# AI SURVEYING:
# ARTIFICIAL INTELLIGENCE IN BUSINESS

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# List of Acronyms & Abbreviations

| | |
|---|---|
| AI | Artificial Intelligent and Alien Intelligence |
| AIT | Advanced Investment Technologies |
| ANN | Artificial Neural Network |
| BI | Business Intelligence |
| CalPERS | The California Public Employees' Retirement System |
| CFS | Classifier Systems |
| COE | Chief Of Engineers |
| CPG | Consumer Packaged Goods |
| CRM | Customer Relationship Management |
| CS | Classifier Systems |
| CTO | Chief Technology Officer |
| CUofTX | Credit Union of Texas |
| DTCU | The Dallas Teachers Credit Union |
| EA | Evolutionary algorithm |
| FAQ | Frequently Asked Question |
| FICO | Fair Isaac Company |
| FOLDOC | Free On-Line Dictionary of Computing |
| GA | Genetic algorithm |
| HP | Hewlett Packard |
| IBM | International Business Machines |
| IDC | International Data Corporation |
| IKBS | Intelligent Knowledge Based System, synonym for Expert System |
| JSSP | Job-Shop Scheduling Problem |
| KDD | Knowledge Discovery in Databases |
| KBS | Knowledge based system |
| KB | Kilo Bytes 1000 bytes |
| LCS | Learning Classifier Systems |
| LTC | Load Tape Changer |
| MIT | Massachusetts Institute of Technology |
| NN | Neural Network = Artificial Neural Network |
| NP | Non deterministically Polynomial |
| NQL | Network Query Language |

| | |
|---|---|
| OLAP | Online Analytical Processing |
| OR | Operational Research |
| SAIC | Science Applications International Corporation |
| SAP | Systeme Anwendungen und Produkte in der Datenverarbeitung (German) |
| S&P 500 | Famous stock index represent sample of 500 leading US industries |
| TD | The Toronto Dominion Bank |
| UCP | Universal Product Code |
| UK | United Kingdom |
| US | United States of America |
| XCON | Expert Configurer |

# Abstract

**Thesis Objectives:**

This report is addressed to all readers interested Artificial Intelligence (AI), particularly company managers. The aim of this dissertation is to determine whether AI has had a noteworthy and slowly escalating impact on business. The objectives are to discover which types of AI methods are used today, and what they are capable of doing.

**Methods and Techniques:**

The survey techniques employed were the "Observations" and "Documents" methods for collecting data. This involved a literature review of books, journals, newspaper, magazines, etc., as well as "field work" research, through which additional data was gleaned from other researchers. Specifically, participation in AI USENET newsgroups allowed for the exchange of opinions and e-mail correspondence with companies working with AI.

**Result:**

The thesis proves that software that contains AI, such as Microsoft's Office package, has already penetrated the market. More pure AI applications have, however, also had a notable and increasing impact on business. AI techniques can eliminate certain menial or repetitive tasks. It also has the potential to detect patterns of behaviour that would not otherwise be discernable by humans. Many of these applications are found in software that helps managers analyse information so as to derive essential parts and categorize the data. Various AI-based support systems are also common.

AI is not presently essential to business success. But in my opinion, AI applications will become essential to many companies in different domains. AI may not always be a solution for every company, but failing to examine the possibility of utilizing AI could have serious implication for a company's future.

# 1 INTRODUCTION

## 1.1 Aims & Objectives:

The term "Artificial Intelligence" (AI) covers a broad spectrum. My research focuses primarily on the issue of whether AI applications have penetrated the business market. The aim of this dissertation is to determine whether AI has had a noteworthy and slowly escalating impact on business. The objectives are to discover which types of AI methods are used today, and what they are capable of doing. Several Case Studies are presented, which have been carefully chosen to illustrate the different AI techniques used in business today.

## 1.2 The Hypothesis:

$H_0$ = AI has had a noteworthy and slowly escalating impact on Business

$H_A \neq$ AI has had a noteworthy and slowly escalating impact on Business

I hope, through this thesis, to discover if the first hypothesis is true or not. If "$H_0$" is true, the logical conclusion would be that businesses need to consider whether AI methods could be used to gain a competitive advantage, and when circumstances warrant implementing AI in the company or, at the very least, keep an eye on AI developments. If "$H_0$" is false, the logical conclusion would be that general businesses do not need to focus their attention on AI.

## 1.3 Structure of Thesis Content

The Thesis uses a chronological method of presentation. Chapter 2 is a review of the methodology that was used to research and prepare this thesis. A definition of terms, such as: "Intelligence" and "Artificial Intelligence", is given in Chapter 3 together with a comparison of human and artificial Intelligence. Chapter 4 covers the history of AI in business, with a focus primarily on the birth of modern AI until today. (This is supplemented by a more comprehensive history of AI in Appendix 4). In Chapter 5, the focus is to explain the AI methods used in business: Expert System, Artificial Neural Network, and Evolutionary Algorithm. The Hybrid Systems, which are used to complement, or in conjunction with these, (Fuzzy Logic and Data Mining), are also discussed.

Chapter 6 is a review the application of Artificial Intelligence in business with Case Studies. Many AI business applications are Hybrid Systems of some kind. This makes organizing my discussion based on AI methods very problematic, and so a decision has been made to organise this chapter into the following business areas: Customer Relationship Management (CRM), Company Management, Production Management, and Finance Management. Under each heading, where needed, there is a short explanation of the scope of the discussion in that section. A humble attempt to predict the future is presented Chapter 7. Chapter 8 presents the conclusions of the thesis. A glossary of definitions for AI terminology is placed in appendix 1.

Business Intelligence is mentioned in several places during the thesis and therefore an explanation of the term seems appropriate. Succinctly stated, Business Intelligence is the process of intelligence gathering applied to business. A more formal definition is presented on the web portal "Whatis?com," which defines it as:

> *"Business intelligence (BI) is a broad category of applications and technologies for gathering, storing, analysing, and providing access to data to help enterprise users make better business decisions. BI applications include the activities of decision support systems, query and reporting, online analytical processing (OLAP), statistical analysis, forecasting, and data mining." (WHATIS?COM, 2001, )*

In other words, Business Intelligence can be a weapon that allows a company to identify threats and opportunities, to establish defensive strategies, and to conquer market shares.

Rather than adding to the large list of existing definitions by creating new definitions for this thesis, already existing definition are used. The majority of this thesis focuses on the relaying of factual information, as well as and the author's perceptions and conclusions. The author has divided this thesis into headings and subheadings similar to those that one might find in an extensive report.[1]

**1**. With regard to the layout of this thesis, I believe that the information presented lends itself best to a stylistic compromise between a report and a factual dissertation. I have, therefore, laid my thesis out primarily in a report format. I believe this to be a strength in terms of for ease of reference. While some readers might perceive such formatting to be a weakness, since it does not conform to established principles of thesis presentation, I believe that it strengthens my research.

# 2 RESEARCH METHODOLOGY

## 2.1 Thesis Planning and Methodology

The methodology chosen to undertake this thesis is in the form of a seven-stage plan:

1. Secondary research: this involves a literature review of books, journals, newspaper, magazines etc. to gather appropriate information about the Artificial Intelligence methods used in the topics of the thesis (time-span approximately10 years).
2. Analysis of stage 1: the information gathered in the literacy research is filtered for the relevant data.
3. Primary research: involves "field work" research gleaned from other researchers by participating in Artificial Intelligence USENET newsgroups (comp.ai.edu, comp.ai.philosophy, comp.ai.genetic, comp.ai.alife were used to exchange opinions) and e-mail correspondence with companies working with Artificial Intelligence to gather appropriate information about the applications used in the topics of the thesis (time-span approximately 5 years).
4. Analyses of stage 3: the data gathered from the "field work" is prepared and reviewed.
5. Comparative analysis of stage 2 and 4: all of the relevant data is analysed for validity, significance and use within the body of the thesis.
6. Conclusion: reflect on what has been learned and try to predict the future.
7. Writing the thesis.

### 2.1.1 Research Methods

The survey approach was used for gathering the data required at this primary stage. Whether to use the questionnaire or the interview method, or both, directed towards executives in large companies was the decision to be made. After talks with the supervisor, the questionnaire approach was discarded. Questionnaire and direct interview methods were considered to be inefficient, due to the large risk of a lack of interest and responses, from busy executives in companies.

That left the "Observations" and "Documents" as methods for collecting the data required. Observation involves witnessing direct Artificial Intelligence application. The Documents method for collecting data consists of a literature review to gain further knowledge, learning, and definitions from the written documentation of research already undertaken.

### 2.1.2 Choice of Research Methods

The secondary research stage was a Documents strategic approach, including a literature review of the relevant Artificial Intelligence methods used in business, using books and the Internet to find the appropriate journals, newspapers, business papers, frequently asked questions (FAQ) sites and university sites. This stage was time consuming and consisted of many notes being taken and articles gathered for future reference. Much reading outside the specific topic area was also done, to gain a firm ground to understand the methods available and also acquire knowledge regarding what technology can give us in the future.

The Primary research stage, which combined the Documents strategic approach and the Observation strategic approach, involved witnessing direct Artificial Intelligence application on web pages to see how applications work, and how it is designed for the user. Active participation in Artificial Intelligence discussion groups on the Internet and e-mail correspondence with companies working with Artificial Intelligence were also used to gather the required data. The data collected in this stage was Artificial Intelligence application in business, case studies, and some possible application outcomes in the future.

### 2.1.3 Data Analysis

The following stages were used throughout the analysis:

1. Getting all the information in the same format in one document;
2. Taking away the non-vital information;
3. Categorizing the applications in a coherent way;
4. Reflecting on the quality of the data and case studies; and
5. Refining the data.

The results of the analysis will be reported in the following topic chapters, where they will be further discussed.

## 2.2 Limitations of the Study

This study had several limitations. First, there was a risk associated with the choosing amongst all the existing definitions in the domain. Second, my knowledge of the Artificial Intelligence method was limited; however, it was solved as much as possible by reading Frequently Asked Questions (FAQs) gathered from the news groups, as well as active engagement in discussions with people all around the world, who are working with Artificial Intelligence. Dividing the business domain into five areas could of course, be done in another way, and certain generalisations were made to make the findings fit only one of these categories. Finally, the author used his sound judgement to reflect on the quality of the data and case studies.

# 3 ARTIFICIAL INTELLIGENCE

In this chapter, definitions of terms such as “Intelligence” and “Artificial Intelligence” are given, together with a comparison of human and Artificial Intelligence. People are becoming more conscious of Artificial Intelligence (AI), seemingly due to fictional books and movies. The latest magnifying glass put over the area of AI is the upcoming movie “A.I.” directed by Steven Spielberg that is most likely to be a blockbuster around the world. The movie will have premier in England this summer. Even though the movie’s facts seem too futuristic, and according to some AI newsgroups (comp.ai and comp.ai.vision) contains some incorrect information, it will still increase the public’s awareness of AI.

Before trying to define AI, it is appropriate to look at the definition of “intelligence.” Veale (2001) at Dublin City University explains, that the problem with defining AI comes from the extreme difficulty of defining “intelligence”. One definition, which can be used, comes from the “Encyclopaedia Britannica”:

> *“Ability to adapt effectively to the environment, either by making a change in oneself or by changing the environment or finding a new one” (BRITANNICA, 2001).*

The conclusion that it is nearly impossible to exactly define “intelligence” is strongly supported (YAM, 2001) (RIFKIN, 1995). The concept of AI is considered so broad that people have found it useful to divide AI into two classes: “strong” and “weak” AI.

## 3.1 Weak Artificial Intelligence

States that some type of "thinking" features can be added to computers to make them more useful for humans.

**(i)** Definitions:

A definition by Rich and Knight in their book “Artificial Intelligence” includes every computer-controlled machine that replaces or helps humans in their work.

> *“Artificial Intelligence is the study of how to make computers do things at which, at the moment people are better.” (RICH, KNIGHT, 1991)*

A good example was when, in 1997, the IBM super computer named Deep Blue tested its processing power and won several chess games against the famous chess player Gary Kasparov (in Appendix 3 are the game results). Trying to fit this occurrence into the "weak" definition above, or the "strong" below, it would be clearly being considered as belonging to "Weak AI".

Does Deep Blue Use AI? People might argue that, because it was the raw processing power that allowed the computer to win, and not that the computer recognized patterns, automatically learned, evolved, or improved its own performance, it should not be classified as an AI application at all. On IBM's web page, the same question was asked of Plimpton (2001), one of the main creators of the super computer. Plimpton answered, "The short answer is 'no.'" He explained his answer by showing that this case does not fall under the definition of "Strong AI" (PLIMPTON, 2001). But if the "Weak AI" definition above is applied, it fits perfectly.

More clear examples of Weak AI could be Expert Systems, but systems like spell-checking software and calculators also belong in this category. It seems easy to argue that the last two examples should not be equated with AI at all. But this is due only to the vast spectrum of definitions of AI. Rereading the first definition, clearly the last two examples fit perfectly.

## 3.2 Strong Artificial Intelligence

"Strong" AI makes the bold claim that computers can be made to mimic the thinking processes of humans. In other words, they try to model the process of the brain.

**(i)** Definitions:

Russell and Norvig (2001) make, in my opinion, a good and an easily understandable definition on their FAQ Internet site:

> *"Strong AI supporters believe that when created, the correctly written program running on a machine actually is a mind, that there is no essential difference between a piece of software exactly emulating the actions of the brain and a human brain itself" (RUSSELL, NORVIG, 2001)*

In my opinion, Strong AI seems better, and at the present time, suited to research, than to business applications. This idea is shared with Goodwins (2001) who claims on the "ZDNet" web site, that if something is presented on the market that businessmen claim uses AI, there is a strong possibility that that application belongs to weak AI.

## 3.3 Artificial Intelligence versus Biological Intelligence

Can AI compete with Biological Intelligence? This question will clearly have a different answer depending when the question is asked. If the question was asked 40 years ago, the answer would be different than if the question is asked today. If the question is asked 40 years from now, what will the answer be? Of course it is impossible to predict the exact answer, but what can be said is that whatever the answer will be, it will not be the same as it was 40 years ago or at the present time.

In 1637, the French philosopher-mathematician René Descartes predicted that it would never be possible to make a machine that thinks as humans do (YOUNG, 1998). Young (1998) and Berry (1983) hold a completely opposing opinion. In the book "The Super Intelligent Machine" Berry proclaims that machines will be able to think as humans think. His proof derives from observing different chatbots in connection with the famous "Turing test".

**(i)** Turing Test

In 1950, the British mathematician Alan Turing declared, in a paper, that one day there would be a machine that would have intelligence equal to human intelligence in every way. And he formulated a test to see if a computer could manage it. In his test, a computer and a woman are placed in two separate rooms. The only communication is though an interrogator that is placed in a third room, who asks identical questions to the computer and the woman in the other two rooms. The test is successful if the interrogator is unable to distinguish the machine from the women by his questions. If that were the case then, according to Alan Turing, it would be unreasonable not to call the computer intelligent (HODGES, 2001).

Panczyk (1999), in my opinion, takes a more logical approach to the competitive question in her article "A smart choice for collectors?" in "Credit Card Management". She believes that it is only possible to outperform the capacity of the human in some cases. She further explains that the more variables that are added to a problem, the harder it becomes for humans, and at a certain point the computer starts to outperform them. Goett (2001) announces the same opinion in her article, "The Next Big Thing" in the "Boston Journal of Business Strategy". It is interesting that she notes that AI is different, and therefore not always comparable to, biological intelligence.

Dr. Martin (2001) believes that new intelligence is so different from human intelligence, that in his article “Alien Intelligence” in the “Journal of Business Strategy” he introduces a new term, "alien intelligence," for it. He also presents, in my opinion, a very interesting table 3-1, which illustrates the difference between human and machine intelligence in a very clinical way.

**HUMAN VERSUS MACHINE INTELLIGENCE**

Fortunately, perhaps, what we are good at machines are bad at, and vice versa. The following table contrasts the capabilities of the human brain and the computer.

| | Human Brain | Computer |
|---|---|---|
| Speed | Slow | Many millions of times faster |
| Wiring | Exceedingly complex | Relatively simple |
| Precision | Makes mistakes | Absolutely accurate |
| Memory of facts | Limited | Vast data warehouses |
| Access to information | Data stored in the head | Data in systems worldwide |
| Associative memory | Many diverse associations | Limited |
| Location | One location | Worldwide connectivity |
| Communication | Slow, imprecise | Fast, accurate |

Given this immense difference in the properties of brains and computers, the capabilities of people and machines are very different:

| | Human | Machine |
|---|---|---|
| Common sense | Yes | No |
| Ability to set goals; and think about meaning and purpose | Yes | No |
| Ability to recognize patterns familiar to humans | Yes | Limited |
| Ability to recognize patterns unknown to humans | No | Yes (with neural networks) |
| Ability to draw analogies and associated diverse ideas | Yes | No |
| Very high-speed logic | No | Yes |
| Ability to execute logical processes that humans cannot understand | No | Yes |
| Accurate storage of a vast amount of data and rules | No | Yes |
| Ability to apply a vast number of rules with precision | No | Yes |
| Ability to do complex calculations | Limited | Yes |
| Absolute accuracy | No | Yes |
| Precise replication in many locations | No | Yes |
| Immediate communication with many locations | No | Yes |
| Immediate worldwide interlinkage | No | Yes |
| Precise cooperation with other machines, worldwide | No | Yes |
| Originality | Yes | No |
| Ability to inspire or lead other humans | Yes | No |
| Wisdom | Sometimes | No |

Table 3-1 Human Versus Machine Intelligence (MARTIN, 2001).

Panczyk (1999) believes, moreover, that computers have the advantage because: their performance never deteriorates due to fatigue, their attention is never lost, and they never ever get emotionally entangled like humans are. Professors Sloman and Dr Logan (1999), in the article “Building cognitively rich agents using the SIM agent toolkit “ in “Association for Computing Machinery”, states that hybrid architecture may have unexpected side effects. They state, “It has been argued that intelligent robots will need mechanisms for coping with resource limits, and that interactions within these mechanisms will sometimes produce emotional states involving partial loss of control of attention, as

already happens in humans" (SLOMAN, LOGAN, 1999). It is my opinion that this could, in a way, simulate the imperfection of humans, Panczyk (1999), mentioned earlier.

Hayes-Roth at Stanford University, in my opinion, makes a very strong point in the article "AI's Greatest Trends and Controversies" in "Institute of Electrical and Electronics Engineers" when she states, "The only position that I find discouraging is the premature conclusion of impossibility". Professor Sloman (2001) at the University of Birmingham made a similar opened observation about the comparison:

> *"We cannot yet say with confidence that there's ANYTHING brains can do which computers will NEVER be able to do, even though there are many things brains can do which existing computers cannot do (and vice versa!)" (SLOMAN, 2001).*

## 3.4 Conclusion

Defining Intelligence is difficult. Consequently, defining AI is also problematic. This could be one of the reasons why there are so many different definitions of AI in the literature and on the Internet. There are clearly different opinions about what should be included in a definition of AI, and what should be excluded. Perhaps AI should not be compared to Intelligence in its definition. However, in my opinion, defining AI too narrowly will limit creative thought.

Kremer (2001) at the University of Calgary, in my opinion stated one of the simplest and best definitions of AI discovered during this research:

| | |
|---|---|
| Weak AI: | Machines can be made to act as if they were intelligent. |
| Strong AI: | Machines that act intelligently have real, conscious minds. |

AI will probably outperform human intelligence in some fields in the future. There are, however, some diverse fields such as artistic ability, emotions, love, etc. that, at this time, it is difficult to believe that AI could contribute to, without a better understanding of the brain. But why would one want to apply AI to such indefinite realms? If AI really thought like a human, it would be stubborn, anxious, angry, and get bored. Maybe AI should not be compared to the human mind. If it can simulate some of the same thought processes to improve performance, fine. The goal, however, should be making AI as helpful to us as possible, and not to merely copy the human brain (Weak AI).

# 4 THE HISTORY OF ARTIFICIAL INTELLIGENCE IN BUSINESS

This chapter covers the history of AI in business, focusing primarily on the period from the birth of modern AI and continuing to the present day. A detailed timetable of Artificial Intelligence that stretches from the 5th century B.C., and Aristotle's syllogistic logic, up to the present time can be found in Appendix 4.

## 4.1 The Genesis of Modern Artificial Intelligence

Panczyk (1999), in the article "A smart choice for collectors?" in "Credit Card Management," points out Artificial Intelligence (AI) technology really took life with the invention of the computer in the early 1940s". Veale (2001) and Young (1998) share a different opinion about the genesis of modern AI. They, along with others, believe that what is today considered as "Modern Artificial Intelligence" started at the first conference on AI convened at Dartmouth College in New Hampshire in 1956. At this conference ten scientists met to discuss the possibility of computers that could "behave" intelligently. According to Veale (2001) this meeting was instigated by the Turing test.

## 4.2 History of commercial AI applications

It was not until the late 1970s that the first commercial AI based System, XCON (Expert System), was developed. At that time, practical, commercial applications of AI were still rare. In the early 1980s, Fuzzy Logic techniques were implemented on Japanese subway trains, and in a production application by a Danish cement manufacturer. Commercial AI products were only returning a few million dollars in revenue at this time (WFMO, 2001).

The Expert Systems that companies are starting to use, and the AI groups in many large companies, were formed on the mid-1980s. Expert Systems started to show limits on the amount of rules they can work with, and 1986 sales of AI-based hardware and software were $425 million (WFMO, 2001). Likewise, interest in using Neural Nets in business applications developed. By the end of 1980s, Expert Systems were increasingly used in industry, and other AI techniques were being implemented, often unnoticed but with beneficial effect (WFMO, 2001). AI revenues reach $1 billion (MIT, Timeline of AI, 2001).

In the early 1990s, AI applications such as automatic scheduling software, software to manage information for individuals, automatic mortgage underwriting systems, and automatic investment decision makers were used. In the mid1990s, AI software to improve the prediction of daily revenues and staffing requirements for a business, credit fraud detection systems, and support systems were developed and used. It was not until the late 1990s that the applications such as data mining tools, e-mail filters, and web crawlers were developed and generally accepted (BUCHANAN, 2001)(WFMO, 2001)

# 5 ARTIFICIAL INTELLIGENCE METHODS IN BUSINESS

In this Chapter, the focus is to explain the following AI methods used in business: Expert System, Artificial Neural Network (ANN), and Evolutionary Algorithm (EA). The latter part of the chapter explores Hybrid Systems, (the AI methods that are used to complement, or in combination with these); Fuzzy Logic and Data Mining.

## 5.1 Expert System

### 5.1.1 Definitions:

McCarthy (2000) at Stanford University defines Expert Systems as:

> *A "knowledge engineer" interviews experts in a certain domain and tries to embody their knowledge in a computer program for carrying out some task." (MCCARTHY, 2000).*

He explains that during the "knowledge acquisition" it will not only be the "knowledge" of experts that will be cloned and built into these systems, but also their intuition and the way that they reason, so that the best options can be selected under any given set of circumstances.

An Expert System can be developed by: Expert System Shell software that has been specifically designed to enable quick development, AI languages, such as LISP and Prolog or through the conventional languages, such as Fortran, C++, Java, etc.

While the Expert System concept may sound futuristic, one of the first commercial Expert Systems, called Mycin, was already in business use 1974 (MIT, Applications of AI, 2001). Mycin, which was created by Edward H. Shortliffe at Stanford University, is one of the most famous Expert Systems. Mycin was designed as a medical diagnosis tool. Given information concerning a patient's symptoms and test results, Mycin attempted to identify the cause of the patient's infection and suggested treatments (MIT, Applications of AI, 2001). According to McCarthy (2000), it did better than medical students or practicing doctors, provided its limitations were observed. Another example of an Expert System is Dendral, a computerized chemist. According to the Massachusetts Institute of Technology, the success of Dendral helped to convince computer science researchers that systems using heuristics were capable of mimicking the way human experts solve problems (MIT, Timeline of AI, 2001).

### 5.1.2 Potential Applications for an Expert System

Expert Systems have been developed for a variety of reasons, including: the archiving of rare skills, preserving the knowledge of retiring personnel, and to aggregate all of the available knowledge in a specific domain from several experts, (when no single expert has complete knowledge of that domain). Perhaps an expert's knowledge is needed more frequently than the expert can handle, or in places that the expert cannot travel to. The Expert System can train new employees or eliminate large amounts of the monotonous work humans do, thereby saving the expert's time for situations requiring his or her expertise. In my opinion the only limit on the possible applications of stored knowledge in an Expert System is what the mind can imagine. In Appendix 4 are additional reasons to implement an Expert System, as presented by the Swedish Expert System Company NovaCast.

### 5.1.3 Conclusion

The Expert System is an AI application that makes decisions based on knowledge and inference (the ability to react on the knowledge), as defined by experts in a certain domain and to solve problems in that domain. The Expert System normally falls under the definition of Weak AI, and is one of the AI techniques that has been easiest for companies to embrace. Commercial Expert Systems were developed during the 1970s, and continue to be used by companies. One advantage of an Expert System is that it can explain the logic behind a particular decision, why particular questions were asked, and/or why an alternative was eliminated. That is not the case with other AI methods.

## 5.2 Artificial Neural Network

Sometimes the following distinction is made between the terms "Neural Network" and "Artificial Neural Network". "Neural network" indicates networks that are hardware based and "Artificial Neural Network" normally refers to those which are software-based. In the following paragraphs, "Artificial Neural Network" is sometimes referred to as “Neural Network” or “Neural Computing”. Neural Networks are an approach, which is inspired by the architecture of the human brain. In the human brain a Neural Network exists which is comprised of over 10 billion neurons; each neuron (Appendix 2) then builds hundreds and even thousands of connections with other neurons (KIMBALL, 2001).

### 5.2.1 Definition:

Aleksander and Morton (1995), in their book “An Introduction to Neural Computing,” define Neural Computing as:

> *“Neural computing is the study of networks of adaptable nodes which, through a process of learning from task examples, store experimental knowledge and make it available for use.” (ALEKSANDER, MORTON, 1995)*

### 5.2.2 Learning

As a Neural Network (NN) is designed, rather than being programmed, the systems learn to recognize patterns (HENGL, 2001). Learning is achieved through repeated minor modifications to selected neuron weights (The weight is equal to the importance of the neuron). NN typically starts out with randomised weights for all their neurons. This means that they do not "know" anything, and must be trained. Once a NN has been trained correctly, it should be able to find the desired output to a given input, however, it cannot be guaranteed that a NN will produce the correct output pattern. NN learns by either a supervised or an unsupervised learning process (KAY, 2001).

**(i)** The Supervised Learning Process

A supervised learning process has a target pattern (desired output). While learning different input patterns, the weight values are changed dynamically until their values are balanced, so that each input will lead to the desired output. There are two supervised learning algorithms: Forward, and Back-propagation, Learning Algorithms.

**(ii)** The Unsupervised Learning Process

An unsupervised Neural Network has no target outputs. During the learning process, the neural cells organize themselves in groups, according to input pattern. The incoming data is not only received by a single neural cell, but also influences other cells in its neighbourhood. The goal is to group neural cells with similar functions close together. Self-organisation Learning Algorithms tends to discover patterns and relationships in that data (KAY, 2001).

### 5.2.3 Artificial Neural Network Techniques

According to Sarle (1999), there are many kinds of Artificial Neural Networks. No one knows exactly how many. This dissertation only examines the most common ones.

**(i)** Perceptron

Frank Rosenblatt introduced the Perceptron in 1959 (MIT, Timeline of AI, 2001). Figure 5-1 has been devised by the author and is a very simple structure with two neuron layers that accept only binary input and output values (0 or 1). The learning process is supervised and the net is able to learn basic logical operations such as AND or OR. It is also used for pattern classification purposes.

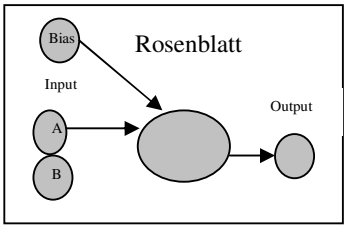


Figure 5-1 Rosenblatt Perceptron

**(ii)** Multi-Layer-Perceptron

Marvin Minsky and Seymour Papert first introduced the Multi-Layer-Perceptron in 1969 (BUCHANAN, 2001). It is an extended Perceptron and has one more hidden neuron layer between its input and output layers. Due to its extended structure, a Multi-Layer-Perceptron is able to learn every logical operation. The Multi-Layer-Perceptron is showed in the figure 5-2 (FRÖHLICH, 1996).

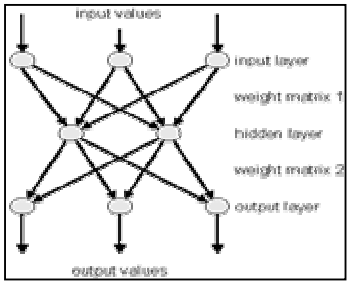


Figure 5-2 Multi-Layer-Perceptron (FRÖHLICH, 1996).

**(iii)** Backpropagation Net

G.E. Hinton, E. Rumelhart and R.J. Williams first introduced the Backpropagation Net in 1986. It has the same structure as the Multi-Layer-Perceptron, but uses the backpropagation-learning algorithm.

**(iv)** Hopfield Net

Physicist J.J. Hopfield first introduced the Hopfield Net in 1982. It consists of a set of neurons, where each neuron is connected to every other neuron. There is no difference between input and output neurons. The main application of a Hopfield Net is the storage and recognition of patterns, e.g. image files (FRÖHLICH, 1996). Three nodes Hopfield Network is showed in the figure 5-3.

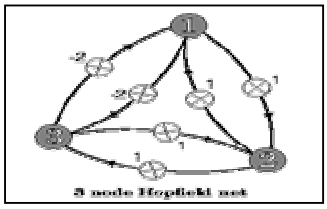


Figure 5-3 Hopfield Network (PERRY, 2001)

**(v)** Kohonen Feature Map

Finnish professor Teuvo Kohonen, at the University of Helsinki, introduced the Kohonen Feature Map (is showed in the figure 5-4) in 1982. Kohonen Net whose neurons compete with each other and the neuron and its neighbourhood with the smallest distance is winning.

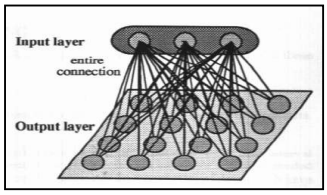


Figure 5-4 Kohonen Feature Map (NAVELAB, 1997)

### 5.2.4 ANN as method of Forecasting.

"Forecasting is essential to business", (TANLER, 2001). Can NN contribute to traditional forecasting methods? Jiang et al. (2001) explain, in the article "Marketing category forecasting…" in the journal "Decision Sciences", that the advantages of ANN over traditional statistical forecasting methods are that ANN do not have to fulfil any statistical assumptions and the ability to handle non-linearity, which are common in business. Further advantages, according to Jiang et al., are that ANN is easy to learn and use, and normally requires less data preparation. Jiang et al. summarize ANN's forecasting advantage over conventional statistical methods in the Journal of "Decision Sciences":

> *"Researchers believe that the Neural Network approach can generalize and 'see through' noise and distortion better than the conventional statistical models" (JIANG et al., 2001).*

Key (2001), who wrote the article "Artificial Neural Networks" in ComputerWorld, shares this view, and proclaims the capabilities of ANN to learn and analyse large and complex sets of data that linear algorithms cannot easily deal with.

### 5.2.5 Conclusion

ANN is inspired by the architecture of the human brain, and learns to recognize patterns through repeated minor modifications to selected neuron weights. There are many kinds of ANN techniques that are good at solving problems involving patterns, pattern mapping, pattern completion, and pattern classification.

ANN pattern recognition capability makes it useful to forecast time series in business. A Neural Network can easily recognize patterns that have too many variables for humans to see. They have several advantages over conventional statistical models: they handle noisy data better, do not have to fulfil any statistical assumptions, and are generally better at handling large amounts of data with many variables.

According to Stottler (2001), a problem with Neural Networks is that it is very difficult to understand their internal reasoning process. In my opinion, however, this is not entirely accurate. It is possible to get an idea about the learned ANN variables' elasticity. By changing one variable at a time, and during that time looking at the changes in the output pattern, at least some information regarding the importance of the different variables will be visible. In my opinion, Neural Networks can be very flexible systems for problem solving.

## 5.3 Evolutionary Algorithms

### 5.3.1 Definitions:

After reading several Evolutionary Algorithm (EA) definitions, Howe's (1993) at the University of Pittsburgh stands out as being quite understandable and complete,

> *"an algorithm that maintains a population of structures (usually randomly generated initially) that evolves according to rules of selection, recombination, mutation and survival referred to as genetic operators. A shared "environment" determines the fitness or performance of each individual in the population. It also tells us that the fittest individuals are more likely to be selected for reproduction (retention or duplication), while recombination and mutation modify those individuals, yielding potentially superior ones." (HOWE, 1993).*

### 5.3.2 Branches of Evolutionary Algorithms:

There are currently four main paradigms in (EA) research: Genetic Algorithm (GA), with two sub- classes and Genetic Programming (GP), Evolutionary Programming, and Evolution Strategy.

**(i)** Genetic Algorithm

In my opinion, a good definition of Genetic Algorithm (GA), is made by Obitko (1998) at the Technical University in Prague's web page under the headline "Introduction to Genetic Algorithms",

> *"Genetic algorithms are inspired by Darwin's theory about evolution. Solution to a problem solved by genetic algorithms is evolved. Algorithm is started with a set of solutions (represented by chromosomes) called population. Solutions from one population are taken and used to form a new population. This is motivated by a hope, that the new population will be better than the old one. Solutions are selected to form new solutions (offspring) are selected according to their fitness - the more suitable they are the more chances they have to reproduce. This is repeated until some condition (for example number of populations or improvement of the best solution) is satisfied." (OBITKO, 1998).*

**(ii)** Genetic Programming

Genetic programming (GP) is a programming technique that extends the Genetic Algorithm to the domain of whole computer programs. In GP, populations of programs are genetically bred to solve problems (HOWE, 1993).

**(iii)** Evolutionary Programming & Evolution Strategy

Evolution programming uses mutations to evolve populations. Is a stochastic optimisation strategy similar to Genetic Algorithm, but instead places emphasis on the behavioural linkage between parents and their offspring, rather than seeking to emulate specific Genetic Operators as observed in nature. Evolutionary Programming is very similar to Evolution Strategies, although the two approaches developed independently (BEASLEY, HEITKOETTER, 2001)

### 5.3.3 Advantage and Disadvantages

Examples of problems where EA have been quite successful are: Timetabling and Job-Shop Scheduling Problem (JSSP), finding the most beneficial locations for offices, etc., and typical Operational Research (OR) problems with many constraints (HEITKÖTTER, BEASLEY, 2001).

Weisman and Pollack (1995), at Ben-Gurion University, claim that GA has proven to be well suited to optimisation of specific non-linear multivariable systems. They explain that GA is used in a variety of applications including scheduling, resource allocation, training ANNs, and selecting rules for fuzzy systems. Heitkötter and Beasley (2001) explain that,

> *"GAs should be used when there is no other known problem solving strategy, and the problem domain is NP-complete. That is where GAs comes into play, heuristically finding solutions where all else fails." (BEASLEY, HEITKOETTER, 2001).*

Several universities agree (HOWE, 1993) (WEISMAN, POLLACK, 1995) that EAs are especially ill suited for problems where efficient ways of solving them are already known.

### 5.3.4 Conclusion

The EA tries to mimic the process of biological evolution, complete with natural selection and survival of the fittest. The four main paradigms are Genetic Algorithm (GA), Genetic Programming (GP), Evolutionary Programming, and Evolution Strategy. EA is a useful method of optimisation when other techniques are not possible. EAs seem to offer an economic combination of simplicity and flexibility, and may be the better method for finding quick solutions than the more expensive and time consuming (but higher quality) OR methods. In my opinion a hybrid system between OR and EA should be able to perform quite well.

An idea from the Author:

If a backward Evolutionary Algorithm is used on an accepted OR solution, maybe then the human eye could easily rearrange the first string in a more effective way. If EA then were to run the string through the normal forward process, the end result could be better than using EA on an unperfected start string.

## 5.4 Hybrid System

The debate over which techniques are the best to solve problems has often been heated and controversial (GRAY, KILGOUR, 1997). However, more and more people have recently begun to consider combining the approaches into hybrid ones.

### 5.4.1 Definitions:

Gray and Kilgour (1997) at the University of Otago, in my opinion, made a simple definition of a Hybrid System discovered during this research:

> *"one that uses more than one problem-solving technique in order to solve a problem" (GRAY, KILGOUR, 1997).*

There is a huge amount of interest (GRAY, KILGOUR, 1997) in Hybrid Systems, for example: neural-fuzzy, neural-genetic, and fuzzy-genetic hybrid systems. Researchers believe they can capture the best of the methods involved, and outperform the solitary methods. In my opinion the debate in chapter 5.2.4 would be unnecessary if ANN is combined with conventional statistic methods in a hybrid system.

The two following chapters, "Fuzzy Logic & Fuzzy Expert System" and "Data Mining" are deliberately placed under the heading of Hybrid System. Fuzzy Logic is a method that is combined with other AI techniques (Hybrid System) to represent knowledge and reality in a better way. Data Mining, does not have to be a Hybrid System, but usually is, for example: IBM's DB2 (Data Mining tool), which contains techniques (IBM, 2001) such as Statistics, ANN, GA, and Model quality graphics, etc. Let us now take a closer look at the methods.

### 5.4.2 Fuzzy Logic & Fuzzy Expert Systems

Withagen (2001) at the University of Bergen explains, that Lotfi Zadeh introduced Fuzzy Logic. He further explains that Fuzzy Logic resembles human reasoning, but uses estimated information and vagueness in a better way (WITHAGEN, 2001). The answers to real-world problems are rarely black or white, true or false, or start or stop. By using Fuzzy Logic, knowledge can be expressed in a more natural way (fuzzy logic instead of Boolean "Crisp" logic).

**(i)** Definitions:

Withagen (2001) definition of Fuzzy Logic is:

> *"It is a departure from classical two-valued sets and logic, that uses "soft" linguistic (e.g. large, hot, tall) system variables and a continuous range of truth values in the interval [0,1], rather than strict binary (True or False) decisions and assignments." (WITHAGEN, 2001)*

Gala (2001), at the University of Mumbai (previously known as the University of Bombay), informs us that Fuzzy Logic is ideal for controlling non-linear systems and for modelling complex systems where an inexact model exists, or in systems where ambiguity or vagueness is common. He additionally claims that there are over two thousand commercially available products using Fuzzy Logic today, ranging from washing machines to high-speed trains.

**(ii)** Fuzzy Expert Systems

Often Fuzzy Logic is combined with Expert Systems, as the so-called Fuzzy Expert System Fuzzy Expert Systems are the most common use of Fuzzy logic (KANTROWITZ et al., 2001), (HORSTKOTTE, 2000). These systems are also called "Fuzzy Systems" and use Fuzzy Logic instead of Boolean (crisp) logic,

Fuzzy Expert Systems are used in several wide-ranging fields, including: "Linear and Non-linear Control Pattern Recognition", "Financial Systems", "Operation Research", "Data Analysis", "Pattern recognition." Etc. (HORSTKOTTE, 2000), (KANTROWITZ et al., 2001), (MARK et al. 2001)

### 5.4.3 Data Mining

**(i)** Definitions:

Data Mining is also known as Knowledge Discovery in Databases (KDD), Data Archaeology, Data Segmentation, or Information Discovery. Port (2001) defines Data Mining in his article "Virtual prospecting from oil exploration to neurosurgery…" in "Business Week":

> *"Data Mining harnesses Artificial Intelligence and slick statistical tricks to unearth insights hiding inside mountains of data. The software is so thorough, and so clever at spotting subtle relationships and associations, that it regularly makes fresh discoveries." (PORT, 2001)*

He assumes that Data Mining always includes AI, or that it is always a Hybrid System with different techniques gathered together. Yet that is not always true, (WELGE, 2000). In my opinion, expanding our definition of Data Mining to include the process of searching for and revealing expected and unforeseen structures in data, this encompass the issues discussed above. Port (2001) claims that Data Mining has taken strong root in industry. In an interview in his article, Harry R. Kolar, head of strategy at IBM's BI unit, explains that Data Mining has become very important for companies today.

### 5.4.4 Conclusion

A Hybrid system uses more than one technique, such as neural-fuzzy, neural-genetic, Fuzzy Expert System, Data Mining (most often), etc., to solve a problem. Fuzzy logic is incorporated into computer systems so that they represent reality better by using "non-crisp" knowledge. Often Fuzzy Logic is combined with Expert Systems, so-called Fuzzy Expert System or more simply, "Fuzzy System."

Data Mining software most often uses various techniques, including Neural Networks, statistical and visualization techniques, etc., to turn what are often mountains of data into useful information. Data Mining does not always contain AI techniques. In my opinion it is quite possible that Data Mining will become a very useful tool for companies in the competition for market shares.

# 6 ARTIFICIAL INTELLIGENCE APPLICATIONS IN BUSINESS

In this chapter a review of the applications of Artificial Intelligence (AI) in business is made. As noted in the introduction, many of the AI business applications are Hybrid Systems of some kind. This makes organizing my discussion based on AI methods very problematic. Therefore, it is decided to systematise this chapter by the business area in which the systems are applied instead. But before beginning to examine such applications, first let us examine one of the major problems (CREDIT TO CASH, 2001) for companies today, namely "information overload".

## 6.1 Information Overload

This carefully chosen headline attempts to capture and quantify a growing problem of information overload in business. Those who are able to handle the problem, will be able to convert this problem to opportunities, an excess of information is essential to business decision-making. In other words, managers wish that they had all available information to help them make decisions. Thanks to the Internet, to huge internal databases easily accessible through corporate intranets, e-mail, and the digitising of everything from faxes to voice mail, there is so much information that it is virtually impossible to timely locate the most valuable information.

> *Port (2001) informs us, in the article "Virtual Prospecting From oil exploration to neurosurgery…" in "The Business Week", that Scientists at the University of California estimate that all of the information ever produced, beginning when man first painted pictures on cave walls and wrote on papyrus, totals approximately 18 exabytes (18 followed by 18 zeros). Yet 12% of the information was produced in 1999 alone. And two-thirds of that was digital (PORT, 2001). In Schwartz's (2001) article, "Artificial Intelligence on Web" in "B to B" magazine, he explains that statistics gathered by IDC show that the average human can only read about 300KB of text per hour without analysing it.*

To be able to analyse information and locate the useful gold nuggets in this information mine is understandably imperative in the highly competitive business market. In my opinion Data Mining can indeed be a solution to the problem. Koch (2001) confirms my opinion in his article, "Five top IT applications in power delivery," in "Electrical World Magazine", he explains that AI techniques, like data mining can give a company more useful information instead of huge volumes of raw data. It seems that various types of AI solutions to the information problem are slowly creeping into the business arena. Many people have contact with AI without knowing it (for example, search engines, the Microsoft office package, and knowledge-based systems. A List in Appendix 5 shows successful AI applications based on Expert System, NN, and GA.

## 6.2 Customer Relationship Management "Behaviour Analysis"

Customer Relationship Management (CRM) is the coordination between sales, marketing, customer service, field support and other customer contact functions (TREJECTA, FAQ, 2001). This chapter will look at how AI can handle information to improve business relationships.

Internet bookstore Amazon.com uses AI to learn about its customers' tastes in books. When someone signs on to Amazon, the software greets the customer by his or her name, and gives him or her recommendations on books. These recommendations, which are based on the customer's previous buying patterns, suggest similar reading material. It is easy to conclude that analysing information is essential in the competitive business market. Dr. Martin (2000) writes about the importance of collecting and analysing customer information in the article "Alien Intelligence " in "Journal of Business Strategy", he implies:

> *"Electronic commerce can be designed so that software can learn what products customers are likely to buy, what changes they would like in the products, where to look for new customers, and so on" (MARTIN, 2000).*

If information is gathered about customers, and the appropriate tools to analyse the data are used, it will then be able to understand what triggers someone to become a customer or not. With these tools companies will be able to categorize customers as either non-profitable, or highly profitable. Analysing customer behaviour could also allow a company to identify which customers are open to changes. In other words, the company that can focus on the most profitable customer target group, and reshape customer behaviour to be more cost-effective, will have a considerable economic advantage over the competition.

I believe, however, that it threatens our integrity. If individuals allow companies to analyse their behaviour so meticulously that it is possible to identify who could easily change their behaviour and to suggest "appropriate" changes, Data Mining would not only be used by companies, but also probably latched onto by politicians, the military and dictators, etc.

One company that makes systems that analyse customer behaviour is Trajecta Inc. This American company, which is based in Texas, makes an optimising system called Virdix. According to Trajecta, Virdix combines advanced analytics, mathematical programming techniques, applied probability, simulation and patented Neural Network technologies to model complex business situations and compute optimal decisions (TREJECTA, 2001). Let us look what this AI tool can do for business in the Case Study "FedEx".

### 6.2.1 Case Study: FedEx

**Federal Express Corporation**

Federal Express Corporation (FedEx), the world's largest express transportation company, discovered, through an internal analysis, that picking up customers' packages from them cost significantly more than servicing customers who dropped off their own packages (TRAJECTA, 2001). Trajecta Inc. helped FedEx to understand why customers were making this request, and what it would take to convert them to customers that dropped off their own packages.

The project consisted of four stages:

1) Surveying customers;
2) Creating predictive models from the survey results, FedEx data, and third party data;
3) Selecting customer groups to become the subjects of promotions; and
4) Examining the results of the groups.

FedEx identified customers whose use of services was targeted for improvement. Quest Business Agency then conducted a survey that was the basis for the predictive models. Trajecta then supplemented the survey data with FedEx and third party business information data. Then it analysed the data with sophisticated data mining techniques such as Neural Networks (TRAJECTA, White paper, 2001), which identified the customer type with the highest propensity for change. The customer base was categorized into segments with similar behaviour and attributes.

Trajecta concluded its predictive analysis three weeks after receiving the survey data. The model was then used to score and profile roughly a third of the entire customer base. From this group, customers with the highest prospects for change were selected. A second group of equal size was selected at random to act as a control group. The company contacted the two groups of customers by phone, and tried to convince them to drop off their own packages. The final stage of the project compared the actual responses of these two groups to the predicted results from Trajecta's model. The recommendations proved to be extremely predictive. The study yielded significant proof that those selected with Trajecta's Data Mining tools considerably increased their "dropping off your own packages" behaviour.

The project resulted in double-digit revenue/expense ratios and double-digit ROI (Return of Investment) for FedEx (WOOD, E-MAIL, 2001). FedEx also gained a new understanding of its customers' behaviour, and the ability to match various promotions with different customer segments. Most importantly, however, Trajecta provided FedEx with a new source of competitive advantage.

### 6.2.2 Credit Card Issuers and Collectors

Other domains in which analysing customer behaviour with AI methods has been successful include credit card issuers and collectors. Expert Systems can help card issuers determine whether to accept a proposed credit card purchase. John McCarthy (2000), a Professor of Computer Science at Stanford University and is one of the founders of modern AI confirms this statement.

At the Telecom & Utilities Collection Conference in November 2000, one speaker was Ranjan Dharmaraja, president of Quantrax Corp., a company that has spent the last decade developing an intelligent system called Intelec (Intelligent Software for the Collections Industry). He confirms the establishment of AI methods in this domain after installing his Expert System in more than 100 U.S. collections agencies, he believes "that the time has come for AI to be accepted as a collections tool" (DHARMARAJA, 2000). The latest information on the Quantrax web page claims that Intelec is installed in over 35 American states and in Canada, in collection operations ranging from 10 to over 1000 users (QUANTRAX, 2001). This amount is confirmed by Email correspondence between the author and Ranjan Dharmaraja (DHARMARAJA, e-mail, 2001). In Panczyk's (1999) article "A smart choice for collectors?" in "Credit Card Management," she talks about Quantrax's Expert System, Intelec. She also mentioned several companies, including Neuristics Corp. and Trajecta Inc., which were presenting their versions of a collection Expert System in 1999. According to her, all of these companies considered the new technology as the essential tool of the future collections office.

Panczyk (1999) mentions further, that MasterCard and Visa both offer their members a Neural Network (NN) method, which can identify deviations in spending habits of cardholders that could indicate fraud. Kay (2001), discusses this service in his article "Artificial Neural Networks " in "Computer world". Rabkin and Tingley (1999) confirm that credit card companies use ANN to detect fraud, in their article "Life & health/financial services ed " in the National Underwriter. They note further that not only ANN, but also Genetic Algorithms and Expert Systems, are used to improve the detection of fraud.

### 6.2.3 Insurance and Mortgage

Additional domains where AI methods have been successfully implemented are insurance, mortgage and their credit scoring for individuals and companies.

Littell (2000), who is president of Broker's Resource Centre, claims in the article “How will Artificial Intelligence systems and Expert Systems impact the estate planning field?” in the “Journal of Financial Service Professionals”, that more and more life insurance companies are using expert underwriting systems for simpler cross-checking of smaller "clean case" underwriting functions so the underwriter can then spend time on more difficult task’s. Rabkin and Tingley (1999) together with (2001) confirm that AI methods assist insurers in this way.

Barnes (2001), a former investment banker and owner of the Boulder West mortgage bank, explains in the article “Instant mortgages” in the “Washington Builder, that two times in the last 18 months, 65 years of mortgage underwriting techniques were abandoned and replaced by AI software applications. He goes on to state that the first wave changed the evaluation of credit reports, and the second wave transformed the review and approval or denial of the loan application. Before, reviewing a consumer credit report required years of experience and training, an underwriter had to study thousands of reports before being trusted to recognize patterns that might cause trouble down the line. The new credit evaluation system is known, in shorthand, as “credit scoring.” and is based on a 300 to 900 point scale (BARNES, 2001). Schneider (2001) confirms, in the article “An intelligent approach to automated underwriting“ in the magazine “Bank Systems & Technology”, that Expert Systems have already found a home in the mortgage business.

### 6.2.4 Conclusion

The benefit of these new systems is that they reduce the amount of time necessary to approve a loan by using the computer to decide based on the variables that have been important throughout history. Without human influence in the decision-making process, it becomes a very clean decision without emotion or preconceived ideas. Whether to apply for or extend a loan is often a critical decision for a company or an individual. With this new fast approval are companies not making it to easy to make loans? Perhaps the time needed before AI came on the scene gave the borrower time to think it though carefully. However, the methods exist and are in use at this moment to make decisions. Evidently AI has penetrated the business of Credit Card Issuers, Collectors, Insurance and Mortgage.

## 6.3 Customer Relationship Management "Support & Marketing"

### 6.3.1 Support

This domain seems still to be dominated by advisory Expert Systems. This chapter will look at support for customers and employees, and an Expert System case study will be presented as well. First, however, the thesis will look at non-Expert System methods – specifically, advisory systems, and e-mail support systems that help employees to read, understand and compose automatic response e-mail.

The most common AI-based advisory system is probably the Office Assistant in Microsoft's Office 97 and 2000. According to Wildstrom (1997) in the article "Good help gets easier to find" in "BusinessWeek," and Allen (2001) in the article "The Myth of Artificial Intelligence" in "American heritage." the Office Assistant use uses "Bayesian belief network" to guess when the user needs help and why. Microsoft's Office package has a broad installed base today, as noted by Guglielmo and Babcock (2000) in their "ZDNet" article "The Microsoft-Free Office**",** more than 90 percent of the Windows market and an even greater share in the Macintosh market (GUGLIELMO, BABCOCK, 2000) This confirms my belief that AI-based products are already among us without our knowledge.

Professor Sloman and Dr. Logan (1999) write about current research concerning agents sorting a manager's incoming e-mail in an article "Building cognitively rich agents using the SIM agent toolkit" in Association for Computing Machinery. That was 1999, and those agents are presently running and helping companies handle increasing floods of e-mail. Deckmyn (1999) inform us in Computer World's article "One size doesn't fit all needs", a problem arose in 1997 when the Toronto Dominion Bank Financial Group (TD) was receiving more than 2,000 e-mail per month from its customers, and that number kept rising. She explains that TD went with Brightware's (now Firepond) AI-based software eServicePerformer, which handles TD's e-mail by automatically understanding the content of the messages, classifying them for appropriate handling, and dynamically composing replies to questions in incoming messages. TD's workers only have to review, approve and send the fully composed, personalized responses.

Despite having spent a large amount of time trying to determine which AI method eServicePerformer uses, the only information the author could find was is that it uses Fuzzy logic (FIREPOND, 2001) to decide which customer template it should use to categorize and respond to the customers' questions. It seems that the exact AI technique is a patented company secret. However, from reading about how the product works with information, ANN is a logical guess.

eServicePerformer delivered a successful AI solution for the bank. When the article was written, the software was responding up to 12,000 messages per month. According to an interview in Deckmyn's (1999) article, Steve Gesner, vice president of interactive services for the bank affirms, "About 40% to 45% of e-mails are answered automatically using AI techniques" said. Let us now look at a clear Expert System.

### 6.3.2 Case Study: HP

**Hewlett Packard Online Advice System (CAST/BW), (EXSYS, 2001).**

Hewlett Packard (HP), one of the leading manufacturers of computer network technology, wanted to increase the support of sales staff, employees, customers and potential clients by providing an online advice system. Nancy Clark at EXSYS explains that this advice system is a pure Expert System (CLARK, E-MAIL, 2001).

The interactive advice system CAST/BW, provides quick, accurate hardware sizing, network configuration, and usage recommendations. The system turns expert knowledge from SAP, HP internal competency centres, the HP Enterprise Server Group, and existing SAP Business Warehouse implementations into an easy-to-use advisory tool.

The Expert System functions in much the same way as working directly with HP's most knowledgeable systems analysts and product representatives. The system results are presented as a HTML page (a World Wide Web browser page), complete with product images, system recommendations and configurations it also offers direct links to order processing.

The inference engine in the Expert System determines the best hardware configuration based on rules in the knowledge base and customer requirements, recommends the configuration, and also provides a link to the HP E Commerce Web page. The results page is dated, customer input is displayed, and a visual diagram with product photos shows the appropriate equipment and system configuration, as well as details on processors and memory (EXSYS, 2001).

The customer is warned of any problems in performance if significant upgrades are recommended. Expert Systems also provide the ability to change/rerun and go through several different configurations based on different criteria (i.e., a cost-driven verses performance-driven comparison). And they make it possible for staff to identify cross-selling opportunities, and to be able to sell a much broader, more complex product line (CLARK, E-MAIL, 2001).

This Case Study shows how an Expert System can provide worldwide knowledge support, 24 hours a day, and reduce work, phone calls, and e-mail. Advisory Expert Systems have a firm ground in business, and have so had for many years. The Internet revolution has opened up the market for support systems, such as in the HP Case Study.

**(i)** Chatbots and robots

We have talked about how AI agents to handle our e-mail, and how Expert Systems give us advice through the Internet. Let us talk about chatbot, a computer on the Internet with who people can have a human-like conversation. The Loebner Prize is awarded to the most human-like computer, and was founded by the controversial Hugh Gene Loebner (LOEBNER, 2001). The last winner was Alice. In the article "The King is ready for a chat…"in "The Guardian", Hunt (2001) explains that Alice was created by Dr. Richard Wallace, together with approximately 300 amateur programmers. He explain further that Dr. Wallace analysed some 6,000 conversations with Alice, looking for input patterns so as to create new responses". According to Hunt, Penny Vinnie, Vice President of Ideas for the commercial chatbot Ask Jeeves.com, believes that the support potential is huge for interactive chatbots, particularly in the telecommunications world.

In the April, 2001 issue of "The Guardian", Fitzpatrick (2001) noted that AI-based robots are seen as a solution to the dramatically increasing number of elderly in Japan. The latest droids, PaPeRo and (Appendix 6), can recognise faces, respond when called for, switch on the television, and hold conversations, much like the chatbots described above. Another of these AI-based support robots is Memoni (Appendix 6). Fitzpatrick (2001) informs us that Memoni can also be used as a kind of secretary, as it keeps a diary and can remember users' schedules.

### 6.3.3 Marketing

Dr. Martin explains, in the article "Alien Intelligence " in "Journal of Business Strategy", that AI techniques can be used to find patterns that indicate which customers with certain characteristics should be targeted for highly focused marketing. Drucker (2000) writes about the company MarketSoft's software eOffers, in the article "Internet Marketing Gets More Analytical" in the paper "Internetweek". He concludes that it is a system that applies analytics and Artificial Intelligence to the management of marketing campaigns. eOffers is a Hybrid System that is partly an ANN and partly an Expert System. eOffers analyses proposed marketing messages and campaigns using rules set by marketing managers and filtered through multiple messages that may be directed at the same customer to select the most appropriate one. The system also controls how often a message should be sent to the same customer. The company Fidelity is working with this marketing management agent system.

The executive vice president of Fidelity's Personal Investment Group, Scott Peters, is quoted in Drucker's article as claiming:

> *"The system lets Fidelity more precisely target its messages to customers as well as control the timing and order of messages to create individualized campaigns. . . Fidelity is seeing measurable financial benefits from new account creation and increased investment in existing accounts. The gains in customer satisfaction have also been clear" (DRUCKER, 2000).*

He concludes, in "Internetweek", that marketing tools are no longer simply a way to automate the creation of campaigns. Rather, they are adding analytic capabilities and deeper integration with other customer relationship management applications to improve marketing effectiveness.

### 6.3.4 Conclusion

The Office Assistant in Microsoft's Office packages uses AI and has a broad installed base today, with more than 90 percent the Windows and Macintosh market (GUGLIELMO, BABCOCK, 2000). At the very least, this proves that support software containing AI has already penetrated the market. Advisory Expert Systems have been on the market for a long time. Nonetheless, the "HP" Case Study in Chapter 4 proves that companies still derive benefits from such systems. This chapter, in which we have also examined chatbots, robots, and marketing agents, supports the assumption that support system based on AI have already entered the business market and are frequently used.

## 6.4 Company Management

### 6.4.1 Control

Forman (2000) writes about employees Internet misuse in the article "Companies cracking down on employee Internet abuse " in "The Columbus Dispatch". Forman notes:

> *"An American Management Association survey this year found that 38 percent of the major U.S. companies (2100 firms) check their employees' e-mail and 54 percent monitor Internet connections. Of the 2,100 firms responding to the survey, 17 percent have fired employees for misusing the Internet. Twenty-six percent have given workers formal reprimands and 20 percent have issued informal warnings." (FORMAN, 2000)*

IT managers have increasingly had problems with employee abuse of the Web. RuleSpace Inc.'s Web Traffic Control is a tool that uses Neural Network (SLAUGHTER, 1999) to analyse the content of a Web page. It can prevent employees from visiting sites that are judged inappropriate based on content such as: pornography, hate material, weapons, drugs, gambling, stock trading, or job searches. Instead of relying on lists of already identified URLs or keywords, it examines text, images and network associations to identify and classify the page (RULESPACE, 2001).

Yasin (1999) explains in the article "IT Wields New Policies " in "Internetweek," that if the page is deemed inappropriate by Web Traffic Control, the software either blocks access or advises the user not to proceed based on criteria set by management. Companies are not only concerned about lost productivity, he point out, but also are afraid of lawsuits that could arise from employees being exposed to an inappropriate Web site on a colleague's screen. Yasin informs us in his article that Xerox Corp has fired more than 40 employees over the past year for inappropriate use of the Web. Spangler (2001) reports in the article "Corporate porn filters mean big business " in "ZDNet News" that systems that prevent employees from visiting sites that a company deems off-limits are fast becoming a standard part of business networks. Moreover, Spangler claims that IDC estimates the market will be worth $636 million by 2004.

### 6.4.2 Content Management Agents

Managers in companies pray for correct and timely information to support their decisions, instead of having to rely on a gut feeling. Information like faxes, e-mails, commercial information, Intranets (small-scale Internets within a company), the Internet, and corporate databases is now flooding companies. Thus, there is an overwhelming need for intelligent agent software that operates on behalf of humans, processing such information in a highly automated and customized fashion.

Schwartz (2000), in his article "Information management gets smart" in "InfoWorld" magazine, discusses Santa Ana-based NQL. NQL, whose customers include General Motors, CMGI, Lycos, and other Fortune 1000 companies, has patented a Network Query Language development platform used for the creation of an intelligent agent. NQL uses: Bayesian inference, Neural Network, and Fuzzy Logic that, in combination, make it possible to handle categorization and delivering the right content to the right person inside Microsoft Office applications.

### 6.4.3 Case Study "DTCU"

Two years ago, the Dallas Teachers Credit Union (DTCU) decided to become a community bank. The problem was where to build a branch office that would allow them to achieve their goal?

A "Business Week" article, written by Otis Port, relates some of the facts of this story. This article explains that DTCU contacted IBM to help them find the most suitable place to locate their new branch. IBM's expertise in Data Mining used their software IBM DB2 Intelligent Miner with its Neural Network and statistical techniques (IBM, 2001) search the demographic data provided for useful information. One of their targets was to locate people who might open checking accounts (which DTCU considered "easy money").

IBM's analysis pinpointed what triggered customers to drive to a certain branch to do business. By correlating where customers live to branch locations, and determining the amount of time it takes to drive the distance between the two, DTCU's Chief Information Officer, Jerry Thompson, discovered that if a branch was within a 10-minute drive, they had a checking account. But if the drive was 10 1/2 minutes, they did not have account

IBM's Business Intelligence application supplemented the data mining findings with virtual maps (Appendix 7). Using customer information such as addresses, income, etc., the software plotted the mined data onto local maps, which allowed the Credit Union to see not only where potential customers lived, but their rough earnings as well. McGeever (2000) explains, in Computer World's article "Business Intelligence", that using these Data mining methods, the Credit Union identified the top 10% of current profit-generating customers. He writes:

> *"By using this geographical data analysis, which draws information about the physical location of bank customers or prospective customers, it increased its customer base from 250,000 professional educators to 3.5 million potential customers"*

According to DTCU, with the maps, it was able to make an impressive visual presentation to its board of directors and to the Texas Credit Union (GEOGRAPHIC INFORMATION SYSTEM, 2001).

Port (2001) informs us, in the article "Virtual Prospecting From oil exploration to neurosurgery…" in "The Business Week", that DTCU opened its branch in north Dallas and turned profitable in only 90 days, instead of the one year that is normal. McGeever (2000) informs us that the credit union has also won its bid to a state commission to become a community bank, thanks to the visual maps.

### 6.4.4 Conclusion

I believe that, in coming years, we will see many more AI-based programs that control what we do on the Internet, and what we send and receive in our e-mail at work. I also believe that while preventing access to inappropriate web sites could be acceptable, checking employees' e-mail is going one step too far. Unless a reasonable limit is set, we will have a "Big Brother" society. Furthermore, with all of the electronic information that companies receive today, it is my opinion that intelligent agents will be used more and more often to process information in an automated and customized ways to ease information overload. In this chapter we have also examined the "DTCU" case study, a successful study that shows how Data Mining with ANN can help managers with their decisions.

## 6.5 Production Management

### 6.5.1 Scheduling

Dr. Martin (2000) cautions us in the article ”Alien Intelligence “ in “Journal of Business Strategy”, that a rich set of choices sometimes causes severe headaches in manufacturing. Martin point out “that half-assembled machines could easy pile up at one workstation while another workstation remained idle”. He describes a case were Genetic Algorithms have helped John Deere & Company with scheduling. Deere, founded in 1837, produces farm products, does business in more than 160 countries and employs approximately 43,000 people worldwide (DEERE, 2001). Martin (2000) concludes that the company, which found it difficult to control their inventory, was able to solve their problem by employing Genetic Algorithm (GA) technique that learned to ‘breed’ factory schedules far better than those humans could. Dr. Martin reports that with help of GA the farm production line is running more smoothly.

### 6.5.2 Case Study “Texaco”

It was noted, in the Denver (2000) article ”Smarter tools join smarter people“ in the journal “United States Oil & Gas Investor,” that tools like ANN give oil companies the advantage of drilling fewer dry holes, hitting drilling targets faster, and exploiting reservoirs more efficiently than their competitors. When an oil company exploits a reservoir, many wells are drilled through similar topography and under similar drilling conditions. Human experts learn from the experience gained during the drilling of the first several wells, and subsequent wells are often brought in more quickly. Neural Networks are a technology that is particularly well suited to automating this type of complex activity, according to the article “Exploration & Production“ in Science Applications International Corporation (SAIC) (SAIC, 2001). Until recently, geologists and geophysicists analysed data. Smith (2001) tells us, in her article” Texaco’s 3-D Pod Improving Oil Exploration“ in “ABC News”, that normally experts could take weeks to analyse the data.

Port (2001), points to Texaco, Inc. as an AI success story in his article “Virtual Prospecting From oil exploration to neurosurgery…” in Business Week. Port believes that for Texaco, Data Mining with ANN played a key role in discovering the huge Agbami oil field (containing an estimated 1.45 billion barrels of oil) off the coast of Nigeria, clearly paid off.

Port states that the signs of oil were spotted with Texaco's GeoProbe data-mining system, this system uses animated pictures (Appendix 8) to help geologists filter out relevant characteristics. Port explains that the traditional methods using static images had missed the discovery. Additionally, he notes one of the many the benefits of using Data Mining for Texaco: it has decreased the time for making drill/no-drill decisions from weeks to hours. Texaco now has a 3-D Visualization Centre (Appendix 8) to analyse seismic data and predict the most productive spots for drilling in oil fields (SMITH, 2001). Port (2001) concludes by informing us that facilities such as Texaco's are now spread around the globe in the oil industry.

### 6.5.3 Conclusion

As demonstrated above, AI software that learned to 'breed' factory schedules generates far better schedules than those that humans could produce with the help of Genetic Algorithms. The "Texaco" case study, moreover, showed how Data Mining with ANN, help solve some of the processing and interpretation problems for companies and in this case played a key role in discovering oil fields.

## 6.6 Finance Management

### 6.6.1 Predicting Stock Portfolios

Some believe that computers with Neural Networks are better at selecting stocks than people are. In an article in "Pensions & Investments," Williams (2001) explains that money managers have been slow to implement methods of AI to select stocks. But he also tell us that more and more companies are starting to use AI, including Fidelity Investments Inc., NeuWorld Financial, Advanced Investment Technologies, the Dutch pension fund ABP, etc.

Standard & Poor (S&P) (2001), which was established in 1860, has provided financial insight and analysis for 140 years. Boyd (2001) tells us, in the "Puget Sound Business Journal," about Standard & Poor's Neural Network called the Neural Fair Value 20 Portfolio. According to Boyd, the AI methods used try to find undervalued stocks and predict when they will become maximum price-appreciation targets. Boyd claims:

> *"Back-testing has shown that S&P's Neural Fair Value 20 Portfolio has outperformed the S&P 500-stock index by 19.8 percentage points over the past five years. In the first two months of 2001, the portfolio rose 6.6 percent, compared with a 6.1 percent decline in the S&P 500." (BOYED, 2001)*

In William's (2001) article "Pensions & Investments" article, Andre Archambault, S&P's Research Director, explains that the Neural Fair Value 20 Portfolio lends credibility to the use of AI methods in the investment business. Archambault gives us a test example and claims:

> *"The portfolio consists of the 20 stocks identified as having the greatest potential for price appreciation over six to 12 months. The portfolio was up 15.8% between Sept. 30, when it was introduced, and April 30, verses a decline of 18.7% for the S&P 500." (WILLIAMS, 2001).*

Andre Archambault states, in William's (2001) article, that because humans often fall in love with stocks, Neural Networks usually outperforms analysts. Even if these AI systems were only a few percentage points more accurate than their predecessors, because of the amounts of money involved, they would be very profitable. It is, therefore, reasonable to assume that if a company has discovered a method that gives it an important advantage over its competitors, it is locked in the safe as a company secret.

Whether for that reason, or simply because AI is rarely used in the stock arena is, difficult to say. It was virtually impossible to find Case Studies that discussed the role of AI in stock picking. However, one company, NeuWord, Inc., boldly claims that AI methods (i.e., ANN) outperform analysts in picking stocks.

### 6.6.2 Case Study "NeuWorld Financial"

Thomas Berghage and Maureen Caudill founded NeuWorld Financial in 1992. Barreto (2000), writes in her article "Artificial Intelligence Offers the Sci-Fi Touch to Hedge Fund Investing at NeuWorld" in **"**Hedgeworld Daily News*"*, NeuWorld started its "Capital Appreciation Fund LP" using AI to select the stocks for a long/short equity investment strategy, and that the fund now is worth $1 million. In Barreto's article, Barry Hippensteel Senior Vice President of NeuWorld, is claiming that this shows that machine that can analyse and pick stocks".

NeuWorld's AI system, which uses Neural Network technology to recognise patterns and intricate relationships, is called Eagle 12. It is pattern recognition that allows the machine to analyse large amounts of data for forecasting purposes. According to Barreto (2001), Eagle 12 analyses 4,000 U.S. stocks quarterly, using 116 variables while Wall Street analyst covers 30 to 40 stocks and uses fewer than 10 variables (WILLIAMS, 2001).

After the analysis Eagle 12 categorizes the stock into five categories. Rice (2001) explains these categories in Buyside Magazine's article, "Money Manager Profile." The first category is stocks that the computer forecasts to increase by 50% or more within the next 12 months, they are normally recommended for purchase. The second category, stocks up between 20 and 50%, are also recommended for purchase. In the third category are the stocks that are expected to be up between zero and 20%. Those stocks are neither recommended for purchase or sale. The last two categories contain stocks that are expected to drop and are, therefore, recommended for sale if they are in the portfolio.

In Barreto's article Hippensteel, Senior Vice President of NeuWorld reports that the firm has been pleased with Eagle 12's work, although the NeuWorld onshore fund has posted mixed results this year. In the third quarter, the fund lost 9.38%, but in August gained 12.54% net of fees (BARRETO, 2000). NeuWorld has also been managing the California Public Employees' Retirement System's (CalPERS) portfolio with Eagle 12.

CalPERS portfolio has shown mixed results, the reason for this is according to Mr Hippensteel that the computer is still learning. In Williams' article Mr. Hippensteel conclude:

> *"The portfolio was up 26.7% in 1999, compared with the 21% gain for the S&P 500. In 2000, a rough year by any measure, the portfolio was down 25.9%, compared with the S&P's decline of 9.1%. A revised system, called Eagle 12, has shown improved results. Between Dec. 1, 2000, and May 1, Eagle 12 gained 12.1% while the S&P declined 4.1%" (WILLIAMS, 2001).*

One year later, in an article by Rice (2001), Mr. Hippensteel reported on the CalPERS portfolio and highlighted its continuing success Hippensteel for almost three years ago they made a $100 million mock portfolio that has done extraordinarily well in the trailing 12 months. Hippensteel tells us that right now that portfolio is up 53.2% and continues by claiming that CalPERS is considering putting $100 million to $200 million under their management and buying a percentage ownership in NeuWorld.

### 6.6.3 Conclusion

Neural Network Modelling attempts to predict stock values and make portfolio decisions. However, finding information regarding Neural Networks' success in the field of finance is difficult, most likely because successful systems are being treated as company secrets.

The discussion of AI in the finance context has generally indicated that AI techniques are somewhat useful to most financial applications. AI techniques should catch on in coming years given the growing complexity of the markets, which will require more computing power and analysis to deal with information overload. It seems that many systems are best used as assistants to an existing teams of experts rather than on their own.

## 6.7 Conclusion

It seems clear that AI has gained a foothold in the world of business. That foothold, moreover, is getting larger and larger as time goes by. You might ask, "Why has it taken so long before these methods are visible in business applications?"

There are, in my opinion, at least four answers to that question. First, it seems that the development of processing power has been a catalyst that made it possible for AI-based system to gain a foothold in the business world. Furthermore, it is just lately that affordable computers with sufficient processing power have become available to companies. Second, AI often competes with business methods that have been quite successful and in use for very long periods of time. So, why risk changing a working concept companies may think. There are also some interpretation difficulties in some AI systems like old tried and true statistical methods win over ANN simply because people are unwilling to use a system where they do not see the effect of each variable (i.e., the Black Box). This can be a high threshold to overcome. Third, many AI applications involve large investments of money and failure can also be very costly, this makes the companies circumspect regarding investment decisions. Finally the forth reason is simply new technologies seems always have a threshold for acceptance. Furthermore, many critics believe that AI has not fulfilled its promise. Yet they do not discard it as a method. It is a fact that companies are using AI and earning money as a result.

# 7 FUTURE OF ARTIFICIAL INTELLIGENCE IN BUSINESS

Brehm's (1997), article "Speakers discuss past, present and future of AI" on MIT's web page, notes that Professor Winston, predicted that scientific breakthroughs in Artificial Intelligence (AI) are still in front of us:

> *"'Assuming that the science of AI is a 100-year enterprise that began in 1950, 2000 will be the halfway point . . . "Molecular biology reached its halfway point when Watson and Crick discovered DNA. That discovery shifted everything, it changed the world. We're waiting for the DNA equivalent in Artificial Intelligence. The goal of AI in the business world has changed over the past decade, moving away from the old idea of "replacing humans" to the higher-impact idea of "making people smarter." AI will become an "essential element in mainstream business systems" of the future'" (BREHM, 1997)*

The author of this thesis shares Professor Winston's opinion that AI will become essential, and that the AI revolution is still ahead of us. After massive reading and discussions in newsgroups about AI, a humble prediction of the future should be in order. In many of the areas discussed below, some progress is already made. Such progress will not only affect AI in businesses, but also life in general.

## 7.1 Customer Relationship Management

**(i)** Communication

Soon, instead of using our hands to operate computers, People will be able to communicate with computers in a much more civilized manner, namely with normal speech. With advances in language processing, computers will have a superior way of acquiring knowledge and exchanging information with humans. In the near future voice recognition and natural language understanding will be a reality. Natural language processing will provide important services for people who do not speak different languages. If a computer is able to understand natural languages, it will also be able to translate from one language to another. Lurie (1999), president of BeeLine Shopper, predicted in the "Automatic I.D." article "10 years later, a prognostication scoreboard tells tale," that language processing will permit presentation of Web sites and news in any one of hundreds of languages, and provide instantaneous translation and publicity on several web sites in several other languages (LURIE, 1999). Another possibility is that a person could have a real-time conversation with another person, who speaks a different language, using a real-time translating computer. Such a useful tool might even be built in our mobile phones in the future. Possible applications for such a device seem limitless.

**(ii)** Support

In the near future, the Japanese will probably have robots that support the elderly in their homes, and different types of intelligent robots will be used in the military around the world. There are a myriad of ethical and moral issues that could arise in the wake of continually developing AI, especially if such technology learns at electronic speed and evolves new programs for itself. In Stanley Kubrick's old film "2001," the AI-based computer H.A.L. decided to kill human astronauts. "The Matrix" and "The Terminator" echo this frightening future scenario. These possibilities frequently appear on the newsgroup "comp.ai.philosophy," as do discussions of Isaac Asimov's rules of robotics (Appendix 9), which could prevent these unlikely scenarios. But if computers could reprogram themselves in intelligent ways that cannot be anticipated, what would happen then?

**(iii)** Marketing

Dr. Martin (2001) speaks of possible future marketing scenarios, using the television, in his article, "Alien intelligence," in the Journal of Business Strategy. According to Dr. Martin, when the device detects emotion in the watcher's face, it could target an advertisement or a specific TV program. Whether or not AI goes in this direction, it is my opinion that the public will see much more focused marketing that targets the right people with appropriate products based on thought analysis of customers' behaviour. There will be more. The last example, in fact, is the natural extension of the AI techniques presented in Chapter 6.1.2, and the "FedEx" case study in Chapter 6.1.3. And perhaps the winning companies will be those that by, collecting vast amounts of customer data and using AI methods to analyse the information, are able to run their business in more intelligent ways.

## 7.2 Company Management

In their Association for Computing Machinery 1999 article, "Building cognitively rich agents using the SIM agent toolkit," Professor Sloman and Dr. Logan (1999) discuss the possibility that, in the future, a manager in a large company could be replaced by a group of software agents that attempt to obtain and summarize information about other companies.

Maney (2001) reports, in his article "Artificial Intelligence isn't just a movie" on the "USA TODAY" web site, that Microsoft scientist Eric Horvitz has been working on AI software that would allow PCs help manage workload by understanding what a person is doing, evaluating that work, and then making decisions about what information and messages should be delivered at a given time. It would categorize incoming messages into different levels of importance and, depending on the priority of the work the employee is doing, determine whether the employee should be interrupted with the message. This would indeed help busy managers.

## 7.3 Conclusion

Discounting such cynical scenarios of robots turning against us, there is a more probable, yet still pessimistic, outcome. My opinion is that AI will likely cause segregation between countries and social groups to increase. The first country that can truly predict fluctuations in the stock market will have a definite economic advantage over the rest. In short, the countries that have the resources and desire to invest in AI will be among the winners. People could also be divided into two main social groups: those who are knowledgeable about computers and can control them, and those who cannot. Those who are charged with and have the power to control the computers will control society, and the services of others will simply not be required.

# 8 CONCLUSIONS & RECOMMENDATIONS

As mentioned earlier (Chapter 6.3.1), many businesses work with AI without knowing it, for example, the Office Assistant in Microsoft's Office packages that uses AI (WILDSTROM, 1997) (ALLAN, 2000). Microsoft's Office package has a broad installed base today with more than 90 percent the windows and Macintosh market (GUGLIELMO, BABCOCK, 2000). At the very least, this proves that software containing AI methods has already penetrated the market. But let us talk about a more deliberate AI application.

A large problem for today's decision makers is the overwhelming amount of ever-increasing mountains of information. The key for managers is being able to examine and isolate essential information on which to base their vital, competitive business decisions. Today's market is as competitive as ever and managers of companies, in my opinion, fail to fulfil their duty to their stockholders if they do not realise and accept methods such as AI, as a possibility.

AI is used successfully today as a tool to refine, derive and analyse vast amounts of information in our society. Some industries, such as the "collections business" have adopted AI in their support systems. These AI techniques can automatically learn about customers and their behaviour using Neural-Network software. Maintenance industries breed efficient maintenance schedules with Genetic Algorithms and use Neural-Network software to try to anticipate problems before they happen.

## 8.1 The Hypothesis:

$H_0$ = AI has had a noteworthy and slowly escalating impact on Business

$H_A \neq$ AI has had a noteworthy and slowly escalating impact on Business

In my opinion, my work on this thesis has proven that hypothesis "$H_0$" is true. The logical conclusion for managers is that they need to focus their attention on AI or, at the very least, keep an eye on AI developments. Businesses should consider whether AI methods could be used to gain a competitive advantage, and when circumstances warrant invest seriously in AI.

Today, AI is not essential to business success. Yet AI can eliminate certain menial or repetitive tasks. It also promises to detect patterns that would not otherwise be visible to the naked eye. In my opinion, AI applications will become essential to many companies in different domains. AI may not always be a solution for every company, but failing to examine the possibility of utilizing AI could be serious for a company's competitiveness in the near future.

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# 10 APPENDIXES

## Appendix 1

Glossary of short definitions for AI terminology. (FOLDOC, 2001) (HOWE, 1993) (WILSON, 2001) (STOTTLER, 2001) (KIMBALL, 2001)

**Agent**
Anything that can be viewed a perceiving its environment through sensors and acting upon that environment through effectors.

**Automatic Programming**
The task of describing what a program should do and having the AI system 'write' the program.

**Backward Chaining**
In a logic system, reasoning from a query to the data. See forward chaining.

**Backpropagation**
Supervised learning. At least a two layer feed forward Neural Network. This is the most widely used type of neural net.

**Bayesian Network**
A mechanism for representing probabilistic knowledge. Inference algorithms in belief networks use the structure of the network to generate inferences efficiently (compared to joint probability distributions over all the variables).

**Character Recognition**
The process of applying pattern-matching methods to character shapes that have been read into a computer to determine the character that the shapes represent.

**Decision Support System**
A program data, which assist in analysis and decision-making.

**Forward Chaining:**
In a logic system, reasoning from facts to conclusions. See Backward Chaining

**Hidden Layer**
One or more layer between the input and the output layer

**Inference Engine**
The processing portion of an Expert System. With information from the knowledge base, the inference engine provides the reasoning ability that derive inferences (conclusions) on which the Expert System acts.

**Intelligent Agent**
Software that is given a particular mission, carries out that mission, and then reports back to the user.

**Input Layer:**
The layer were the input information is presented

**Knowledge Acquisition**
The gathering of expertise from a human expert for entry into an Expert System.

**Machine Learning:**
A field of AI concerned with programs that learn from experience. It includes Reinforcement Learning and Neural Networks among many other fields.

**Non-linear Planning (NP):**
A planning paradigm, which does not enforce a total (linear) ordering on the components of a plan.

**Output Layer**
The layer, which produces a neural net's output.

**Speech Recognition**
Conversion of speech into text.

**Symbolic AI**
Try to replicate how we human do things. It uses a high-level computer programs used to model cognitive process. It is based on the "Physical symbol system hypothesis". It occurs in Expert System, logic reasoning, planning, and problem solving etc.

**Sub symbolic AI**
Try to simulate the brain function. Attempts to build AI models using understanding of the human brain neural processes. It has given raise to ANN (Artificial Neural Network).

**Visual Pattern Recognition**
The ability to reproduce the human sense of sight on a machine.

# Appendix 2

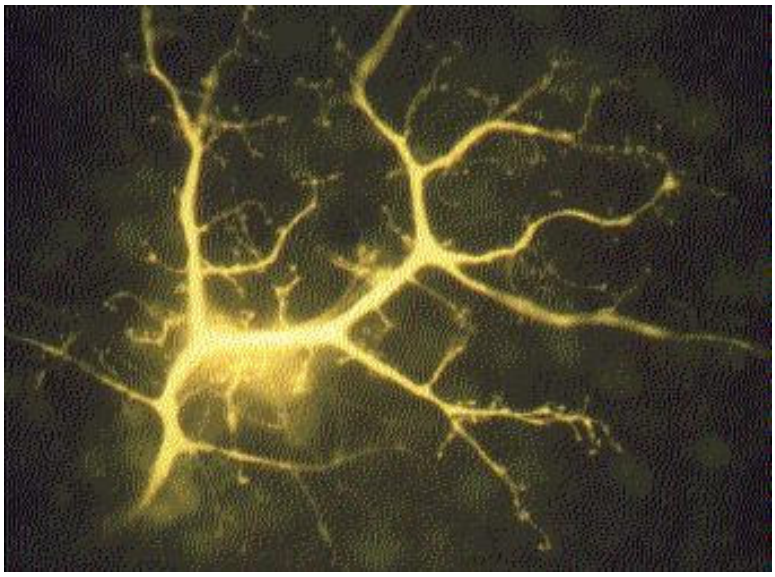

Figure 10-1 Photo of a neuron (KIMBALL, 2001)

# Appendix 3

| | |
|---|---|
| Game 1 5/3/97: Kasparov wins | Game 2 5/4/97: Deep Blue wins |
| Game 3 5/6/97: Draw | Game 4: 5/7/97: Draw |
| Game 5: 5/10/97: Draw | Game 6: 5/11/97: Deep Blue wins |

Table 10-1 Game results IBM vs. Kasparov (DEEP BLUE, 2001)

# Appendix 4

**CHRONOLOGY OF ARTIFICIAL INTELLIGENCE**
The following history of Artificial Intelligence is gathered from Imperial College and the University of Pittsburgh. () History of AI made from American Association of Artificial Intelligence and Massachusetts of Technology Artificial Intelligence Lab (USA TODAY, 2001), (MIT, Timeline of AI, 2001), (WFMO, 2001) BUCHANAN, 2001)(TRUDEL, 2001)

**ANCIENT HISTORY**
Greek myths of Hephaestus and Pygmalion incorporate the idea of intelligent robots. Many other myths in antiquity involve human-like artifacts. Many mechanical toys and models were actually constructed, e.g., by Hero, Daedalus and other real persons.

**5TH CENTURY B.C.**
Aristotle invented syllogistic logic, the first formal deductive reasoning system.

**3 TH CENTURY B.C.**
A papyrus that was bought in a Luxor antique shop by Edwin Smith in 1882 was prepared representing 48 surgical observations of head wounds. The observations were stated in symptom-diagnosis-treatment-prognosis combinations as: IF a patient has this symptom, THEN he has this injury with this prognosis if this treatment is applied. This was the first known Expert System.

**15TH CENTURY**
Invention of printing using moveable type. Gutenberg Bible printed (1456).
Clocks, the first modern measuring machines, were first produced using lathes.

**16TH CENTURY**
Clockmakers extended their craft to creating mechanical animals and other novelties. Rabbi Loew of Prague is said to have invented the Golem, a clay man brought to life (1580).

**17TH CENTURY**
Hobbes published The Leviathan, containing a material and combinatorial theory of thinking. Pascal created the first mechanical digital calculating machine (1642). lly.

**18TH CENTURY**
The 18th century saw a profusion of mechanical toys, including the celebrated mechanical duck of Vaucanson and von Kempelen's phony mechanical chess player, The Turk (1769).

**19TH CENTURY**
1832 Charles Babbage designed the 'analytical engine,' a mechanical programmable computer. He had earlier designed a more limited Difference Engine in 1822, which he never finished building. Herman Hollerith patented a tabulating machine to process census data fed in on punched cards. His company, the Tabulating Machine Company, eventually merged into what was to become IBM.

**20TH CENTURY FIRST HALF**

1937 Alan Turing conceived of a universal Turing machine that could mimic the operation of any other computing machine. However, as did Godel, he also recognized that there exist certain kinds of calculations that no machine could perform. Even recognizing this limit on computers, Turing still did not doubt that computers could be made to think.

1943 Walter Pitts and Warren McCullock showed how Artificial Neural Networks could compute, relying on the use of feedback loops.

1948 Nobert Wiener published Cybernetics, a landmark book on information theory. "Cybernetics" means "the science of control and communication in the animal and the machine."

**20TH CENTURY SECOND HALF "MODERN HISTORY"**

1950 Turing proposed his test, the Turing test, to recognize machine intelligence.

1951 Marvin Minsky and Dean Edmonds build the first Artificial Neural Network that simulated a rat finding its way through a maze.

1955 - 1956 Allen Newell, Herbert Simon, and J.C. Shaw wrote Logic Theorist, the first AI program. It proved theorems using a combination of searching, goal-oriented behaviour, and application of rules.

1956 A two-month summer conference on thinking machines was held at Dartmouth University. John McCarthy coined the term "Artificial Intelligence" as the topic of the Dartmouth Conference, the first conference devoted to the subject. Demonstration of the first running AI program, the Logic Theorist (LT) written by Allen Newell, J.C. Shaw and Herbert Simon (Carnegie Institute of Technology, now Carnegie Mellon University).

1958 John McCarthy and Marvin Minsky founded the Artificial Intelligence Laboratory at the Massachusetts Institute of Technology. John McCarthy developed the LISP program at MIT for AI work.

1961 Mortimer Taube, an engineer, authored the first anti-AI book, "Computers and Common Sense: The Myth of Thinking Machines." It did not receive much attention.

1963 The Stanford University founded the Artificial Intelligence Laboratory under John McCarthy.

1965 Brothers, Herbert L. Dreyfus, a philosopher, and Stuart E. Dreyfus, a mathematician, wrote a strongly anti-AI paper, "Alchemy and AI"

1966 First Machine Intelligence workshop at Edinburgh - the first of an influential annual series organized by Donald Michie and others. Negative report on machine translation kills much work in Natural Language Processing (NLP) for many years.

1967 Dendral program (Edward Feigenbaum, Joshua Lederberg, Bruce Buchanan, Georgia Sutherland at Stanford) demonstrated to interpret mass spectra on organic chemical compounds. First successful knowledge-based program for scientific reasoning.

1968 Marvin Minsky & Seymour Papert publishes Perceptrons, demonstrating limits of simple neural nets.

1969 Marvin Minsky and Seymour Papert published their book, Perceptrons—An Introduction to Computational Geometry.

1970s Earlier machine learning efforts aimed at enabling computers to automatically optimize appropriate weights for variables they had been told were important to solving a problem. Now efforts were directed to automatically deriving those variables themselves—in other words, automatic concept formation.

1970 Jaime Carbonell (Sr.) developed SCHOLAR, an interactive program for computer-aided instruction based on semantic nets as the representation of knowledge

1971-1972 Alain Colmerauer and Phillipe Roussel wrote the computer language, PROLOG It was revised in 1974 to force logical statements (i.e., IF ... THEN) to be written only in the Horn clause format. This permitted it to solve problems that required showing something was NOT true to be concluded in a finite number of steps. PROLOG became the favored AI language outside the U.S. where LISP still held sway.

1972 on Edward Shortliffe, a Stanford doctoral student under Bruce Buchanan, and others wrote Mycin, an Expert System to diagnose infectious blood diseases and recommend antibiotics, with dosage adjusted for patient's body weight. They also created the first Expert System shell, that contained the inference engine, which contained the logic of how rules were to be applied. Mycin could also deal with probabilistic rules, which Dendral couldn't. Mycin could outperform human clinicians in some trials. A difficulty that arose during the writing of these and subsequent Expert Systems has been the extraction of the knowledge from human experts into the rules, the so-called knowledge engineering.

1972 Herbert Dreyfus expanded his "Alchemy and AI" paper into an aggressively anti-AI book, "What Computers Can't Do."

1973 Sir James Lighthill, Cambridge University's Lucasian Chair of Applied Mathematics, advised the British government to cease most AI research in Britain. Ted Shortliffe's PhD dissertation on Mycin (Stanford) demonstrated the power of rule-based systems for knowledge representation and inference in the domain of medical diagnosis and therapy. Sometimes called the first Expert System. Earl Sacerdoti developed one of the first planning programs, ABSTRIPS, and developed techniques of hierarchical planning.

1975 Marvin Minsky published his widely read and influential article on Frames as a representation of knowledge, in which many ideas about schemas and semantic links are brought together. Paul J. Werbos invented the back-propagation algorithm that enabled multilayer Neural Networks that had the ability to perform classification operations beyond simple Perceptrons.

1979 Bill VanMelle's PhD dissertation at Stanford demonstrated the generality of Mysin's representation of knowledge and style of reasoning in his Emycin program, the model for many commercial Expert System "shells".

Late 1970s First commercial Expert System was developed. It was XCON (for eXpert CONfigurer), developed by John McDermott at Carnegie Mellon. Practical, commercial applications of AI were still rare.

1980s Fuzzy Logic was introduced in a fuzzy predictive system used to operate the automated subway trains in Sendai, Japan. This system, designed by Hitachi, reduced energy consumption by 10% and lowered the margin of error in stopping the trains at specified positions to less than 10 centimeters. Commercial AI products were only returning a few million dollars in revenue. First industrial application of a fuzzy controller by Danish cement manufacturer, F.L. Smidth & Co. A/S to regulate the operation of a cement kiln, which is a complex process subject to random disturbances that made it difficult for an operator to control. First Expert System shells and commercial applications.

1984 GE built an Expert System based on electric locomotive diagnosis knowledge of one expert, David Smith, who was close to retirement. Called the Diesel Electric Locomotive Troubleshooting Aid, it could diagnose 80% of breakdowns, and provide repair instructions.

1985 Speech systems now able to provide any of the following: a large vocabulary, continuous speech recognition, or speaker independence.

1987 Etienne Wenger published his book, "Artificial Intelligence and Tutoring Systems: Computational and Cognitive Approaches to the Communication of Knowledge," a milestone in the development of intelligent tutoring systems.

1987 Marvin Minsky publishes The Society of Mind, a theoretical description of the mind as a collection of cooperating agents.

End of 1980s Expert Systems were increasingly used in industry, and other AI techniques were being implemented jointly with conventional software, often unnoticed but with beneficial effect.

1990s and 2000s
Automatic scheduling software to automatically create better project schedules faster Advanced learning software that works like human tutor in teaching one-on-one with each student Continuous speech recognition programs that accurately turn speech into text Face-recognition systems, Washing machines that automatically adjust to different conditions to wash clothes better Automatic mortgage underwriting systems, Automatic investment decision makers, Software that improves the prediction of daily revenues and staffing requirements for a business, Credit fraud detection systems Help desk support systems that help find the right answer to any customer's question faster , Shopping bots on the web, Data Mining tools E-mail filters, Automated advice systems that personalize their responses And many, many more., Many commercialises of such products and services aren't identifying their use of Artificial Intelligence in their products and services. Probably they're not doing so because "Artificial Intelligence" is not perceived to sell, while improved intelligent solutions to a customer's problem does.

Late 90's Web crawlers and other AI-based information extraction programs become essential in widespread use of the world-wide-web. An Artificial Intelligence system, Remote Agent, was given primary control of a spacecraft for the first time. 2000 Interactive robot pets (a.k.a. "smart toys") become commercially available, realizing the vision of the 18th century. novelty toy makers. The Nomad robot explores remote regions of Antarctica looking for meteorite samples

## Appendix 4

- Capture, refine, package and distribute expertise.
- Difficult or impossible to describe problem as algorithms.
- Desire to "preserve" specialist skills.
- Essential to receive expert advice quickly.
- When decisions must be made even with incomplete information.
- Expert skills are mainly of "heuristic" nature.
- Provide expertise when human expertise is not available.
- A large amount of unstructured information needs to be "filtered".
- Provide expertise more uniformly and rapidly than available from human experts.
- High-risk situation where quick "ultra reliable" decisions are a demand.
- Imperative to be able to distribute expert knowledge or policies.
- Desire to make expert skills (silent knowledge) explicit.
- Several experts' knowledge must be used for the activity.
- Solve problems where complexity exceeds human ability.
- Solve problems where the required scope of knowledge exceeds that of any individual.
- Desire to make expert skills more consistent Complex problems with many influencing factors Qualified training method ("master training") Skills must be accumulated and modified easily.

Table 10-1 Motives for implementing (NOVACAST, 2001)

# Appendix 5

**Production**

Control processes at desired conditions.
Quality assurance
Computer vision
Product Forecasting
Time series forecasts
Optimisation problems
Simulation
Jet Engine Diagnostics
Capacity planning
System design
Product quality control

Programming
Process control
Routines for detecting defects
Diagnosing causes of defects
Output prognosis – quality
Selection of materials
Quality control
Knowledge structuring
Design optimisation

Evolvable Hardware
Digital Filter Design. RADAR / SONAR/ GPS signal processing.
Fusion of information from multiple sensors.
Aerodynamic design.
Optimal Design of Shell-and-Tube Heat Exchangers

**Personnel Employment tests**

Right man for the job
Training system
Policy bank

**Marketing Applications**

Fashion forecasting
Retail assortment planning
Retail promotion strategies
Retail grocery product demands
Market share forecasting

Neural Network Based
Expert System Based
Genetic Algorithm Based

**Business and Finance**

Market timing
Direct Mail Solicitation
Simulation Predicting and evaluating bankrupt firms
Thrift failures
Bank interest rates
Foreign exchanges rates
Stock price performance
Mortgage risks
Credit applications
Credit analysis
Optimisation problems
Stock market analysis
Stock market forecasting
Stock portfolio adviser

Negotiations technique
Prognosis on shares, currency, etc.
Credit evaluation
Company analysis
Investment advice
Structure tax rules

Electricity market simulation.
Scheduling problems
The Job-Shop Scheduling Problem (JSSP)
Timetabling
PID-Controller design.
Economic optimal growth modelling.

**Business activity prognosis**

Optimal Business strategy and tactics
Optimal price policy
Form policies
Competitor analysis
Result prognosis
Supplier evaluation

**Others**

Understanding natural language
Speech recognition
Character recognition
Fingerprint identification
Handwriting recognition
Paint formulary

Table 10-2 Successful AI applications in Business: (MCCARTHY, 2000) Et al. (JIANG ET AL., 2001) (STOTTLER, 2001) (NOVACAST, 2001), (FRÖHLICH, 1996) (BEASLEY, HEITKOETTER, 2001) (STORN, 2001):

# Appendix 6

Figure 10-2 Tomy's Memoni (MEMONI, 2001)

Figure 10-3 NEC's PaPeRo (PAPEPO, 2001)

# Appendix 7

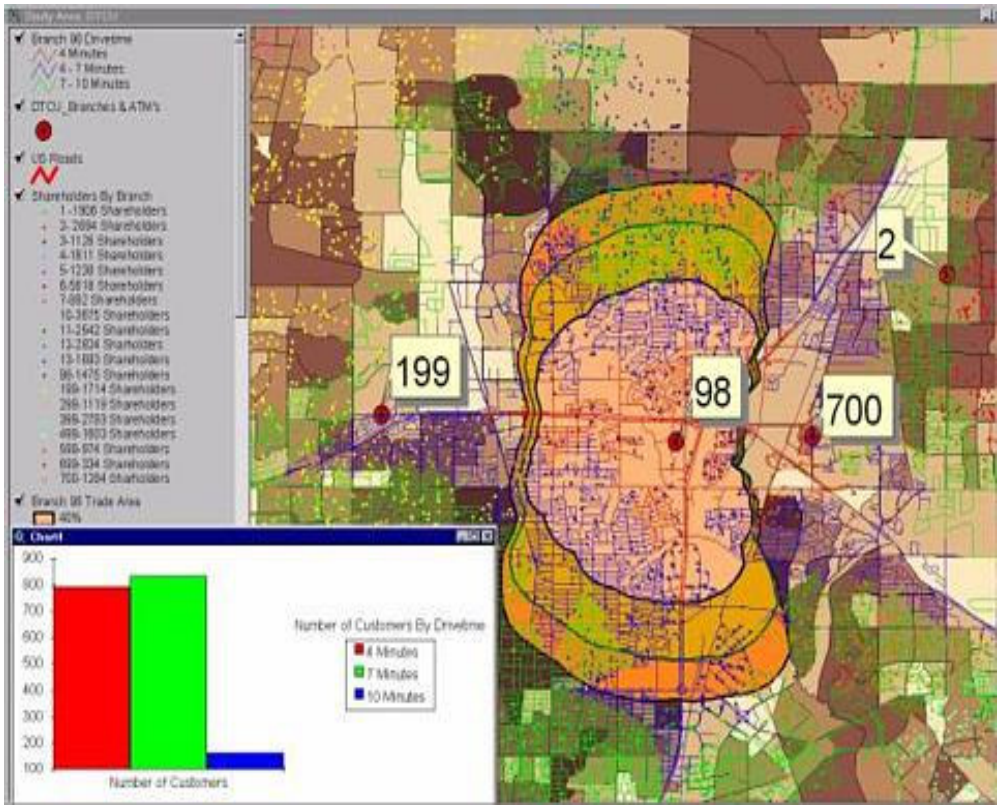


Figure 10-4 Visual Map for DTCU case study (URRICO, 2001)

# Appendix 8


Figure 10-5 Visual data representation for Texaco case study II (SMITH, 2001)

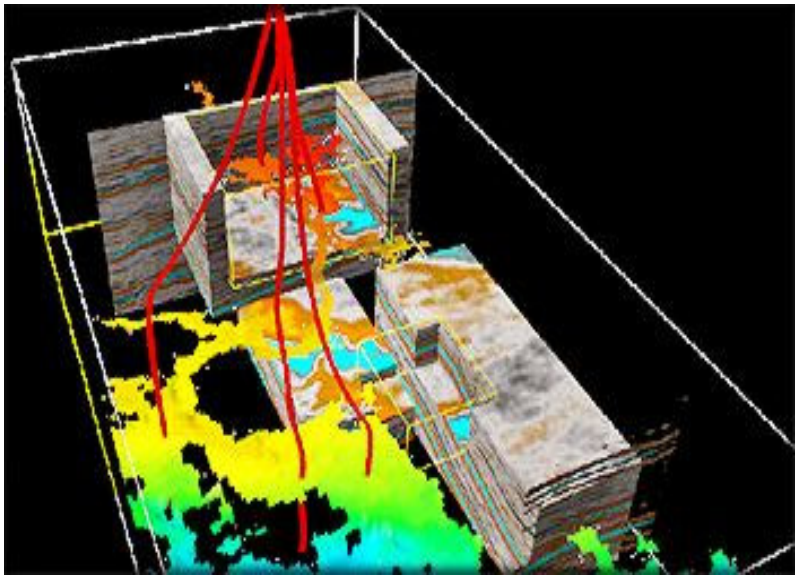

Figure 10-6 Visual data representation for Texaco case study II (SMITH, 2001)

## Appendix 9

| |
|---|
| **1) A robot may not injure a human being, or, through inaction, allow a human being to come to harm.** |
| **2) A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.** |
| **3) A robot must protect its own existence as long as such protection does not conflict with the First and Second Laws.** |

Table 10-3 Rules of Robotics made by Isaac Asimov: (MOREM, 2001)