Management of Reengineering Knowledge: AI-based Approaches

Daniel E. O'Leary*
University of Southern California, USA

ABSTRACT **Knowledge about 'best practices' for reengineering can be critical to a firm's ability to evolve and respond to competition. As a result, this paper addresses the issue of how to manage reengineering knowledge. Multiple forms of knowledge representation are adapted to address two primary issues: When and what should a firm reengineer? Four different knowledge-based models and prototypes are developed to illustrate capture of particular types of reengineering knowledge. The prototypes are used to draw inferences about issues in knowledge management and to illustrate feasibility. Distribution of best practices reengineering knowledge can then be accomplished using knowledge servers or making software and knowledge bases available to download off the world wide web. Copyright © 2000 John Wiley & Sons, Ltd.**

INTRODUCTION

This paper addresses management of best practices reengineering knowledge designed to solve two primary issues: When and what should a firm reengineer? Knowledge-based models are generated using rule-based, uncertainty-based and case-based knowledge. The distribution of the knowledge contained in those AI-based models is accomplished through knowledge servers and other world wide web-based approaches.

Reengineering

Reengineering has been defined (Hammer, 1990, p. 104) as using '... the power of modern information technology to radically redesign our business processes in order to achieve dramatic improvements in their performance'. He argues that reengineering should obliterate existing processes and start over to reinvent processes.

In order to accomplish this obliteration, Hammer (1990) elicited seven 'principles of reengineering' that are to be applied to systems in order to reengineer them:

- Organize around outcomes, not tasks
- Have those who use the output perform the process
- Subsume information processing work into the real work that produces the information
- Treat geographically dispersed resources as though they were centralized
- Link parallel activities instead of integrating their results
- Put the decision point where the work is performed
- Capture information once and at the source

These are the core general concepts (or 'first

* Correspondence to: Daniel E. O'Leary, University of Southern California, 3660 Trousdale Parkway, Los Angeles, CA 90089-1421, USA
E-mail: oleary@rcf.usc.edu

principles') for reengineering a business process. Similar first principles have been developed by other pioneers, such as Davenport and are summarized in Davenport and Short (1990), Davenport (1993) and Hammer and Champy (1993).

This approach of redesigning systems has had a substantial impact on the use of AI and knowledge-based systems in reengineering. Most research using AI has concentrated on redesign through obliterating a process and using the design principles in order to develop a better approach (e.g., O'Leary and Selfridge, 1999). As a result, AI and knowledge-based approaches typically capture a domain independent representation of a process as a flow network and use a number of operators, based on different principles of reengineering, to change that process to make it, e.g., more efficient, by reducing the number of handoffs, or some other criteria.

The focus of reengineering based on design principles (the 'obliteration approach') suggests that previous domain-specific or process-specific knowledge about the processes plays a limited role. Virtually all the previous research using AI to reengineer employs no domain specific knowledge (e.g., O'Leary and Selfridge 1999). Instead, in general, the obliteration focus suggests specifically analyzing each particular process situation. Ultimately, this approach treats reengineering as required to constantly generate new processes based on general concepts.

Best Practices

The 'obliteration approach' ignores previous knowledge about processes and domains that has been generated as part of other efforts. However, that base of knowledge has become an important source of reengineering expertise. The extent to which reengineering knowledge is now available is exemplified by the number of people for whom reengineering is a fulltime job. For example, one report suggested that over half of the *Fortune* 500 have the equivalent of Vice Presidents of Reengineering (*Boston Sunday Globe*, 1995).

An alternative approach to reengineering is to use a so-called 'best practice'—the best-known way of doing things. Ultimately, best practices are changes in the technology of processes. For example, apparently for many years horse saddles did not have stirrups. After successful use on the battlefield they became a critical part of virtually all saddles. Stirrups are a 'best practice'. In some cases, like stirrups, the technology advancement of these best practices are tied to particular industries. However, in other cases, best practices from one industry can be used in another industry. These are so-called generic best practices. For example, as reported in Hammer (1990) Ford developed a process for paying bills that removed 'invoices', so that the firm paid for goods when goods that they ordered arrived, rather than waiting for an invoice to trigger the payment process. This removed roughly one-third of the paper from the process facilitating improved quality and less work in the administrative payment process. It is generic since this same approach could be used in a number of different industries.

Research Questions

The view of reengineering as one of finding best practices implies that best practices be found, documented and categorized and used elsewhere. As a result, knowledge about best practices must be managed and communicated. Thus, as noted by Bill Dauphinais (Price Waterhouse, 1996, p. 653) there is a '... near-universal interest in the integration of work and communication of knowledge'.

As a result, this paper is concerned with how we can manage reengineering best practices knowledge. In the case of reengineering best practices, perhaps two of the most important problems facing firms are

1. How does a firm know that they are ready for reengineering?
2. How does a firm know which reengineering application to pursue?

This Paper

This paper proceeds in the following manner. The next section briefly discusses some background material. The third section uses a rule-based approach to capture knowledge about reengineering readiness. The fourth section uses uncertainty- and rule-based knowledge and Bayes' Net approaches to capture knowledge about which reengineering application to pursue. The fifth section discusses one approach to capturing reengineering best practices. That approach is extended to a case-based approach in the sixth section. The seventh section summarizes some knowledge management findings of the four models discussed in this paper. The eighth section discusses distribution of reengineering knowledge using a number of vehicles, such as knowledge servers. The final section briefly summarizes the paper and reviews some extensions.

BACKGROUND AND PREVIOUS LITERATURE

A recent survey of the literature and of firms by O'Leary and Selfridge (1999) found that there had been little or no AI-based research on either determining whether a firm was ready for reengineering or on which application should be pursued. Further, O'Leary and Selfridge (1999) found no applications focusing on capturing and communicating knowledge about reengineering 'best practices'.

Zero-based redesign of processes using principles of reengineering is one way to reengineer processes. However, in order to change processes to capture 'best practices' capturing and leveraging knowledge about those best practices needs to be pursued. In this paper four primary approaches are discussed and used to manage reengineering best practices knowledge: Rule-based Expert Systems, Bayes Nets, Document-based Databases and Case-based Databases.

Rule-based Expert Systems (M.4)

This paper develops knowledge-based systems using the expert system shell, M.4. (Documentation is available for M.4 in a number of sources, including, Cimflex Teknowledge (1991). M.4 is a rule-based expert system shell that provides a language used to generate knowledge in the form of rules. Prototype systems using M.4 were developed to address both research problems in order to help evaluate our ability to capture best practices knowledge.

M.4 allows the representation of probabilistic information using certainty factors. Certainty factors are explored in more detail in Buchanan and Shortliffe (1985).

M.4 can also be used to develop case-based systems. Cases can be represented in M.4 and the system can reason about them, e.g. finding a previous case that most closely fits the current situation.

Bayes' Nets

Bayes' nets are acyclic graphic representations of variable and decision dependencies. Bayes nets can be used to represent any decision problem that can be represented as an acyclic graph, e.g., decision trees or expert systems (Howard and Matheson, 1981).

One way of constructing Bayes nets treats nodes as a variable having a probability distribution across a set of values for that variable. Arcs in the graph connect the variables. Probability distributions are associated with variables and conditional probability distributions are associated with related variables. Bayes nets can be used to represent knowledge about probability-based relationships derived from experts or from empirical studies.

One of the better known tools for generating Bayes nets is Hugin (http://hugin.dk/hugintro/versions_pane.html). The tools provide graphical user interfaces that permit the user to draw the graph and guide the user through generating the necessary data for all the necessary probability distributions.

Document-oriented Databases

Document-oriented databases store documents as records. The documents within it are categorized in a number of different ways and the values of each of those categorizations is treated as a field. Those documents are then categorized in a number of different ways with fields used to capture the values in those categories. Perhaps the best known such commercial document oriented database system is Lotus Notes. In the case of Lotus Notes, documents may include, e.g., e-mail messages. Fields by which the message is categorized could include person, date, subject, etc. The resulting databases have also been referred to as qualitative databases, since the information on which the documents are categorized is often nonnumeric qualitative data. Similarly, documents on the world wide web, can be used as a qualitative or document-based database. Given a document oriented database a user can make queries for documents that meet certain field criteria. Such queries can include multiple fields as seen in typical search engines.

IS A FIRM READY FOR REENGINEERING?

One of the most critical reengineering issues is whether or not a firm is ready to conduct reengineering. One of the few systematic efforts at trying to capture and weight the factors that contribute to the feasibility of whether or not a firm should reengineer was developed by CSC Index (1992). In particular, CSC Index developed what they called a measure of 'Reengineering Readiness' based on a questionnaire with 20 questions. The questions were divided into knowledge about six different categories: 'Commitment' (e.g. management commitment); 'Governance Structure' (e.g. key roles have been identified), 'Communication' (e.g. communication needs have been identified), 'Capabilities' (e.g. 'there are leadership skills available for the change'). 'Other Change Initiatives' (e.g. other change initiatives are identified in the project) and 'Change Foundation' (e.g. 'we understand the cultural implications'). Each category has three questions, except for 'Capabilities' which has five questions. Each question required respondents provide an answer ranging from 'Not at all characteristic' ('1') to 'Very Characteristic' ('7'). Respondents would assign a number between 1 and 7 to each question for their firm. The responses from the questions would then be tallied. CSC Index then differentiated between three levels *'High Level of Readiness'* (100–140—an average of 5 to 7), *'Need for Critical Programs'* (60–99—an average of 3 to 5) and *'Danger Area'* (20–59—an average of 1 to 3). A summary is presented in Figure 1.

Model 1 Reengineering Readiness

I generalized the CSC Index approach in order to allow the points from each of the individual six groups to be tracked and categorized in the same manner as CSC Index does for the model as a whole. In this revised model, similar to the CSC model, if a user generates an average of 5 to 7 in a category (not just overall) then they are earn the assessment *'High level of readiness'* for that category. If they average less than 5 but at least 3 then they are assigned to the assessment *'Need for Critical Programs'* for that category. If they average less than 3 then they are assigned to the *'Danger Area'* for that category. In addition, the model I built also uses the total assessment as in the original model. The new model provides an increased level of detail.

The model does not contain any probability information. It is purely deterministic in the numeric values assigned to responses. As a result, the model did not employ M.4 certainty factors or a Bayes' Nets formulation. Instead a pure rule-based approach was used.

The extended model was programmed in M.4

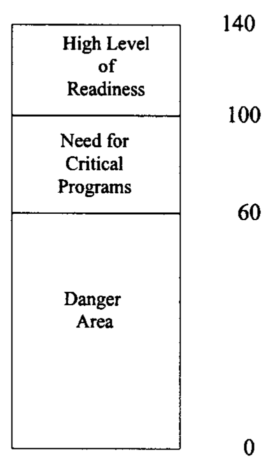

Figure 1 Reengineering readiness (CSC Index, 1992)

using knowledge derived from CSC Index (1992). The system guides the user through the questions allowing an overall assessment of the state of their firm. The complete system has over 200 knowledge base entries. The system was tested extensively. Ultimately, the system was validated using complete enumeration of each value between 1 and 7 for each question. An excerpt from that prototype, focusing on the portion of the knowledge related to 'management committment' is presented in Table 1.

CHOOSING A REENGINEERING PROJECT

Once a firm has decided that they are ready for reengineering, perhaps the most important issue is 'what process should they reengineer?' For example, a firm might choose an application in customer service, distribution or manufacturing. A survey, abstracted in CSC Index (1994), suggests that there are a number of factors that influence the choice of projects. The knowledge generated from that survey can be used to build a system to facilitate choosing a reengineering project. In addition, that survey gathered data that can be used to generate empirically-based probabilities that could be included in the system.

Two different approaches were developed to solve the problem. First, using the certainty factors in M.4, a rule-based approach was developed to generate recommendations. Second, a Bayes' Net was developed. Each approach provides a different way of characterizing and using the probability information generated from that survey.

Rule-based Certainty Factor Model (Model 2)

The rule-based certainty factor model is based on assuming that we can capture the appropriate knowledge necessary to diagnose which applications a firm should choose for reengineering. Some sample rules and certainty factors are summarized in Table 2.

Rather than using all potential factors, the prototype employed a model that used three different factors: method, location and industry. 'Method' refers to the approach used to compare differ applications, such as, activity-based costing (ABC), process modeling or other approaches. 'Location' in this case refers to whether the application will be implemented in Europe or North America. 'Industry' refers to the particular industry in which the application is being made, for example, automotive, insurance or pharmaceutical. The basic model can be extended to broaden the number of sets of factors and the number of categories within each factor can be expanded, based on the available data.

The certainty factors have been constructed for demonstration purposes only. The abstracted CSC Index (1994) survey provided only limited data so these parameters are estimated for illustrative purposes.

Bayes' Net (Model 3)

Alternatively, classic Bayesian probabilities provide a viable alternative to capture knowledge about choosing applications. As a result, a prototype Bayes' net was built to test the feasibility of using such empirically generated survey data to build a system to help choose area of the reengineering application.

The implementation employed the same basic model as the rule—based certainty factor approach: Industry, Location and Method of Analysis. As with the certainty factor model, sample probabilities were generated, roughly based on some of the numbers in CSC Index (1994). Unlike the certainty factor model, additional conditional probability distributions were necessary in order to meet the requirements of the Bayesian model.

The resulting model is illustrated in Figure 2, along with the resulting probabilities estimated for the sample problem. Again, the probabilities are estimates for illustrative purposes only.

BEST PRACTICES

Document-based databases offer an alternative approach to capture and store knowledge about processes. Price Waterhouse has developed a product called 'Knowledge View' to facilitate knowledge sharing using qualitative databases

Table 1. Selected excerpt from general model of reengineering readiness (Model 1)

question(commitment1) = 'to what extent does the firm understand and share the case for action and vision of a major reengineering project (1 = no case for action or vision and 7 = a strong case for action and substantial vision)?'

question(commitment2) = 'to what extent have senior managers been actively campaigning for the reengineering initiative (1 = no senior manager involvement and 7 = extensive senior manager involvement)?'

question(commitment3) = 'to what extent does the organization attach urgency to the reengineering project (1 = no urgency and 7 = extreme urgency)?

legalvals(commitment1) = integer.
legalvals(commitment2) = integer.
legalvals(commitment3) = integer.
legalvals(committotal) = integer.

if (commitment1 = A) and (A = 1 or A = 2)
then commit1recommendation = the
firm_needs_to_have_a_strong_case_for_action_and_vision_before_proceeding_with_a_reengineering_project.

if (commitment2 = B) and (B = 1 or B = 2)
then commit2recommendation =
senior_management_needs_to_buy_in_and_have_active_involvement_or_the_project_will_not_fly.

if (commitment3= C) and (C = 1 or C = 2)
then commit3recommendation = there_needs_to_be_a_sense_of_urgency_or_the_project_will_not_work.

if (commitment1 = A) and (A = 3 or A = 4 or A = 5)
then commit1recommendation =
it_seems_that_there_is_a_need_for_a_stronger_case_for_action_and_greater_vision.

if (commitment2 = B) and (B = 3 or B = 4 or B = 5)
then commit2recommendation =
senior_management_needs_more_buy_in_and_more_active_involvement_for_project_success.

if (commitment3 = C) and (C = 3 or C = 4 or C = 5)
then commit3recommendation =
there_is_a_need_for_a_greater_sense_of_urgency_to_assure_success_of_the_project.

if (commitment1= A) and (A = 6 or A = 7)
then commit1recommendation =
there_is_a_strong_case_for_action_and_the_firm_has_a_vision_all_necessary_to_make_the_project_work.

if (commitment2 = B) and (B = 6 or B = 7)
then commit2recommendation =
senior_management_buys_in_and_has_active_involvement_all_critical_for_project_success.

if (commitment3 = C) and (C = 6 or C = 7)
then commit3recommendation = there_is_a_sense_of_urgency_required_to_make_the_project_work.

if commitment1 = A and commitment2 = B and commitment3 = C and (A+B+C)=D
then committotal = D.

if committotal = D and D<9
then commitsummary =
danger_area_there_are_some_serious_problems_here_that_suggest_strongly_that_reengineering_will_not_work.

if committotal = D and D> = 9 and D<15 then
commitsummary =
there_is_a_chance_but_there_is_a_need_for_some_critical_programs_basically_the_firm_is_on_the_bubble _for_making_reengineering_work.

if committotal = D and D> = 15
then commitsummary =
there_apparently_is_a_high_level_of_readiness_so_that_it_seems_to_be_a_good_time_to_proceed_with_ reengineering.

goal = [commit1recommendation,commit2recommendation,commit3recommendation,commitsummary].

Table 2. Selected knowledge for general model of choice of reengineering project (Model 2)

question(industry) = 'what industry is the firm in?'

question(location) = 'what is the location of the firm?'

legalvals(industry) = [insurance,chemical,automotive,pharmaceutical,other].

legalvals(location) = [north_america,europe].

legalvals(method) =
[activity_based_costing,benchmarking,process_value_analysis,competitive_analysis,other].

legalvals(reeng_domain) =
[customer_service,order_fulfillment,sales_marketing,distribution,manufacturing,procurement,research_development,other].

if industry = insurance
then method = activity_based_costing cf 20 and benchmarking cf 40 and process_value_analysis cf 10 and competitive_analysis cf 20 and other cf 10.

if method = activity_based_costing
then reeng_domain = order_fulfillment cf 15 and reeng_domain = distribution cf 15 and reeng_domain = manufacturing cf 40 and reeng_domain = procurement cf 15 and reeng_domain = other cf 15.

if location = north_america
then reeng_domain = customer_service cf 25 and reeng_domain = order_fulfillment cf 16 and reeng_domain = sales_marketing cf 11 and reeng_domain = distribution cf 4 and reeng_domain = manufacturing cf 15 and reeng_domain = procurement cf 9 and reeng_domain = research_development cf 4 and reeng_domain = other cf 16.

if industry = insurance
then reeng_domain = customer_service cf 60 and reeng_domain = sales_marketing cf 30 and reeng_domain = other cf 10.

goal = [reeng_domain].

to capture case-based information. (Other consulting firms have developed or are developing similar systems.) As noted by Paul Pederson (Price Waterhouse, 1996, p. 654),

> When we learn something in one part of the firm, that knowledge is acquired . . . and shared worldwide through database replication. That means that a best practice established in Dallas one day can be used the next day in Tokyo.

Knowledge View maps the knowledge into 'Value Chain Process Areas' and 'Support Process Areas'. There are five Value Chain Processes, and an example area is 'Perform Customer Service'. There are ten Support Process Areas and an example area is 'Manage Financials'.

The principle database within Knowledge View is a Lotus Notes database (Price Waterhouse, 1995). As a result, Knowledge View is a document-based database that captures documents such as books and articles about business improvement, synopsis about companies from bench marking efforts and engagements, expert opinion documents, Industry/trade associations and other sources.

A CASE-BASED APPROACH (MODEL 4)

Unfortunately, Knowledge View is not generally available. In addition, Knowledge View does not fully exploit AI-based knowledge management potential. The user is responsible for some work that could be done using intelligence built into the system. In particular, case-based reasoning could be used to assist database users to find best practice solutions to their problems.

Like document-based databases, case bases

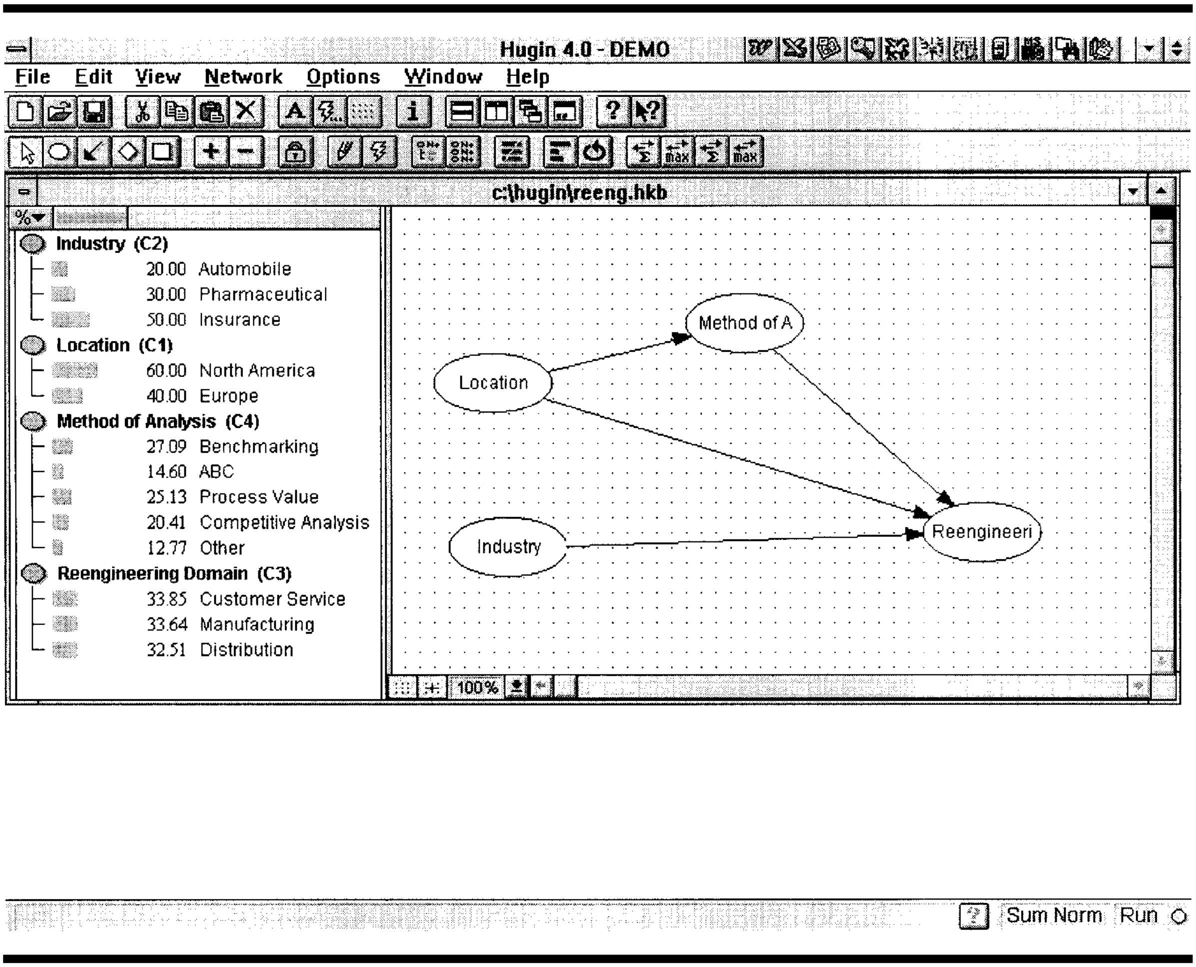

Figure 2 Sample Bayes Net (Model 3)

can used to find solutions to existing problems. As a result, I have constructed a small case base of reengineering best practices firms (e.g., Ford mentioned above) in order to generate a preliminary model for the necessary knowledge for such an approach. Criteria that I have built into my case-based database for reengineering knowledge include the following:

1. Company
2. Industry
3. Generic or Non-generic Process (e.g. generally financial and accounting processes are generic)
4. Agents Impacted (e.g. suppliers or buyers)
5. Side of supply chain affected (e.g. buying side)
6. Resources Impacted (e.g. inventory)
7. Primary Process Impacted (e.g. accounts payable)
8. Major Process Changes (e.g. quite using invoices)
9. Technologies Used (e.g. scanning)
10. Market Power Required (e.g. strong control of distribution)
11. Reengineering Principles Impacted (e.g. have those who use the output perform the process)
12. Overall Impact on Number of People (e.g. decreased by 75%)
13. Overall Impact on Quality of Information (e.g. decrease in number of matching orders to goods received)

A number of different kinds of investigations can be done using this case base, aimed at both system inputs and outputs. The user can present a 'problem process' (e.g. accounts payable) and the system will determine what, if any cases it has that represent best practices for those processes. The user can present a competitor to the system and see if the competitor is represented as having a best practice in the system.

The case base of reengineering knowledge about companies is stored as objects in a prototype built using M.4. A number of different kinds of rule-based matching are built into the system to facilitate matching of user needs and data available in the case base. In general, I assume that the user wants to find a case that best meets their needs along one or more of the above noted prespecified case attributes. The system is deterministic, however, probability-based information could also be built into the system. An excerpt from the prototype is presented in table 3. If the user answers 'automotive' the excerpt model finds that there is a best practices from the automotive industry in the case base at Ford in the area of accounts payable. This prototype was not done to illustrate all possible investigative rules, but only to illustrate the type of knowledge required for such a system.

MANAGEMENT OF REENGINEERING KNOWLEDGE

This paper has presented a number of different knowledge-based approaches for managing reengineering knowledge. Four prototype systems (Models 1–4) have been developed ranging from deterministic rule-based expert systems to probabilistic expert systems and Bayes' nets to reengineering cases. Each of those models provides some insights into the requirements for managing reengineering knowledge.

Model 1

Rule-based expert systems appear to be a particularly efficient way to manage reengineering questionnaire knowledge concerning whether or not a firm should reengineer, particularly given the well-structured approach generated by CSC Index (1992). Questions or sets of questions can be added, deleted and changed with only minimal additional change to the knowledge base. Rules can be added in order to add the responses from any particular group of questions or subgroup. For example, for the model presented earlier we could combine the responses of any set of categories, if there was a well-founded reason to do so. Further, electronic versions of these questionnaires can be updated more easily than paper-based version and easily can be converted to paper versions.

Models 2 and 3

The probability-based models 2 and 3 are perhaps the least effective ways of capturing and using reengineering knowledge. Probabilities are likely to be less stable than the basic model in which they are embedded. As a result, system recommendations can easily become dated. In addition, the basic model on which they are based, although closely tied to the real world (CSC Index 1994), currently is too broad to be able to make detailed choices that would be necessary at the firm specific level.

Model 4

However, the case-based approach provides representation of reengineering choices that are more detailed and directly related to concerns such as 'what is my competition doing'. Further, the case-based approach presented here can be easily changed to capture additional best practices. New cases can be added or old cases can be deleted without changing the rules that are used to analyze the cases. As a result, it appears to be a particularly efficient approach to managing knowledge about choices of best practices reengineering. In addition, the case-based approach is most like the document-based database approaches and as a result, probably the easiest to generate from existing databases of best practices.

Table 3 Case-based prototype for choice of reengineering application (Model 4)

```
/*----------object class definition..........*/

classdef(industry) = [
  supers = []
].

/*..........class instance of reengineering cases.....*/

instdef(automobile) = [
  class = industry,
  industry_name = automobile,
  company_name = ford,
  process = generic,
  agents_impacted = suppliers,
  primary_process = accounts_payable
].

/*......sample goal, questions, legal values and rules......*/

goal = [final_conclusion].

question(industry_category) = 'What category of industry is your company?'.

legalvals(industry_category) = [automobile, computer, paper].

question(status) = 'Would you like to continue considering case attributes?'.

legalvals(status) = [continue, all_done].

if industry_category = Category and
  classinst(industry, INDUSTRY) and
  INDUSTRY <-getslot(industry_name) = Category and
  INDUSTRY <-getslot(primary_process) = C and
  display(["Found a competition-based match for",C,nl])
then conclusion_competition_match = good.

if industry_category = Category and
  classinst(industry, INDUSTRY) and
  INDUSTRY <-getslot(industry-name) = Category and
  INDUSTRY <-getslot(company_name) = D and
  display(["at",D,nl])
then company_conclusion = good.

if conclusion_competition_match = good and company_conclusion = good and status = all_done then
final_conclusion = good_match.
```

WEB-BASED DISTRIBUTION

Distribution of knowledge to a large base of potential users has proved difficult. However, with the advent of the internet and world wide web, knowledge-based models can now be made available in a number of ways.

The so-called 'knowledge server' approach (e.g. Eriksson, 1996) provides the user with access to the knowledge on an available server.

Wide-area networks and the internet-based World Wide Web allow developers to provide intelligent knowledge servers. Expert systems running on servers can support a large group of users who communicate with the system over the network.

There are server-based and client-based solutions using knowledge servers. Recently, some expert system shells have announced tools that are designed to facilitate server use of knowledge bases (e.g. http://www.exsys.com/Wren/wren.html). Reengineering knowledge presented here can be placed on a knowledge server where users could directly access and use the expert system software and knowledge bases, without a need to download it to the client. Alternatively, for example, JAVA-based programs can be downloaded and run locally at the client level (e.g. Erikkson, 1996).

Another approach is to make software and knowledge bases available on the web for downloading. For example, the government agency 'OSHA' has developed ASBNABOX.EXE, a self-extracting file with software and knowledge base in it (http:/www.osha.gov/oshasoft/asbestos/) that provides a system and knowledge on how to handle asbestos. For those situations where expert system software already has been distributed to the users, a variety of knowledge bases can be made available on the web to address different decision problems.

SUMMARY AND EXTENSIONS

This paper has addressed the issue of how can we use AI-based approaches to manage knowledge regarding two important questions about reengineering:

1. Is a firm ready to do reengineering?
2. Which reengineering application should the firm perform

If reengineering is viewed as a problem of managing knowledge about 'best practices' then our concern becomes one of how can we manage that reengineering knowledge. In order to understand how to manage 'best practices' knowledge a number of different AI-based approaches were examined. As part of the analysis this paper provided a number of different prototype systems designed to facilitate management of that knowledge. Distribution of that knowledge in an internet environment can employ knowledge servers, direct downloading of integrated software and knowledge bases and direct downloading of various knowledge bases to solve particular decision problems.

Extension: Models are Prototypes

Each of the models discussed here is a prototype and as a result can be extended to include further detail, more rules, etc. For example, generation of the 'readiness index' (could be extended beyond the basic questionnaire information to include industry and other competitive information. Further, each of the models of choice of application could have been extended to include a broader base of choices.

Extension: Probabilities in Choice of Application

The probability estimates in the models of choice of application were generated from the limited information available in CSC Index (1994). Estimates as to some of the probability distributions were required to be made, primarily because conditional probability distribution information was not provided. An alternative approach is to perform additional research specifically designed to gather that data. Such analysis could include further empirical work or be based on estimates from experts. However, in any case, the estimates summarized in the prototypes provides a first step.

ACKNOWLEDGEMENTS

Earlier versions of this paper were presented at WITS'98 (Workshop on Information Technology and Systems) and Workshop on AI in Reengineering and Knowledge Management, AAAI, Providence Rhode Island, July 1997. The author would like to thank the attendees for their comments on those earlier versions.

References

Boston Sunday Globe, November 12, 1995, p. A 127.

Buchanan B, Shortliffe E. 1985. *Rule-based Expert Systems*. Addison-Wesley: Reading, MA.

Cimflex Teknowledge 1991. *M.4 User's Guide*. Cimflex Teknowledge.

CSC Index 1994. State of Reengineering Report, North America and Europe, Executive Summary.

CSC Index 1992. Getting started form—Reengineering Readiness scale.

Davenport T. 1993. *Process Innovation: Reengineering Work through Information Technology*. Harvard Business School Press: Boston, MA.

Davenport T, Short, JE. 1990. The new industrial engineering: information technology and business

process redesign. *Sloan Management Review* Summer, 11–27.
Eriksson H. 1996. Expert systems as knowledge servers. *IEEE Expert* **11**: No. 3, June, http://www.computer.org/pubs/expert/abs96.htm #14ex0696.
Hammer M. 1990. Reengineering work: don't automate, obliterate. *Harvard Business Review* July/August: 104–112.
Hammer M, Champy J. 1993. *Reengineering the Corporation: A Manifesto for Business Revolution*. Harper Business Press: New York.
Howard R, Matheson JE. 1981. Influence diagrams. *Readings on the Principles and Applications of Decision Analysis*, Strategic Decisions Group: Menlo Park, CA, pp. 719–762.
O'Leary D, Selfridge P. 1999. Knowledge management for business processes. *Communications of the ACM (Virtual Edition)*, reprinted in ACM's *Intelligence*, volume 10, number 4.
Price Waterhouse 1995. Knowledge View. Price Waterhouse.
Price Waterhouse 1996. *Technology Forecast: 1996*. Price Waterhouse.