process looks very different from that of a traditional process. But what exactly does a reengineered process look like?

One attribute of a reengineered process is that several jobs are combined into one. The most basic and common feature of reengineered processes is the absence of an assembly line; that is, formerly distinct jobs or tasks are integrated and compressed into one. Companies have found

that work performed by different people as a series of separate tasks led to errors, an absence of accountability and an inability of employees to see the big picture. This made it impossible to improve quality, customer service, or speed. Poor quality and delays also led to increased costs for rework [Schnitt, 1991].

Using BPR, companies are compressing responsibility for various steps in a process and assigning them to one employee or case team. This individual or team now serves as the single point of contact for a customer. The payoffs for using such integrated processes can be fantastic. Eliminating handoffs means doing away with errors, delays, and rework that they engender. Typically, it has been found that an individual or team working on an entire process is ten times as productive than an assembly line type process. Integrated processes have also reduced overhead costs. Because employees involved in a process assume responsibility for making sure that customers' requirements are met on time and with no defects, they need less supervision. Instead, a business encourages these empowered employees to find innovative and creative ways to reduce cycle time and cost continually while producing a defect-free product or service. Improved control is another benefit of integrated processes; because they involve fewer people, assigning responsibility for them and monitoring performance is easier [Hammer and Champy, 1993].

As the author has already eluded to, BPR compresses processes vertically as well as horizontally. Where employees had to go up the managerial hierarchy for an answer in the past, they can now make their own decisions. Instead of separating decision-making from real work, decision-making becomes part of the work. The antiquated assumption that must be discarded here is that people actually performing work have neither the time nor the inclination to monitor and control it and they lack the depth of knowledge required to make decisions about it. Instead management must see that by compressing work vertically, one experiences fewer delays, lower overhead costs, better customer response, and greater empowerment for workers [Hammer and Champy, 1993].

BPR allows steps in a process to be completed in a natural order. Typically, conventional processes required that person one complete task one before passing the results to person two to complete task two and so on. But what if task two could be completed at the same time as task one? This linear sequencing of tasks imposes an artificial precedence that slows work down. Delinearizing processes speeds them up in two ways. First, jobs get done simultaneously. Second, reducing the amount of time that elapses between earlier and later steps of the process narrows the window for major change that might make the earlier work obsolete or make the later work inconsistent with the earlier.

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Organizations thereby encounter less rework, which is another major source of delay [Hammer and Champy, 1993].

Another common characteristic of BPR processes is no more standardization. Traditional processes were intended to provide mass production for a mass market. In a world of diverse and changing markets, that kind of logic has become obsolete. An example of this is medical triage. Can one imagine going into a hospital emergency room with a bleeding head wound and wait as long to see a doctor as the child with a rash. Triage avoids this problem. A screening takes place to prioritize who sees a doctor first, what doctor one sees and so on. This is why processes need multiple versions. Traditional one-size-fits-all processes are usually very complex, since they must incorporate special procedures and exceptions to handle a wide range of situations. A multi-version process, by contrast, is clean and simple, because each version needs to handle only the cases for which it is appropriate (designed for) [Hammer and Champy, 1993].

Another recurring theme in BPR is that work is performed where it makes the most sense. In traditional organizations, work is organized around specialists and not just on a factory floor. Accountants know how to count, and purchasing clerks now how to file. Hammer and Champy [1993] tells of one example where a company ran an experiment and learned that it expended $100 in internal costs to buy $3

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worth of batteries. It also learned that 35 percent of its purchase orders were for amounts less than $500. A notion to spend $100 internally to expend $500 or less did not sit well, so the company decided to off-load the responsibility for purchasing goods onto the process customers. In other words, the accountants, as well as everyone else, now buy their own supplies. Customers know from whom to buy and what to pay, because purchasing has negotiated these prices and given the customers a list of approved vendors. Each operating unit has a credit card with $500 credit limit. At the end of each month, the bank that issued the credit card sends the company a tape of all card transactions, which the company then runs against its internal general ledger system, so that the individual work unit's budget gets charged for their supplies.

As a result, the requestors receive their products more quickly and with less hassle, and the company spends far less than $100 on the processing costs. This example illustrates what is meant by a customer of a process performing some or all of the process in order to eliminate handoffs and overhead and therefore cut costs.

Another kind of nonvalue-adding work that gets minimized in a BPR process is checking and control. Processes that have been reengineered use controls only to an extent that it is economically feasible. Conventional processes are rife with checking and control steps, which do not add

value but are included to ensure that people aren't abusing the process. In a typical purchasing process, for example, a purchasing department checks the record of the person requesting an item to make sure that person is authorized to acquire the requisitioned goods in the dollar amount specified and verify that the departments budget is good for the bill. All this checking is to make sure that people in an organization are not buying items that they should not. While this objective may be defendable, many organizations fail to recognize the costs associated with strict control. It takes time and labor to do all this checking; in fact, it may take more time and effort to do the checking than to do the actual purchasing. Worse, the cost of checking may even exceed the cost of goods being purchased [Hammer and Champy,1993]. Emery [1993] states that processes should exhibit a more balanced approach. Instead of tightly checking or controlling a process, reengineered processes often have deferred controls. These control systems will, by design, tolerate modest and limited abuse by delaying the point in time at which an abuse is detected. However, the reengineered control systems more than compensated for any possible increase in abuse by dramatically lowering the costs associated with the control itself.

Reconciliation is also minimized in a reengineered process. The most widely lauded example of this recently was in the Ford Motor Company. Ford's old accounts payable

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process contained three points of contact with vendors: at the purchasing department through a purchase order, at the receiving dock through receiving paperwork, and at accounts payable through an invoice. Three points of contact meant enormous opportunities for inconsistencies; a purchase order could disagree with either a receiving document or an invoice, and either of them could disagree with the other. By eliminating invoices, Ford reduced the points of external contact from three to two and the opportunity for inconsistency by two-thirds. As a result, the checking and reconciliation work that accounts payable had heretofore performed became unnecessary, which meant that the accounts payable organization could shrink dramatically [Hammer and Champy, 1993].

The author's favorite example of reducing reconciliatory points is told by Hammer and Champy [1993]. Wal-Mart maintained Pampers inventory at its distribution centers, from which it filled orders coming from its stores. When the distribution center inventory began to run low, Wal-Mart would reorder more diapers from Proctor & Gamble (P&G). As a functional manager that handles inventory knows, managing inventory is a delicate balancing act. Too little inventory makes for unhappy customers and lost sales. Too much incurs high financing and storage costs. Not only that, inventory management is itself a costly activity. With the idea of improving this aspect of its business, Wal-Mart approached

P&G with the observation that P&G probably knew more about diaper movement through warehouses than Wal-Mart, as it had information about usage patterns and reorders from retailers all over the country. Wal-Mart suggested, therefore, that P&G should assume the responsibility of telling Wal-Mart when to reorder Pampers for its distribution center and in what quantity. Everyday, Wal-Mart would tell P&G how much stock it was moving out of the distribution center to the stores. When P&G felt it was appropriate, it would tell Wal-Mart that it was time to reorder and how much. If a recommendation seemed to make sense, Wal-Mart would approve it, and P&G would ship the goods.

The new arrangement worked so well that over time Wal-Mart suggested that P&G henceforth skip purchase recommendations and just ship the diapers it thought Wal-Mart would need. In other words, Wal-Mart off-loaded its inventory replenishment function onto its supplier, illustrating the principle of relocating work across organizational boundaries. In this case, though, the boundaries were intercompany, not intracompany. Both companies reap advantages from this redesign. Wal-Mart has eliminated costs associated with maintaining its Pampers inventory. The stock is managed more effectively, since P&G indeed can do a better job than Wal-Mart. Therefore, the retailer has less inventory on hand and suffers fewer out-of-stock situations. Lower inventory levels frees up space in Wal-Mart's distribution

center, and reduces the retailer's need for working capital to finance that inventory. P&G gets additional shelf space as a preferred supplier, and much sought after end-aisle displays. P&G also experienced internal performance benefits from the reengineered process. First, P&G can run its manufacturing and logistics operations more efficiently now that it has the information it needs to better project product demand. In addition inventory no longer moves to Wal-Mart in large lots, but continually in small ones. Other manufacturer-retailer combinations, such as Levi Strauss and its customers, also use this approach, known as "continuous replenishment."

The use of the "case manager" is also a recurring characteristic of a reengineered process. This mechanism proves valuable when the steps of a process either are so complex or are dispersed in such a way that integrating them for a single person or even a small team is impossible. Acting as a buffer between the still complex process and the customer, the case manager behaves with the customer as if he or she was responsible for performing the entire process, even though that is really not the case.

To be able to answer the customer's questions and solve customer problems, the case manager needs access to all the information systems that the people actually performing the

process use and the ability to contact those people with questions and requests for further assistance when necessary.

B. BPR THROUGH INFORMATION TECHNOLOGY

A business which equates technology with automation cannot reengineer. To paraphrase what has been addressed time and time again in this thesis: merely throwing computers at an existing business problem does not cause it to be reengineered. In fact, the misuse of technology can block reengineering altogether by reinforcing old ways of thinking and old behavior patterns.

Applying information technology to business reengineering demands inductive thinking, an ability to first recognize a powerful solution and then seek the problems it might solve, problems the company may not even know it has. A fundamental error that most companies commit when they look at technology is to view it through the lens of their existing processes. They ask, "How can we use these new technological capabilities to enhance or streamline or improve what we are already doing?" Instead, one should be asking, "How can we use technology to allow us to do things that we are not already doing?" Reengineering, unlike automation, is about innovation. It is about exploiting the latest capabilities of technology to achieve entirely new goals. One of the hardest parts of reengineering lies in recogniz-

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ing the new, unfamiliar capabilities of technology instead of its familiar ones [Hammer and Champy, 1993].

Let us now discuss a few of these old familiar technologies and contrast them with today's technologies. The old familiar rule was that information could appear in only one place at a time. Then shared databases came along. Information can now appear simultaneously in as many places as it is needed. When information was captured on paper and the file folder, only one person at a time could work with the contained information. Consequently, work involving this information tended to be structured sequentially, with one individual completing one's task, then passing the information on to the next individual in line. Database technology changes this rule and allows more people to use the information simultaneously [Hammer and Champy, 1993].

Another old rule or assumption was that managers make all decisions. Within old traditional processes, workers were expected only to do the job, not to think or make decisions about the process. Then, managers did in fact have broader perspectives, based on having more information than did the typical employee. In today's market and in face of the tough competition, the costs of hierarchical decision-making are now too high to bear. Referring everything up the ladder means decisions get made too slowly for a fast-paced market. Today companies that remain competitive understand that frontline workers must be empowered to

make their own decisions, but empowerment cannot be achieved simply by giving people the authority to make decisions. Modern database technology allows information previously made available only to management, to be made widely accessible. Having decision making tools like this available to workers at the process level, allows decisions to be made more quickly and problems to be resolved as soon as they occur [Hammer and Champy, 1993].

One last old assumption that will be discussed is that plans get revised periodically. Today, high performance computing allows plans to be revised instantaneously. For example, a manufacturer gathers data on product sales, raw materials price and availability, labor supply, and so on and once a month produces a master production schedule. A computer supplied with real-time data from point-of-sale terminals, commodity markets, and perhaps even weather forecasts, among other information sources, could constantly adjust the schedule to match real-time, not historic, needs [Hammer and Champy, 1993].

Obviously, there are other examples of how technology can improve the way companies conduct their business processes, however it should be clear to the reader that further advances in technology will break more rules and old assumptions about these processes. To reiterate, the real power of technology is not that it can make the old processes work better, but that it enables organizations to break

old rules and create new ways of working, that is, to conduct BPR [Hammer and Champy, 1993].

C. BENCHMARKING

One additional tool available to redesign teams is "benchmarking." Essentially , benchmarking means looking for the companies that are doing something best and learning how one might do it in order to emulate these companies' processes [Camp, 1989].

The problem with benchmarking is it can restrict a redesign team's thinking to a framework of what is already being done in its company's own industry. By aspiring only to be as good as the best in its own industry, a team sets a cap on its own ambitions. Used this way, benchmarking is just a tool for catching up, not for jumping ahead of one's competition [Camp, 1989].

Benchmarking can, however, spark ideas in the team, especially if teams use as their benchmarks companies from outside their own industries. For example, the idea around which Hewlett-Packard reengineered its materials purchasing process came from a senior manager who joined the company from t.e automotive industry. He brought with him a completely different mindset, and a new purchasing model [Hammer and Champy, 1993].

If a team is going to benchmark, according to Hammer and Champy [1993], it should benchmark from the best in the

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world, not the best in its industry. If a team's company is in the consumer packaged goods business, the question is not who is the best product developer in packaged goods, but who is the best product developer, period. That is the company from which the redesign team might get great ideas.

Hammer and Champy [1993] state that there is still an inherent danger in using benchmarking to generate new ideas. What if it does not turn up a new idea? Is it possible that no one in another company has had a great idea yet that is applicable to a process that the team is seeking to reengineer? Just because that is the case, however, does not give a redesign team an excuse to be complacent. Rather, team members might consider it a challenge: A redesign team can create the new world-class benchmark.

This concludes the discussion on benchmarking. However for an excellent how-to on benchmarking, it is recommended that a functional manager read Camp [1989]. Further, append x G provides a list of corporations which are considered to be the best in specific business practices.

The author readily admits that the surface of the subject of reengineering has barely been scratched. However, this discussion will hopefully spark the interest of those functional managers who have had little if any exposure to the notion of process redesign vice incremental process improvement. For further reading and research in BPR, Hammer and Champy [1993] is highly recommended.

VII. CONCLUSION

A. ANSWERS TO RESEARCH QUESTIONS

Using IDEF0, the REAP team identified five activities to design what it called an "Improved Process." This thesis sought to identify, if possible, in some detail how a functional manager would proceed to design an improved process. In doing so, the validity of methods identified by the REAP team was assessed.

How the methods identified by the REAP team can be used by a functional manager has been outlined in some detail by the guidelines provided in chapters three through six. These guidelines provide the DoD functional manger with readily available guidance on two separate methodologies the author referred to as business process improvement and business process redesign (BPR). While guidelines cannot substitute for a manager's own research and study of either of these two methodologies, they do provide a checklist to ensure the groundwork has been laid for a suc essful redesign effort. Additionally, these guidelines represent a summarization of the most current information available on business process redesign.

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Numerous case studies, traditional management theories as well as emerging management theories, and organizational experiences were found to describe and validate the REAP team's PIP methods. However, despite this validation of individual mechanisms acting independently, it is still difficult to assess how well each method will perform as an integral sub-entity of the overall redesign effort. Much of the evaluation of the individual methods will still be left to the good judgement of each functional manager.

This author, even though a member of the REAP team himself found that the team did not differentiate the difference between what the author refers to business process improvement and business process redesign (BPR). It is the author's hope that this document will serve as a dual purpose reference in addressing both techniques depending on what the present goals are of the functional manager.

B. AREAS FOR FURTHER RESEARCH

While most individual methods have been validated by various scientific and academic institutions, the PIP has not been validated in its entirety within the DoD. Further study needs to be undertaken to assess the practicality of this redesign process within DoD.

Additional research is needed in determining how and to what extent BPR overlaps with popular quality improvement programs and techniques like Total Quality Management (TQM)

and continuous process improvement. Because there is on-going research of TQL on the campus of the Naval Postgraduate School (NPS), and since the REAP team is also located at NPS, it appears that NPS is strategically positioned for the pioneering research of these two topics within DoD. The elite academic faculty along with the vast number of management students seeking topics for Master theses would greatly facilitate this pursuit.

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

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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

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- 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.

Control

Input ⟶ Activity ⟶ Output

Mechanism
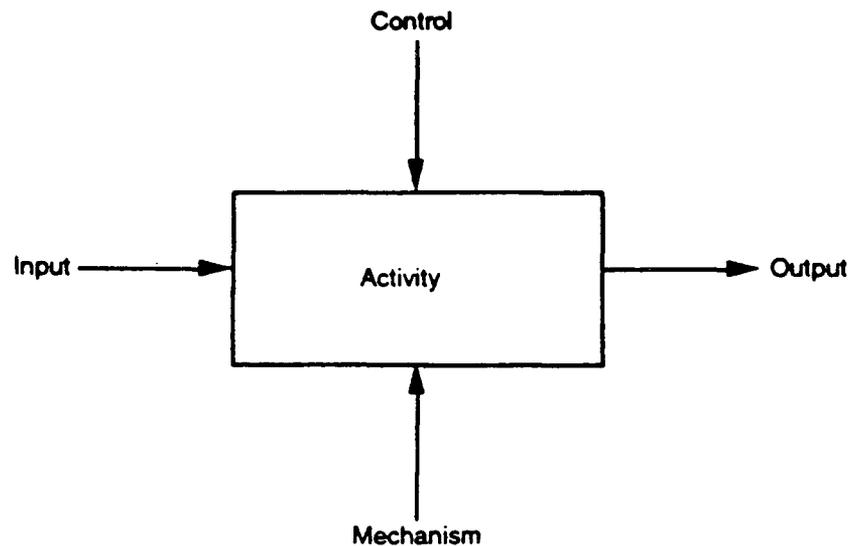
Figure 3. IDEF0 Graphical Syntax

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

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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

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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.

A0
Design
Electronic and
Electrical Products

A1
Perform
Electronic and
Electrical
Functional Design

A2
Perform
Design Analyses

A3
Perform
Electronic and
Electrical
Physical Design

A2.1
Validate
Functional
Design

A2.2
Generate
Physical
Design
Requirement

A2.3
Analyze
Physical
Design
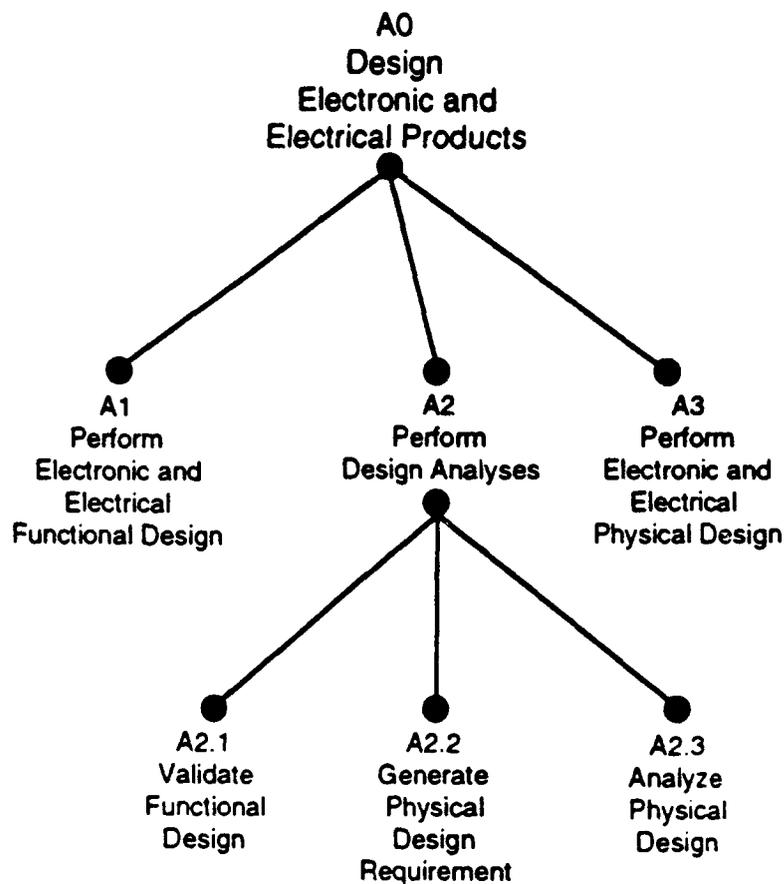
Figure 4: Activity Node Tree
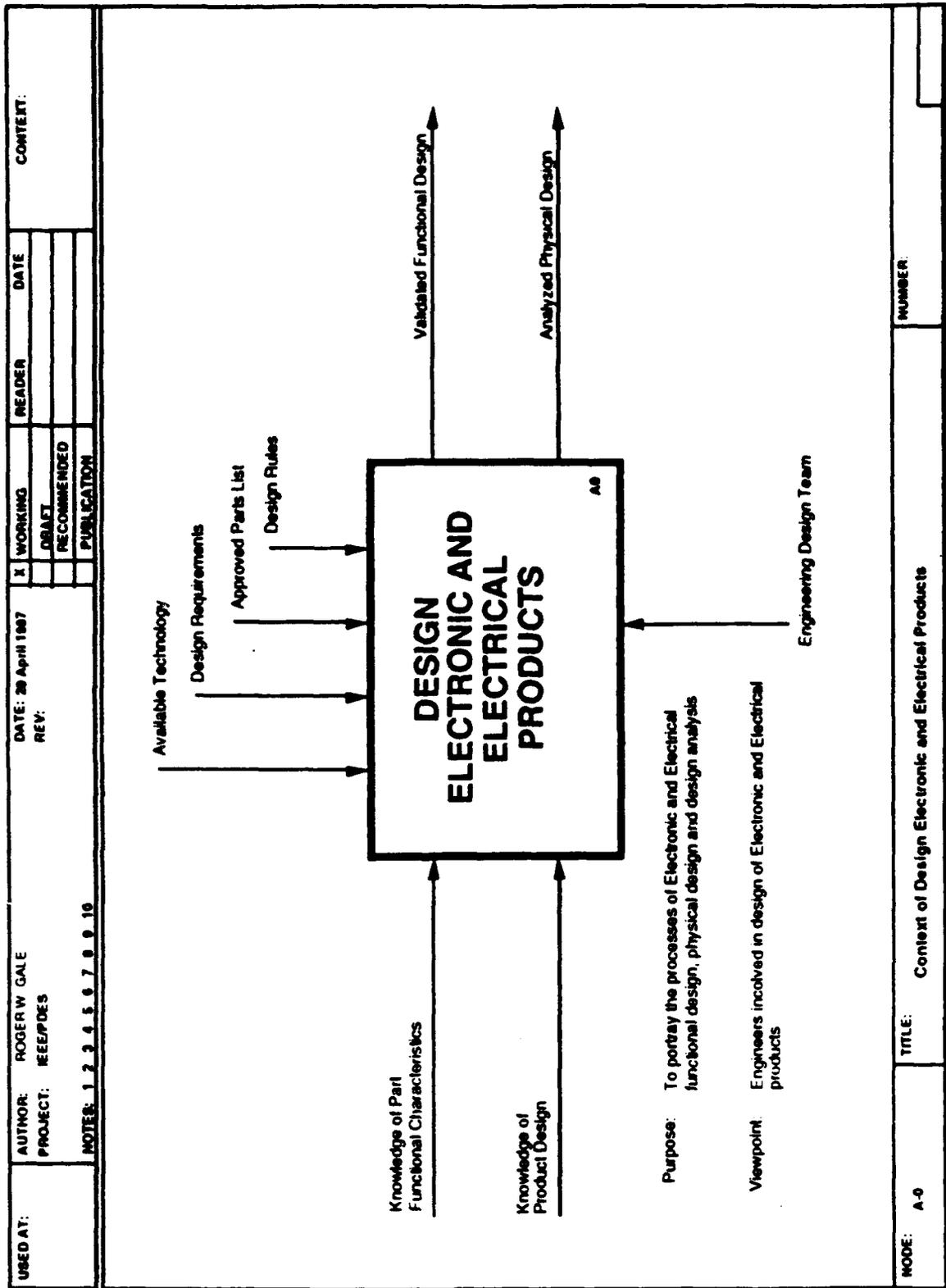
Figure 5: Context Diagram

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Figure 6: Decomposition Diagram

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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.

Experience of Implementing Change
Requirements to Redesign
DoD Policies
Availability of Resources
Organizational Environment
AS-IS Environment

Knowledge of AS-IS Environment

Experience of AS-IS Environment

Existing Organizational Structure

Environment for Discontinuous Thinking

Recommended Changes

Improved Processes

Organizational Commitment

Post-Implementation Audit Report

Marshall Resources — A1

Create an Environment for Discontinuous Thinking — A2

Design the Improved Process — A3

Implement Changes — A4

Identified Customers and Suppliers

Project Resources

Recommended Changes

Incentives

Experience
Resources
Knowledge of Discontinuous Thinking
Redesign Team Interrelationships
Knowledge of Customer & Supplier Needs
Knowledge of AS-IS Processes
AS-IS Processes
Resource Inventory
Consultants
REAP Database
Techniques and Methods

AS-IS Environment
Organizational Environment

Organizational Structure

Interpersonal Experience

Open, Supportive Environment

Environment for Discontinuous Thinking

Active Participation

Promote Involvement
A24

Creative Thinking

Enhance Creative Thinking
A23

Cross Functional Thinking

Expand Viewpoint Thru Cross Functional Thinking A22

Avoid Hostile, Threatening Environment
A21

Knowledge of Discontinuous Thinking

Conventional Thinking

Team Building and Communication Techniques

Cross Functional Techniques

Facilitators
Consultants

Incentives

Attendance

Project Resources

REAP Database
Techniques and Methods

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APPENDIX D: PRODUCTS AND VENDORS WHICH SUPPORT ELECTRONIC VOTING

1. **VisionQuest**

   Collaborative Technologies
   8920 Business Park Drive
   Suite 100
   Austin, TX 78759
   (512) 794-8858
   (512) 794-8861 (FAX)

2. **Group Matrix**

   Ventana
   1430 E. Fort Lowell Road
   Suite 100
   Tucson, AZ 85719
   (602) 325-8228
   (800) 325-1938
   (602) 325-8319

3. **OptionFinder**

   Option Technologies
   1275 Knollwood Lane
   Mendota Heights, MN 55118
   (612) 450-1700
   (612) 450-9413 (FAX)

4. **SmartChoice**

   SmartChoice Technologies
   614 River Road
   Hoboken, NJ 07030
   (201) 379-2306
   (201) 420-9568
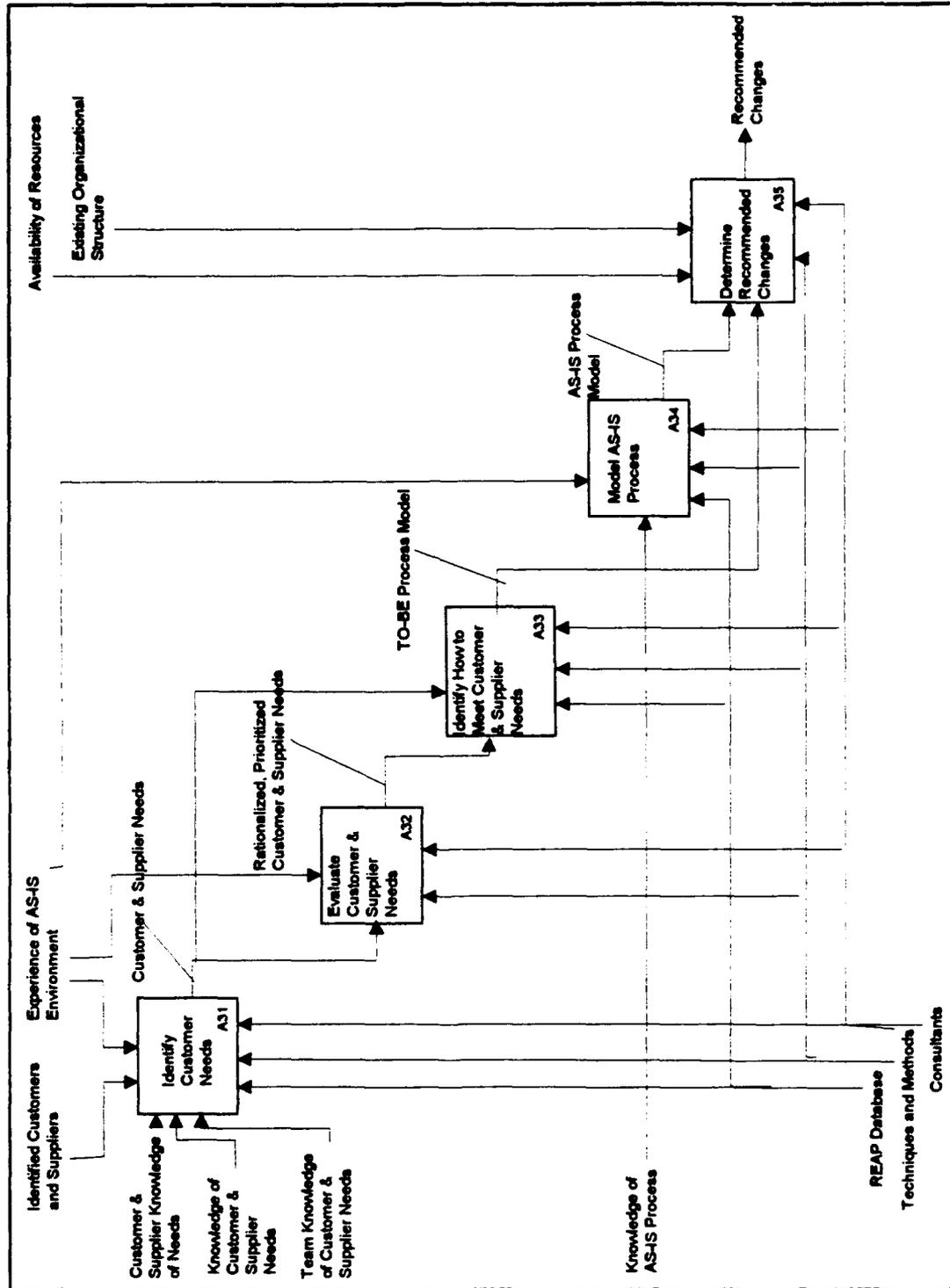
* Design/IDEF is an IDEF0 Supported Software
Created by Meta Software Corporation of Cambridge Massachusetts
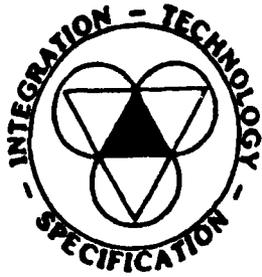
IDEF USERS GROUP

AN ASSOCIATION FOR ENTERPRISE SYSTEMS INTEGRATION METHODS

PRODUCT AND SERVICES GUIDE

(REVISED 9/92)

IDEF Users Group
1900 Founders Drive
Kettering, Ohio 45420
Phone: (513) 259-4702
Fax: (513) 259-4343

NAME/CONTACT/PHONE	D	V	C	T	I	IDEF0 INFO	IDEF1X FUNCTION	IDEF2 DYNAMIC	COMMENTS
Automation & Robotics Research Institute 7300 Jack Newell Blvd, S. Fort Worth, TX 76118 Contact: Dr. Don Liles Phone: (817) 794-5900	X		X	X		X	X	X	Currently using IDEF methodologies in classes as well as with several major industries. Can offer "tool independent" training in the IDEF methods, as well as project applications.
BDM International, Inc. Advanced Manufacturing and Data Systems Division 1801 Randolph Road, S.E. Albuquerque, NM 87106-4295 Contact: R. R. Preston Phone: (505) 848-5324 Fax: (505) 848-5741	X		X	X	X	X	X	X	BDM professional staff members provide a complete range of enterprise systems integration and design capabilities and turnkey systems. BDM professionals employ systems integration methods using automated tools purchased from various vendors. Each application is based on client requirements. BDM professionals have a broad base of experience using functional, information, dynamic and other complimentary modeling methods and techniques for advanced development of methods and systems. BDM also provides expertise for advanced development of methods and systems.
Booz-Allen & Hamilton, Inc. Operations Technology Group 2201 Buena Vista Drive S.E. Suite 300 Albuquerque, NM 87106-4265 Contact: Alan S. Nanco Phone: (505) 247-8722 Fax: (505) 242-4821			X	X	X	X	X	X	Booz-Allen & Hamilton, Inc., is a global management and engineering consulting firm committed to helping industry and government solve complex problems. Our services include: strategic planning, business re-engineering, detailed analysis, design, development and implementation. We offer "hands-on" experienced professionals with the skills and capabilities to use a wide range of methods, techniques and tools (including IDEF) for helping our clients address a broad range of projects and challenges.

D=Developer/Researcher   V=Tool Vendor   C=Consultant   T=Trainer/Educator   I=Integrators

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NAME/CONTACT/PHONE	D	V	C	T	I	IDEF0 INFO	IDEF1X FUNCTION	IDEF2 DYNAMIC	COMMENTS
Computer Devices Intl 2970 Presidential Drive Suite 100 Fairborn, OH 45430 Contact: Marie Apicella Phone: (513) 427-6324 Fax: (513) 427-6416			X	X	X	X	X		PC-IAST for MIAM Modeling COM*Plus 3 Schema heterogeneous database Management under IDEF1X Active dictionary control Full range of consulting, design and integration services Training in IDEF0, IDEF1X and Precise MIAM
Creative Management Processes P.O. Box 80014 Baton Rouge, LA 70898 Contact: C.M. Parks, Ph. Phone: (504) 388-5364			X	X	X	X	X	X	Teaching and consulting in the IDEF methods.
Dr. Thomas P. Cullinane, CMRE 7 Irving Road Weston, MA 02193 Phone: (617) 899-2739			X	X	X	X	X		Teaching and consulting in the IDEF methods.
D. Appleton Company, Inc. 222 Las Colinas Blvd. Suite 1141 Irving, TX 75039 Contact: Larry Patrick Phone: (214) 869-1066			X	X	X	X	X		Software: ModelPro (IDEF1X), Personal/Leverage and RCST/LEVERAGE (IDEF0 & IDEF1X) We are a Systems Integration Consulting company providing professional service and products to facilitate enterprise modeling, business integration and software development. We provide a full range of IDEF training and we have broad consulting experience in various industries. Our model authoring, analysis and management tools are available on a variety of platforms including PCs, Macintoshes, VAX/VMS and IBM Mainframes.

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NAME/CONTACT/PHONE	D	V	C	T	I	IDEF0 INFO	IDEF1X FUNCTION	IDEF2 DYNAMIC	COMMENTS
Downey & Small Associates, Inc. 10103 East Bexhill Drive Kensington, MD 20895 Contact: Elizabeth Downey Phone: (301) 946-5858 Fax: (301) 946-1101			x	x	x	x	x		IDEF ANALYSES, TRAINING, FACILITATION & CONSULTATION. Turnkey process improvement analyses. Also, full range of IDEF courses and workshops enable development of in-house modeling and project management capability, including sessions for executive sponsors and senior management. Facilitated workshops for interactive model development. Also, consultation support for project planning and start-up, and process modeling and improvement. Integration of client planning, operations, and support systems emphasized. IDEF EXPERIENCE: Dr. Small since 1976; Ms. Downey, 1980; the Company, 1981. Applications include strategic planning and automation requirements for the auto industry, manufacturing plant floor operations improvement, operations concepts for information management, and C3 battle operations framework for Strategic Defense.
Eclectic Solutions Corp. 5580 La Jolla Blvd. Suite 130 La Jolla, CA 92037-7692 Contact: Pat Duran Phone: (619) 696-7529 Fax: (619) 558-7928	x	x	x	x	x	x	x	x	Full IDEF0, IDEF1 and IDEF1X support through training, consulting & automated tools. Enterprise Engineering with specialty in Computer Integrated Manufacturing. Over 17 years experience with SADT/IDEF. IDEF0-COINS™ IDEF1X-COINS/1X™

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NAME/CONTACT/PHONE	D	V	C	T	I	IDEF0 INFO	IDEF1X FUNCTION	IDEF2 DYNAMIC	COMMENTS
Knowledge Based Systems, Inc. 2716 Longmire Drive College Station, TX 77845 Contact: David Rice, Lou Blinn Phone: (409) 696-7979 Fax: (409) 696-7277	X	X	X	X	X	X	X	X	AI™ Tools: AI0, AI1, AI1X - Automated IDEF-0, IDEF-1, and IDEF-1X Software all running under DOS. We are a full service IDEF supplier offering automated tools, consulting services, and training courses for new or experienced modelers. Our newest products are reconstructions of the original Air Force IDEF methodology manuals and two new tools: AI6 (Process Flow Description Capture) and AI4 (Object-Oriented Design) which currently run on a MacIvory Workstation.
Logic Works, Inc. 214 Carnegie Center Suite 112 Princeton, NJ 08540 Contact: Jeffrey Marshon Phone: (609) 243-0088 Fax: (609) 243-9192	X						X		The ERwin family of IDEF1X database design tools supports forward and reverse engineering for a variety of popular DBMS's, and the intuitive interface facilitates rapid development on Microsoft Windows, Apple Macintosh, and Sun/ Motif Workstations. winServer, a client server IRDS-compliant repository, is designed to support enterprise modeling efforts.
Meta Software Corporation 150 Cambridge Park Drive Cambridge, MA 021402 Contact: Andrew Levin Phone: (617) 576-6920 Fax: (617) 576-0519 Email:avi.metasoft@bbn.com	X	X	X			X	X		Design/IDEF delivers graphical support for Functional (IDEF0) modeling, Data/Information (IDEF1/1X) modeling and Behavioral (IDEF/CPM) modeling. Design/IDEF available in MS-Windows 3.0, Macintosh and Unix/X-Windows. IDEF models are data file compatible and transferrable across hardware platforms. Meta Software brings more than 25 years experience and research and development in the utilization of graphics for description, design and analysis of complex systems engineering problems.

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NAME/CONTACT/PHONE	D	V	C	T	I	IDEF0 INFO	IDEF1X FUNCTION	IDEF2 DYNAMIC	COMMENTS
New England Business Consultants 61 Elm Street Methuen, MA 01844 Contact: Richard Bevilacqua Phone: (508) 794-0375 Fax: (508) 685-3719		X	X	X	X	X	X		Trainers and consultants with 15 years SADT/IDEF experience. We offer applications in ERA, IDEF-0, IDEF-1, IDEF1X and SADT as part of an enterprise engineering approach to develop effective business systems and processes.
Triune Systems P.O. Box 24003 Huber Heights, OH 45424 Contact: Doug Bernard Phone: (513) 237-0762 Fax: (513) 237-0762	X						X		AutoSADT 1.7 Graphics based IDEF0 application for the Apple Macintosh. AutoSADT is fully integrated, supporting glossary text for all IDEF0 arrows and activity boxes, and narrative text for each node ($495). AutoSADT 1.7E An executive version of AutoSADT 1.7 that supports up to 10 nodes per model. Model renumber, export and merge functions of AutoSADT 1.7 are not included. AutoSADT for Windows. First quarter 1993.
Wisdom Systems, Inc. 1300 Iroquois Avenue Suite 140 Naperville, IL 60503 Contact: Dennis Wisnosky Phone: (708) 357-3000 Fax: (708) 357-3059	X	X	X	X	X	X	X	X	IDEFine™ tools and methodologies automate the IDEF modeling process and guarantee proper syntax and consistency. (IBM-AT). IDEFine-0 Creates and maintains IDEF0 models within and across projects within integrated diagrams and text. IDEFine-1x Supports all elements of IDEF1x model building. IDEFCost Performs a core function cost analysis IDEF-glossary Provides definitions of all terms in the model IDEFast is a timeline approach to identify bottlenecks IDEFqual Links to QFD within TQM programs Other products support systems development, IDEF training and hardware controllers (PLCs).

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NAME/CONTACT/PHONE	D	V	C	T	I	IDEF0 INFO	IDEF1X FUNCTION	IDEF2 DYNAMIC	COMMENTS
CACI International, Inc. 1100 North Globe Road Arlington, VA 22201 Contact: Joe Oabbecke Phone: (703) 841-4430 Fax: (703) 528-4196	x	x	x	x	x	x	x	x	CACI is an international information systems and high technology services company which can provide a complete solution to your business process re-engineering needs. CACI provides full IDEF support through training and consulting. The company supports the Corporate Information Management Business Process Improvement Program. Using CACI's SIMprocess provides an animated view of your process at work, dynamically assessing functional models for low outputs, identifying bottlenecks and inefficient use of resources, breaking out "product", resource, and activity costs, and substantiating your business case for resource allocation and process improvement. SIMprocess extends the IDEF methodology by capturing attributes in a model of your process. SIMprocess provides quick and easy formulation of WHAT IF Alternatives, and allowing the user to address technology insertion issues. SIMprocess provides a "fly before you buy" evaluation of a selected re-engineered process and organization.
SofTech, Inc. 460 Totten Pond Road Waltham, MA 02154-1960 Contact: Clarence Feldmann Phone: (617) 890-6900 Fax: (617) 890-6055	x	x	x	x	x	x			Training and consulting in IDEF0, with 20 years experience on over 60 large programs. Original developer of the IDEF0 method. Familiar with most IDEF tools and platforms. Systems developer and integrator capability, to follow through to full implementation and maintenance of systems.

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Topic	Firm
Accounts payable	Mazda
Activity accounting	Hewlett-Packard
Activity based costing	Hughes Aircraft Company
Activity based costing	Tektronix Corp.
Agile mfr/rapid cooperation	USAF/bunker bomb system
Agile mfr/rapid cooperation	USAF/bunker bomb system
Application processing	IBM Credit
Batch manufacturing	Kao Corp
Benchmarking	AT&T
Benchmarking	Digital Equipment
Benchmarking	Ford Motor
Benchmarking	IBM
Benchmarking	Motorola
Benchmarking	Texas Instruments
Benchmarking	Xerox
Billing and collection	American Express
Billing and collection	Fidelity Investments
Billing and collection	MCI
Claims processing	Social Security Admin
Computer integrated mfg	Rockwell International
Consumable item mgt	DLA, CIM support ctr
Consumable item mgt	Price Club
Creativity	DuPont
Creativity	Frito-Lay
Credit card operations	MBNA America
Cross-functionality	Chaparral Steel
Custodial services	ServiceMaster
Customer loyalty	Intuit
Customer loyalty	Sewell Village Cadillac
Customer sat, auto insurance	USAA
Customer sat, auto service	Mastercare
Customer sat, life insurance	Great West Life
Customer satis, office prod	Staples
Customer satisfaction	Federal Express
Customer satisfaction	GE Plastics
Customer satisfaction	L.L. Bean
Customer satisfaction	Xerox
Decentralized MIS	New York Life
Decentralized MIS	United Parcel

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Distribution and logistics	L.L. Bean
Distribution and logistics	Wal-mart
Electronic data interchange	DFAS
Electronic data interchange	DFAS
Employee empowerment	Corning
Employee empowerment	Dow Chemical
Employee empowerment	Milliken
Employee empowerment	Toledo Scale
Equipment maintenance	Disney
Factory automation	Matsushita
FDA drug approval processes	Syntex
Flexible manufacturing	Allen-Bradley
Flexible manufacturing	Baldor
Flexible manufacturing	Motorola
Flexible mfg	Toyo Engineering Corp.
Health care	Shouldice Hospital
In-line inspection	McDonnell Aircraft
In-sequence inspection	Boeing Aircraft
Just-in-time	Harley-Davidson Company
Knowledge-based equip design	General Electric
Logistics benchmarking	Westinghouse/Materials Acquisition Ctr
Mobilizing human resources	Citibank
Mobilizing human resources	Dayton Hudson
Mobilizing human resources	Fairfield Inn (Marriott)
Modular product design	Tandon Computer
New product introduction	Canon
New product introduction	Chinon
New product time-to-market	Hewlett-Packard
Nuclear waste licensing process	DOE Civ Radioactive Waste
Off-the-shelf components	Test Systems, Inc
Open information environment	Apple Computer
Open information environment	Dow Jones
Open information environment	KMPG Peat Marwick
Open information environment	Thinking Machines Corp.
Order fulfillment	L.L.Bean
Paperless design	Boeing
Participative management	CP Industries
Participative mgt	Monsanto Corp.
Pizza delivery	Domino's Pizza
Product development	Kodak
Product diversity	Groupe Bull
Production management system	Hino Motors
Quality assurance	Pratt-Whitney

Quality manufacturing	Cincinnati Milacron
Rapid design and production	Boeing Helicopter
Robotic mfg	Motorola
Strategic service vision	Southwest Airlines
Swift delivery	MicroWarehouse
Swift delivery	PC Connection
Team-based TQM	Ben & Jerry's ice Cream
Team-based TQM	New England Utilities
Team-based TQM	Random House
Team-based TQM	Wang Laboratories
Transaction costs	Wal-mart
Value strategy, job redesign	Taco Bell

Topic	Firm	Last name
Activity analysis	Coopers & Lybrand, Deloitte	Brimson
Activity analysis	Coopers & Lybrand, Deloitte	Spicer
Activity based budgeting	KMPG Management consulting	Morrow
Activity based cost system	KMPG Peat Marwick	Troxel
Activity based costing	Cost Technology, Inc.	Volpe
Activity based costing	Naval Postgraduate School	Euske
Activity based costing	Portland State University	Turney
Agile manufacturing	Lehigh University	Nagel
Auto industry competitiveness	Case Western Reserve University	Helper
Automated travel system	DFAS	Butrey
Automated travel system	Naval Reserve Force	Ledet
Benchmarking and comp analysis	Boston University	Miller
Benchmarking and comp analysis	INSEAD	DeMeyer
Benchmarking and comp analysis	JPICS	Rousch
Benchmarking and comp analysis	National University	Ta
Benchmarking and comp analysis	Technological University	Harriison
Benchmarking and comp analysis	Victoria University	Corbett
Benchmarking and comp analysis	Waseda University	Nakane
Benchmarking and comp analysis	Waseda Univesity	Kuroso
Benchmarking and comp analysis	Yonsei University	Kim
Breakthrough service	Perf Research Assoc	Zemke
Busn process design	Booz, Allen & Hamilton	Nanco
Busn process improvement	Naval IS Mgt Center	Chadwick
Busn process re-engineering	BTG, Inc.	Lantzy
Busn process re-engineering	BTG, Inc.	Moir
Busn process re-engineering	CACI	Hogan
Busn process re-engineering	CACI	Oebbecke
Busn process re-engineering	D. Appleton	Gardner
Busn process re-engineering	Oracle Federal	Pellicci
Busn process re-engineering	Price, Waterhouse	Hollander
Command & control	US Space Command	Soares
Customer satisfaction	British Airways	Ayling
Customer satisfaction	Citibank	Nemeroff
Customer satisfaction	Singapore Airlines Ltd	Singh
Data exchange	Westinghouse Corp.	
EDI	Harbinger EDI Services	Goetzman
Electronic data interchange	DLA	Bennet
Enterprise data dictionary	BDM International	Benson
Fund Admin Data Automated Sys	Navy Comptroller Office	Wyant

Furniture industry supply mgt	Applied Technology Ctr	Noble
IDEF and technology transfer	Systems Research & Applic	Beharah
IDEF and technology transfer	Systems Research & Applic	Chen
IDEF in activity based costing	Systems Research & Applic	McDonald
IDEF in CALS phase II	Bremer Associates, Inc.	Patrick
Implementing activ based costing	University of Amsterdam	Roozen
Integrating methods	Texas A&M University	Menzel
Integrating methods	USAF	Painter
ISO 9000	AT&T	Klock
Lean production	MIT	Roos
Logistics management	Air Force Institute of Technology	Shumacher
Logistics management	DOD-Logistics System Dev. Dir.	Smirnov
Logistics management	Federal Quality Institute	Manthos
Logistics management	John Upton	Upton
Logistics management	Logistics Management Insititute	Wightman
Logistics management	Naval Postgraduate School	McMasters
Manufacturing strategy	Air Products & Chemicals	Senn
Manufacturing strategy	AT&T	Seelig
Manufacturing strategy	Boeing Helicopter	Hilaman
Manufacturing strategy	Chrysler	Plonka
Manufacturing strategy	FMC Corp.	O-Brien
Manufacturing strategy	Lehigh University	Goldman
Manufacturing strategy	Motorola	Woods
Manufacturing strategy	Naval Indust Resources Sys Gp	Plonsky
Manufacturing strategy	Texas Instruments	Patterson
Manufacturing strategy	TRW	Ferrell
Manufacturing strategy	Westinghouse	Engwall
Manufacturing strategy	Westinghouse/Electronics Sys Gp	Wood
New product development	University of Chicago	Griffin
New product development	University of Chicago	Griffin
Process improvement IDEF	Downey & Small	Downey
Process improvement IDEF	Downey & Small	Small
Process modeling	New England Busn Consult	Bevilacqua
Process modeling	New England Busn Consult	Thornhill
Quality customer initiatives	DLA/Directorate of Contracting	Ray
Quality customer initiatives	DLA/PROCAS	Brunk
Quality function deployment	Westinghouse/Electronic Sys Gp	Kramer
Quality manufacturing	Seifried Assoc	Seifried
Records management	Abby Olson	Olson
Strategic sourcing	Michigan State University	Monczka
Strategic supply management	Motorola	Bhote
Strategic supply mgt	Applied Digital Data Systems	Ryan
Strategic supply mgt	University of San Diego	Doyle

Strategy deployment	Manchester Business School	Berry
Supplier evaluation	Hughes Aircraft	Austin
Supplier evaluation	Hughes Aircraft	Austin
Supplier evaluation	Intel	Whittier
Supplier evaluation	Purch Solutions/Rockwell Intl	Hollingsworth
Supplier relationships	University of Indiana	Hall
Supply chain benchmarking	UVA Darden Busn School	Kamauff
Supply chain logistics	Ernst & Young	Tyndall
Supply chain mgt	Honeywell	McLaughlin
Systematic teamwork	Mgt Dev Associates	Coleman
Systematic teamwork	Mgt Dev Associates	Kepner
Target costing	University of Edinburgh	Mitchell
Target costing	Univesity of Dundee	Innes
Time-to-market	Thomas Group, Inc.	Thomas
Vendor integration	Lehigh University	Preiss
Warehouse control system	Northeastern University	Cullinane

Topic	Firm	Last name
Customer-driven perf measures	Schonberger, Inc.	Schonberger
Integrated performance measurement	Boston University	Nanni
Perf measurement for world class mfg	Unitronix Corp	Maskell
Performance measurement	Aeritalia SpA	Marenco
Performance measurement	British Aerospace	Flicker
Performance measurement	Cambridge University	Gregory
Performance measurement	Coopers & Lybrand, Deloitte	Spicer
Performance measurement	Cost Management Strategies	Soloway
Performance measurement	Ernst & Young	Christensen
Performance measurement	Ernst & Young	Hill
Performance measurement	Eurosept Associes	Deglaire
Performance measurement	Groupe HEC	Lebas
Performance measurement	Grumman Aerospace	Rennie
Performance measurement	Harris Corporation	Saathoff
Performance measurement	IBM Eurocoordination	Greenwood
Performance measurement	KPMG Peat Marwick	James
Performance measurement	KPMG Peat Marwick McLintock	Hazell
Performance measurement	Lucas Engineering	Crawford
Performance measurement	McDonnell Douglas	Thomas
Performance measurement	Philips International	Moeliker
Performance measurement	Proctor & Gamble	Meyer
Performance measurement	Proctor & Gamble GMbH	Klopsch
Performance measurement	SESA	Garcia-Cabanas
Performance measurement	Siemens AG	Kruske
Performance measurement	T&N plc	Tudor
Performance measurement	Texas Instruments	Parikh
Performance measurement	Texas Instruments Deutschland	Baumer
Process perf. measurement	LTV Aircraft	Reid
Process perf. measurement	LTV Aircraft	Ehresman

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