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# Reengineering Through Information Engineering: Experience from the Division of Narcotics Enforcement Case

SANG C. PARK  
RAHUL BHASKAR  
UNIVERSITY OF WISCONSIN

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## ABSTRACT

Drug enforcement agencies like many other government agencies are faced with an environment in which they cannot change or modify processes easily using ordinary information technology. In order to carry out business process reengineering to improve their processes efficiently and effectively, we propose a systems development methodology called Information Engineering (IE). In this paper, specifically, we show how these techniques can be used to reengineer business processes in a drug and narcotics enforcement organization.

We have shown that Information Engineering (IE) provides an effective tool to reengineer the existing processes in the Division of Narcotics Enforcement. Our application of IE to the Wisconsin Drug Enforcement Agency is proven to be very effective. Through this experience, IE proves itself a suitable reengineering methodology in organizations which encounter reluctance to the changes internally and tough recourse constraints externally.

## INTRODUCTION

In this age of higher expectations and tight budgets, many organizations find themselves struggling to improve performance and adapt to changing needs. At the same time methods of rationalization and automation are not yielding the improvements that companies need (Hammer 1990). This phenomenon is prevalent in most organizations which have attempted to improve business processes using automation.

It has been proven that Information Technology (IT) and business process redesigning are natural partners for improving processes. Davenport and Short (1990) suggest that the companies that have used Information Technology to redesign business processes have found enormous successes. This suggests a deeper exploration into information technology itself, especially systems development methodologies, and applying it to business process reengineering in an organization that includes public safety institutions, especially law and drug enforcement agencies.

In order to carry out business process reengineering, we propose a systems development methodology called Information Engineering (IE). IE is a set of techniques which can be successfully applied to the planning, analysis, design and construction of an information system (Martin 1990). In this paper, we show how these techniques can also be used to reengineer business processes in a drug and narcotics en-

forcement organization.

In the case of drug enforcement agencies as well as other public safety sector agencies at the federal, state or local level, conditions are not helpful for applying information technology to improve business processes. We discuss this in the section dealing with impeding factors. The subsequent sections describe information engineering as a methodology for reengineering, and how information engineering can be used to reengineer at a narcotics enforcement agency.

## LITERATURE SURVEY ON REENGINEERING

The importance of business process redesigning has been stressed in the seminal work of Hammer and Champy (1993). They attempt to demonstrate how existing corporations can reinvent themselves. They propose a technique called "reengineering" to accomplish this. In their observation of corporations, they arrived at the conclusion that some companies are doing substantially better than others by changing their business processes. They found that these companies did not need to change the business they are in but how they did that business.

In their work, Davenport and Short (1990) discuss many of the issues relating to performing business process reengineering. They discuss and provide examples for five major steps:

1. develop business vision and process objectives,
2. identify processes to be redesigned,
3. understand and measure existing processes,
4. identify information technology levers, and
5. design and build a prototype of each process.

Using the concepts of information technology to redesign a business process has helped many companies. Ford Motor Company has combined these processes to reduce by 75 percent the number of people needed to support its account payable process (Hammer 1990).

Combining Information Engineering with CASE tools and joint application development techniques is becoming an accepted way of improving the use of information by redesigning business processes. Recently in their work, Andrew and Leventhal (1993) have proposed a methodology they call "Fusion" in which they explain using the concepts of CASE tools, Information Engineering and Joint Application Development as a method of managing information better. These methods, when used together, can help an organization redesign and improve its processes.

### REENGINEERING AND DEPARTMENT OF NARCOTICS ENFORCEMENT (DNE)

The nature of work at a drug enforcement agency results in a very typical environment. In the following sections we discuss some of the factors which impede the introduction of information technology to the DNE. This in turn will inevitably necessitate reengineering using Information Technology. We focus on how information engineering can be used to overcome these negative impeding factors.

#### Impeding Factors

In our working relationship with drug enforcement agencies, we find that they are faced with an environment in which they cannot change or modify their processes easily using ordinary information technology. The impeding factors which inhibit their processes can be broadly categorized as follows.

##### External:

1. The most influential external factor is that drug enforcement agencies are dependent on external agencies to fund their projects. This reliance compels drug enforcement to be dependent on the contemporary political beliefs of donor agencies;

2. In addition to political beliefs, drug enforcement is influenced by public perception of drug enforcement which is not very clear. People in general perceive drug enforcement as a small part of a complex law enforcement system;

3. Additionally, the work environment of drug enforcement agencies is in constant flux. Increased violence on the streets has caused many changes in the work environment of drug agents. Many times they are "outgunned" on the

streets which effectively distracts them from issues such as technology; and

4. To make things more difficult, drug enforcement agencies are set up on civilian principles and work during regular office hours against an enemy that is working round the clock against them. Particularly in the area of "intelligence gathering" the time a drug investigator spends is minimal compared to the actual time required.

##### Internal:

1. There are various internal factors which are responsible for impeding reengineering in a drug enforcement department. The most important of these is poor or no training at all in the use of information technology. Law enforcement traditionally has been the last to automate. In a survey conducted by University of Wisconsin - Madison of all the law enforcement agencies in the state, less than 5% of the personnel claimed any kind of proficiency in computers (Gupta, and Bhaskar 1993);

2. Even if the personnel are trained in information technology, the equipment available to them is antiquated. Some agencies have equipment that does not fit their requirements. The reason for this phenomenon is a cost-driven strategy and overall resistance to automation by employees. In order to save money less than optimum equipment is bought for users who are resistant to any kind of computerization;

3. Additionally, either there is no champion of the technology in the division or employees work in a vacuum without any moral or material support from superiors. Demands are very stringent on managers who are too busy fulfilling their daily obligations to plan for the introduction of new technologies;

4. In a drug enforcement agency, end users are traditionally very resistant to the concept of adapting new ideas. The reason is mainly lack of time they can devote to learning.

5. Other major problems of these agencies are burnout effect and meager salaries paid to agents. These result in a high turnover. The capability of a department to retain its personnel is jeopardized seriously due to these reasons; and

6. Another characteristic which inhibits adaptation to new technologies in drug enforcement is that worker belief in the status quo is very strong. The hierarchical nature of the organization reinforces this belief.

Information Engineering can be implemented very effectively in DNE and can help overcome these impeding factors. We describe the principle behind Information Engineering and how it can be applied to reengineering processes at a DNE in the following section.

#### Characteristics of Information Engineering

**Information Engineering: A Suitable Reengineering Approach for DNE.** Information Engineering is more suitable

for reengineering processes of DNE and in taking care of the impeding factors mentioned above in three ways:

1. First, it is a top-down approach that fits in with the hierarchical nature of a typical drug enforcement agency. It creates an automatic champion in the organization;

2. Secondly, the involvement of end users is encouraged by the nature of the IE process (Martin 1990). Moreover, it requires less proficiency on computers. Correspondingly, IE helps to persuade reluctant end users by involving them. In the traditional systems development approach, users are innocent by-standers who passively receive information that systems analysts provide whereas IE/JAD (Joint Application Development) requires intensive involvement of users. Overall increase in the morale of personnel as a result of a better working environment will slow down the turnover rate in a department. This will also increase the productivity of personnel who stay in a department;

3. Lastly, Information Engineering is responsible for getting the right information at the right place at the right time in the whole organization. This is possible because information engineering develops a knowledge repository about the enterprise and its data, processes and system model. This encourages enterprise-wide cooperation among separately built systems.

Most IE characteristics help to mitigate internal impeding factors. Nonetheless, many external impeding factors can be diluted by following this approach. IE helps to educate external donor agencies of work being done in a department and how the new processes will help improve the organization. It is thus easier to convince legislators of the needs of drug enforcement divisions. Improving the performance of an agency will also help to give it a distinct character and recognition. In addition, the saved processing time can be devoted to actual investigation.

**Various Paths in Information Engineering.** Information Engineering provides various paths in developing systems: forward engineering, reverse engineering, reengineering, and maintenance. Among these, the reengineering process is the dominant premise.

1. Forward engineering is the general movement from the top to the bottom of the entire systems development life cycle, and begins with a definition of broad business concepts. As projects progress through the systems development life cycle, these concepts are refined to successively greater levels of detail until they are ultimately transformed into an application system.

2. Reverse Engineering is the general movement from the bottom to the top of the cycle. From the already implemented system, design, analysis, or design recovery (in an Information Engineering coherent form) is performed. Typical reverse engineering includes developing a data model

directly from the definitions block of the COBOL code. This technique ensures that a depository of the existing procedures is created in the form of an encyclopedia in addition to normalizing the existing data models. Reverse engineering old applications to conform to IE data models and process models can also be undertaken. This will ensure that the existing system is utilized most efficiently in order to be replaced by a reengineered system. This approach will help calm the status quo beliefs of employees in a drug enforcement agency.

3. In order to reengineer an existing system it might have to be reverse engineered first, then forward engineered.

4. Maintenance or modification is a pathway in which developers enter at appropriate steps in the cycle, make changes, then push those changes through to execution.

Although our primary concern is reengineering, we can combine various paths of information engineering to mitigate the impact, to alleviate the problem of impeding factors in the department and to adapt effectively to a radically changing environment. Starting with maintenance first, then reverse engineering followed by forward engineering provides a graceful migration from the "legacy" system to the new reengineered system.

#### APPLICATION OF INFORMATION ENGINEERING TO THE DIVISION OF NARCOTICS ENFORCEMENT

As described above, Information Engineering has many facets which help in reengineering and implementation of a new system. In the following section we describe how these methods are being implemented at the Wisconsin Division of Narcotics Enforcement (DNE).

We take the example of monthly reporting, one of the processes which needs improvement. In addition to this, DNE is taking various steps to improve its fundamental functions and realign them with its business goals. A monthly report is generated from data collected from 36 agents across Wisconsin. This report is used to analyze the performance of the department and to communicate trends of the department to upper management. Monthly reports have a secondary role of communicating the performance of each regional office. A typical creation of a monthly report will go through the following steps:

Each agent fills out a report and mails it to the central division where data from these reports are entered in a database. From this database, statisticians generate a raw form of the monthly report which is checked by supervisors. Supervisors include a senior analyst who checks the format and integrity of the data elements' values, a director who checks the consistency and accuracy of each data element in the report, and an administrator who checks the overall look of

the report. Notes are prepared for any corrections and are forwarded to a secretary who types up the final monthly report which is then sent to senior management.

Immediately, reverse engineering takes place. The code is rewritten and an encyclopedia is created. The code may not need much change to be automated to a level where the supervisor can run it. At the same time the information obtained from the program is improved to fit with the overall IE model of the organization. Figure 1 summarizes the hierarchy of processes for creating a monthly report. The dependencies of these processes are shown in Figures 2 and 3.

After reverse engineering, the next step is to analyze potential problems that current processes in DNE have. Additional analysis can be undertaken using a CRUD matrix and inefficient processes can be reengineered. Since the CRUD matrix shows the interaction between processes and data elements (entities), it can be used to locate potential

problem areas. Figures 4 through 7 illustrate four typical such areas.

Figure 4 indicates a potential error in updating information. The same piece of information on cocaine that was confiscated is rewritten or updated three times by the data entry clerk, the supervisors, and the secretary. It is also true that these processes are done redundantly. Steps are underway to identify redundant processes such as "typing in agent reports" by the data entry clerk and "typing up final monthly reports" by the secretary. In the reengineered system, agents are able to directly input their reports into the computer, and the monthly report is generated directly to senior management by a user-friendly Executive Information System (refer to Figure 9).

Figure 5 indicates a potential security and control problem, which is very common in numerous organizations. The raw form of the monthly report is passed from person to

**Figure 1**  
**Process Hierarchy for DNE (after Reverse Engineering)**

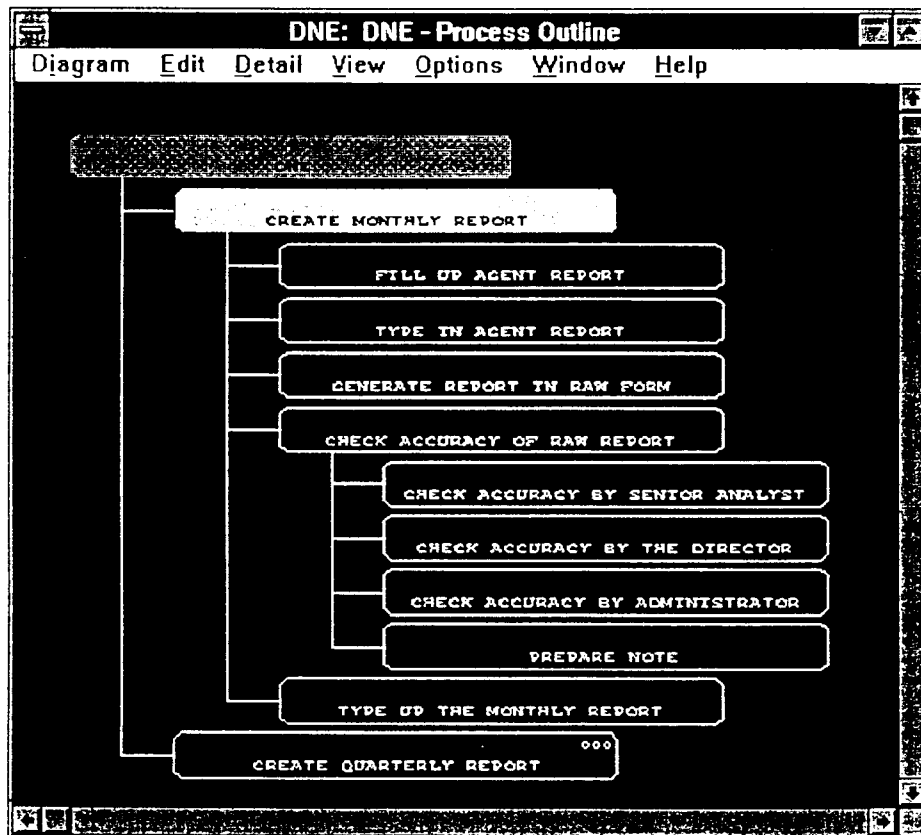


Figure 2  
 Process Dependency for Create\_Monthly\_Report (after Reverse Engineering)

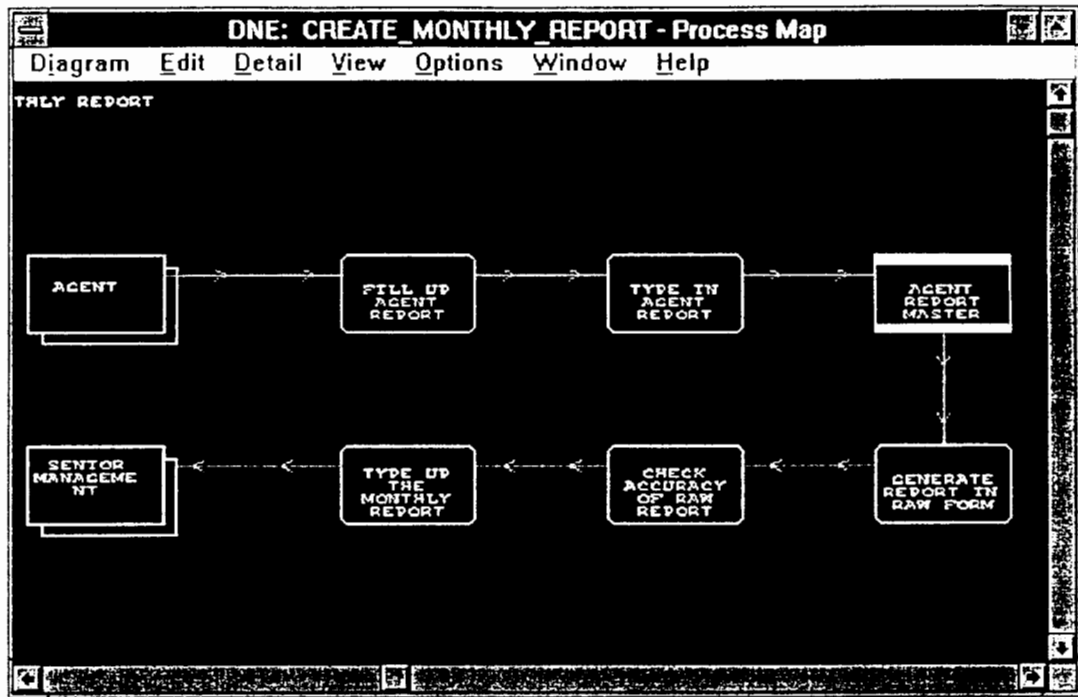


Figure 2  
 Process Dependency for Create\_Monthly\_Report (after Reverse Engineering)

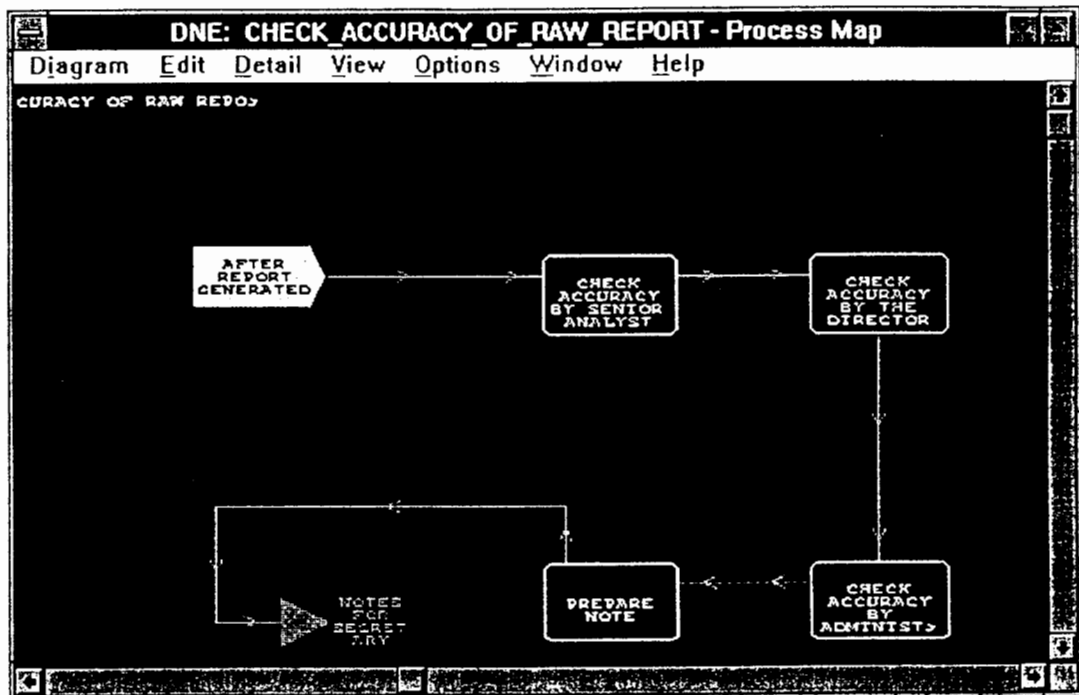


Figure 4

Potential Error in Updating Information

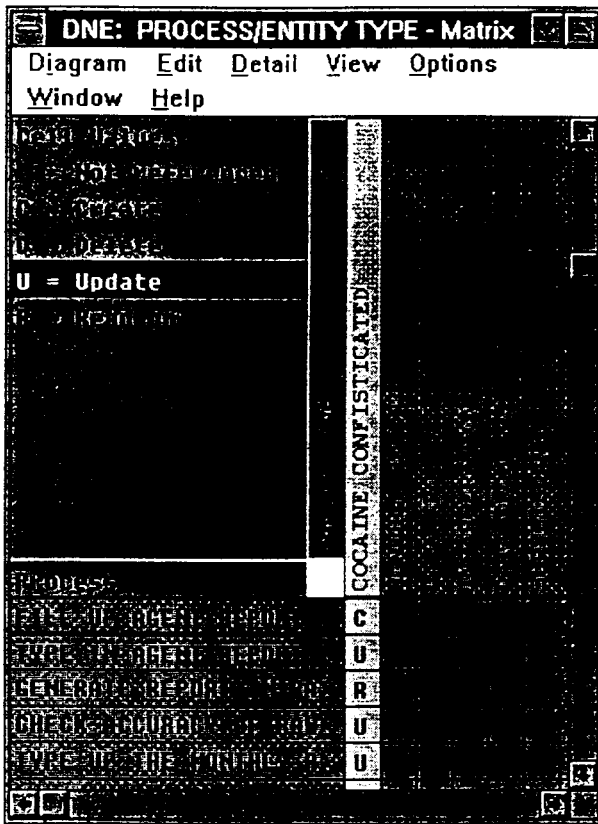
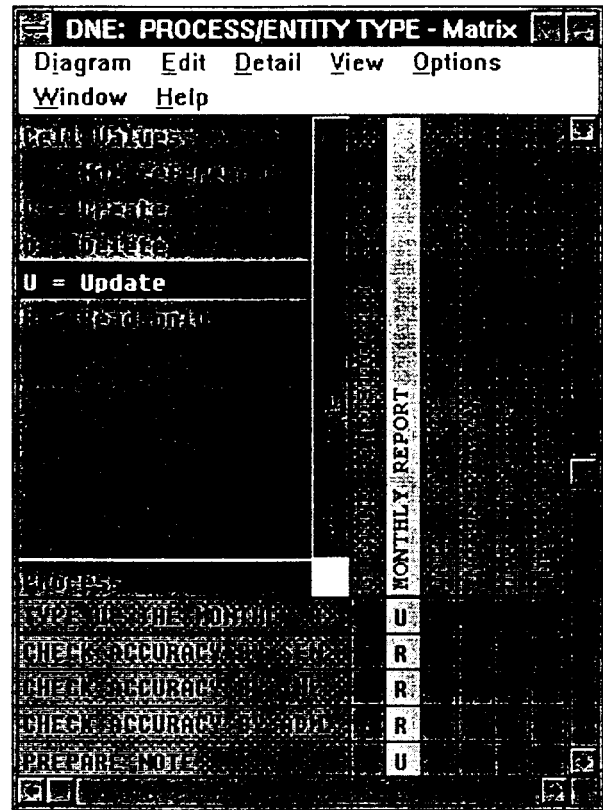


Figure 5

Potential Security and Control Problem



person for accuracy checks before being submitted to senior management who are the ultimate users of the information. This was deemed to create potential security and control problems. Each person involved in accuracy checking focuses only on one part of the report not on all of the information. Nonetheless all of the sensitive information is being passed from one person to the other. Data of a sensitive nature should be handled by the least number of people and there should be a supervisory control of the integrity of the data as it passes from one person to another. Mistakes can creep in while the data is being handled. In the reengineered system, syntactic checking by the senior analyst is accomplished by an intelligent document checking subsystem. This system also provides a wide variety of form templates so that the administrator can choose whatever form he/she wishes to see. The major accuracy checking is done by the director interactively with the computer database. Figure 9 summarizes this change.

As shown in Figure 6, the processes of creating a monthly report and a quarterly report entail essentially the same sub processes but were being done as two distinct activities. In

the reengineered system, generating different types of reports is performed with a minimum effort. Senior management can simply adjust the report time period, and the system can generate corresponding reports (not only the regular reports but also adhoc interim reports).

As indicated in Figure 7, some data elements are not created inside the DNE (i.e. data from Internal Revenue Services, and from the Division of Criminal Investigation), but imported from outside databases. This has a potential interface problem. There may be a possible delay in getting information while converting to a heterogeneous data format. In the proposed system, this interface is smoothly handled without conversion. A fourth generation language called FOCUS which can handle different types of existing database formats is used to develop a homogeneous environment for generating reports and maintaining databases.

In summary, several processes are reengineered to make the whole process efficient and effective. The monthly report generating process itself was changed to eliminate some activity of the data entry clerk, the statistician, the secretary and the job of typing in the information, running the code

**Figure 6**  
Processes Dealing with Identical Data Elements

Entity Type	COCAINE CONFISCATED	MONTHLY REPORT	DATA FROM DCI	INTEGRATION	DATA FROM IRS	SURVEILLANCE
Process						
CREATE MONTHLY REPORT	C	C	C	C	C	C
CREATE QUARTERLY REPO	C	C	C	C	C	C

and generating a report. Senior management can have different types of reports at any time without delay. Each report contains accurate pieces of information at any given moment. In addition, information is compressed and organized so that senior management can benefit from all the features of the Executive Information System including “drill-down” which nails down report items from the abstract to the detailed, and “management by deviation” which pinpoints any problematic activities and locations. The changed process hierarchy and process dependency diagrams are shown in Figure 8 and 9.

Information about white collar crime is currently being collected by an external entity. This type of crime has a direct influence on the working of the Division of Narcotics Enforcement. The politics of the workplace cry for a change to bring this process under the aegis of the DNE. To accomplish the above-mentioned goals in addition to other system goals of the DNE, business analysis was undertaken with IBM. Sessions were set up for three consecutive days and overall business aims of the DNE were created. The mission of the drug enforcement agency was identified. In order to achieve this mission and fulfill these business aims it was decided that there is a need to reengineer the processes of the department. Redundancy, inefficiency and incompetency were identified as some of the main problems to tackle. In addition a drug enforcement database was proposed in which all records would be kept. Since drugs involve an interplay of money and crime, it was deemed necessary to develop a system of drug enforcement that can eventually be expanded to include white collar crimes and intelligence-gathering activities.

**Figure 7**  
External Data Source and Interface Problem

Entity Type	COCAINE CONFISCATED	MONTHLY REPORT	DATA FROM DCI	INTEGRATION	DATA FROM IRS	SURVEILLANCE
Process						
CREATE MONTHLY REPORT	C	C	C	C	R	C
CREATE QUARTERLY REPO	C	C	C	C	C	C

**CONCLUSIONS**

We have shown that Information Engineering (IE) provides an effective tool for reengineering existing processes in the DNE. Our application of IE to the Wisconsin Drug Enforcement Agency has proven to be very effective.

The immediate result was an improvement of the processes which were well understood and documented. Inefficient processes were identified and reengineered within a short time period. As a by-product, this led to increased participation by the end users and their commitment to the projects being undertaken to improve these processes. Many personnel who were reluctant to come on board and thought that changes were threatening to them are now partners in the progress of the DNE. This has resulted in improved morale of workers at the same time.

Through this experience, IE has proven itself a suitable reengineering methodology in organizations which encounter reluctance to changes internally and tough recourse constraints externally. In fact, Information Engineering tools give a very concrete method of implementing reengineering methods. End users and systems developers are increasingly

Figure 8  
Reengineered Process Hierarchy for DNE (after Forward Engineering)

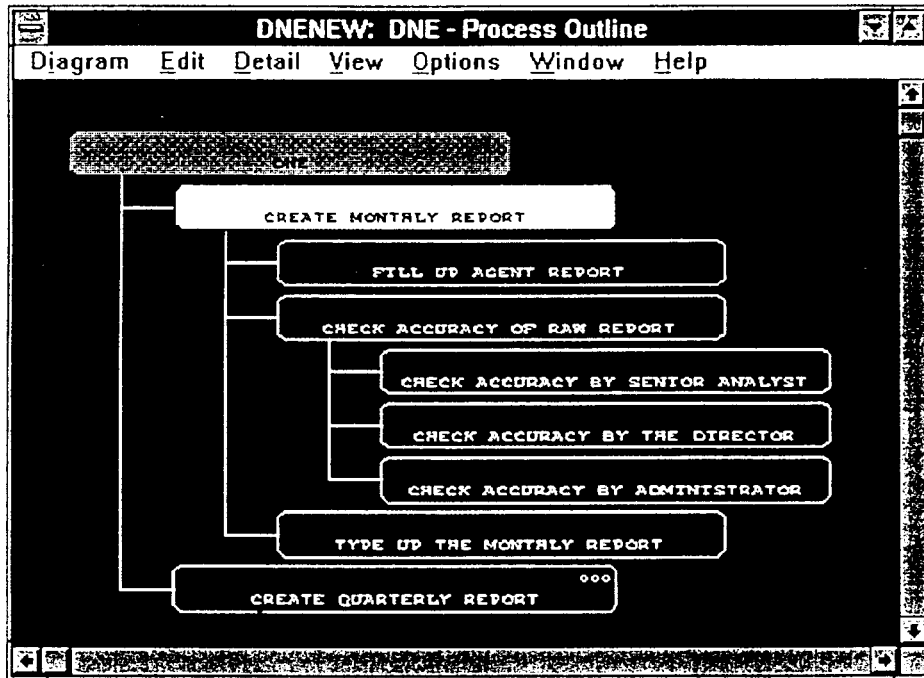
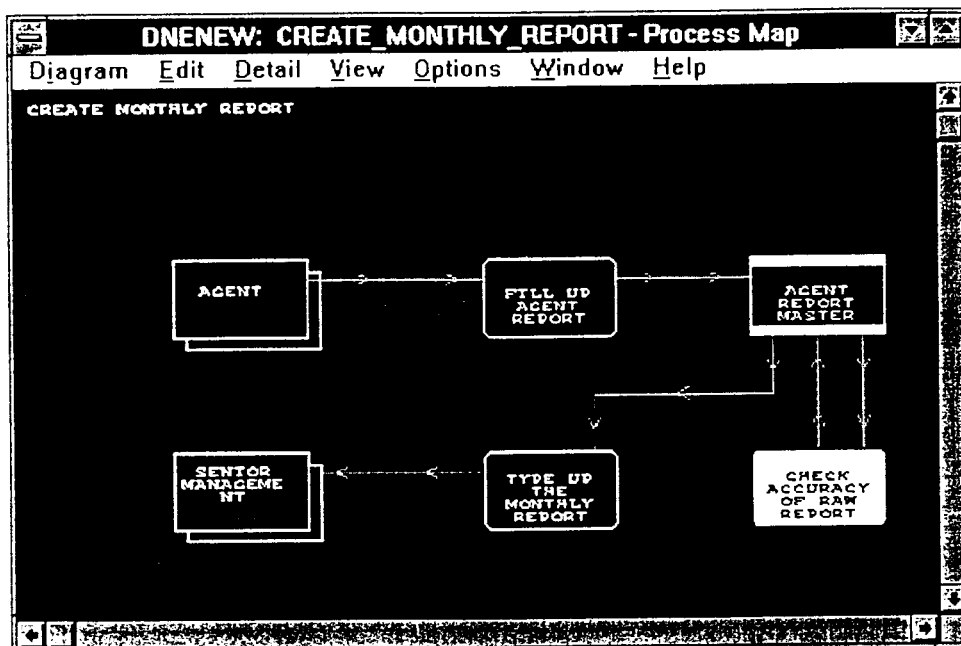


Figure 9  
Reengineered Process Dependency for Create\_Monthly\_Report (after Forward Engineering)





turning to IE tools such as IEF and KnowledgeWare for systems development. Using these tools as suggested in this paper, end users can get involved in direct management of an organization and influence the way a company is run in the future.

The simple and straight forward nature of this methodology allows us to use these tools and methods in any organization of any size without major changes. Visualization of the processes is crystal clear and enables management to make decisions based on the best use of available resources. Additionally, it encourages workers to get involved in the decision making process.

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### ABOUT THE AUTHORS

**Sang Chan Park** received the M.B.A. degree from the University of Minnesota, Minneapolis, and the Ph.D. degree in MIS from the University of Illinois, Urbana-Champaign. He is now an Assistant Professor of Operations/Information Management, School of Business at the University of Wisconsin, Madison. His research interest includes applying Information Technology (IT) for reengineering existing systems and applying Artificial Intelligence (AI) theory to the design of knowledge-based systems for various management principles. He has published several articles in *Decision Support Systems*, *IEEE Transaction on Systems, Man, and Cybernetics*, and *IIE Transaction*, as well as in several books.

**Rahul Bhaskar** is a Ph.D. candidate in Management Information Systems, School of Business at the University of Wisconsin, Madison. He holds M.S. in Operation Research, M.S. in MIS and an MBA from the University of Wisconsin, Madison. He has worked on board British commonwealth merchant navy ships as a second mate. He has been working with Wisconsin Department of Justice for the last two years as a technology consultant and system operator for their Bulletin Board System. His research interests include the Knowledge Based Decision Support Systems, Machine Learning, Reengineering, Outsourcing, Mathematical and Statistical Modelling.