The Presentation of Business Process Models

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Abstract

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It has become common practice for businesses encompassing all industries to utilize a tool or technique to capture the data and flow of processes running through a company. As companies grow and the volume and complexity of the business processes increases, it becomes of greater importance to rigorously record the functions being performed. As a consequence of this, the simple diagrams that once represented the flows of information steadily become page after page of complex transactions. Effectively communicating the information stored within these large and often complex models to the end user is a significant problem. This research addresses the issues surrounding the presentation of such large scale and complex Business Process Models to the end user.

An in depth literature review and benchmarking study was carried out, with the intention of investigating the current practices used within industry, and identifying any operational issues regarding these practices. Through this research work, a methodology is developed to allow the transformation and transportation of a selected area within a complex business process model. This transformation/transportation process allows the generation of a new model, containing clear and simple process logic and presented in a user-friendly format.

The entire methodology is an automated process allowing the end user to quickly select an area within a complex process model, then transform and transport this area into a model of reduced complexity. This in turn increases the value process modelling on a cooperate wide scale, as the reduction of complexity could increase the volume of users utilising process modelling, promoting a shared vision of an organisation.

Acknowledgements

This MPhil research was completed as part of the Master of Philosophy at the School of Engineering, Sheffield Hallam University, between October 2001 and June 2003. The work is my own and the results obtained during the MPhil program are to the best of my knowledge, original, the work of others used or drawn upon is attributed to the relevant source.

I would like to thank all of the people who have contributed to the successful completion of this research work. In particular my project supervisor Professor Terrence Perera for his input and guidance throughout the programme. I would also like to thank my family and friends for their support and patience throughout my time at Sheffield.

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Introduction

1.1 Introduction

In an increasingly competitive market place only businesses that can stay cost effective will survive (Porter 1980a, 1985). This has forced organisations to continually look for new technology and business practices that can remove processes that do not add value to a product or service (Mintzberg and Quinn 1995).
It has long been established that effectively sequencing tasks to produce an end result can drastically reduce costs. This idea was underlined by the rise of business process re-engineering, which in the late 80s and early 90s made organisations think about their business practices, often for the first time (Hewitt 1995 and Davenport 1990). This has lead to the development of many sophisticated software packages dedicated to business process modelling. The purpose of this software is to capture, document and analyse business processes (Davis 2001a p4).

Initial research conducted has suggested that the uptake of these dedicated modelling packages by organisations has been slow, and in the examples where a package has been purchased, the use of the tool is often limited. Although some companies do utilise a specific tool to form the basis for their day to day process modelling needs, many others will use a variety of tools for one off projects, then never use the tool again.

Through discussions with process modelling vendors and by studying there past case studies, it is evident that this utilisation of process modelling tools for specific projects is a flourishing market. The use of these modelling tools on a corporate wide scale, however, has been a slower uptake.

The lack of companies corporately adopting modelling tools as their standard procedure for capturing business processes is puzzling. If BPR has lead to an appreciation of the importance of business processes (Hewitt 1995 and Davenport 1990), then why hasn't there been an increase in the use of modelling tools that reflects this growing awareness?

Although there is information available concerning process modelling, it is largely product information and successful case studies developed in cooperation with the product vendors. There has been very little published about the operational and development issues surrounding process modelling.
The scarcity of information available pointed to one possible reason for the slow uptake of modelling tools. It also meant that to gain a true appreciation of the perception of process modelling within industry, meetings with model users and vendors would be necessary.

It was through these meetings that the following reasons were identified to explain the slow uptake of process modelling tools.

- **Lack of awareness** – As the Author experienced, there is a lack of information available. There are very few community events for practitioners dedicated process modelling, which as a result means that companies are not being exposed to the potential advantages through meeting with companies successfully using process modelling. Many companies are simply unaware that these tools exist.
- **Poor understanding of potential benefits** – There is a perception within industry that modelling packages are simply diagramming tools, and their functionality is limited to drawing pictures. There is no appreciation for the potential cost savings and process understanding that a modelling package can bring.
- **Resource intensive** – The adoption of any new business practice, particularly in relation to software tools will be an expensive and resource intensive process. Staff will require training, computers will need upgrading and the cost of the tool itself has to be considered. Companies often fail to see beyond these costs to the potential savings that can be made.

The issues identified above illustrate the main reasons why the uptake of process modelling tools has been slow. They do not, however, explain why the use of such modelling tools after a product has been purchased remains limited to one off projects. It is this question that will be further investigated.

1.2 Operational Issues

Large-scale organisations such as British Telecom do utilize modelling tools to great effect, in order to perform a number of different tasks (BT Exact 2002):

- Conceptualise the processes within the organisation.
- Structure these processes.
- Analyse the performance of these processes.
- Optimise these processes for efficiency.

Initially the use of process modelling tools within B.T was limited to dedicated teams working on very specialised tasks. The users were, therefore, highly trained and experienced with the software. The success and versatility of the modelling tool, however, has meant that the use of the software has begun to spread throughout the organisation.

The potential advantage of corporate wide modelling for organisations is that all areas and aspects of business can be captured through the use of the same standardised models. The real benefit of process modelling is then felt through the communication and sharing of process logic and new ideas. It is vital then, that a common approach to modelling is applied (Scheer, 1998) so that companies may gain all the benefits that process modelling has to offer (Pidd, 1996).

The use of a process modelling tool on a cooperate wide scale, however, is not without problems. As more and more users are added, the licensing costs will obviously increase, and a company might have to intensively train a greater number of its staff. These issues are largely economic and have to be resolved by the individual businesses.

There is however, a technical issue that forms another obstacle to the success of cooperate wide process modelling, that could potentially be resolved.

The increase in the use of modelling tools within B.T has meant that many more users with little or no experience with process modelling have come in to contact with the software in some way.

The problem that faces these new users is that they are often presented with large business models which can be several pages long, with the majority of the data being of little relevance to them. The user would have to filter out the part of the model that represents their individual responsibility. This can often be a complex and confusing task, particularly if the software is not in a format with which they can relate.

After initial discussions with Industrial contacts it became evident that although there are obvious benefits to process modelling, the impact it might have on an organisation was being limited by the presentation capabilities of the tools being used. These presentation issues were restricting the use of the tool itself to smaller projects.

This lead to the obvious question, was there a better way to present the complex data in a model in a more user friendly and understandable way?

1.3 Objectives of the Research

The aim of this research therefore is to gain a greater understanding of the issues surrounding the presentation of large scale business process models. Once these issues have been identified a method must be found to overcome any presentation problems so that corporate wide modeling can be facilitated.

These aims will be accomplished in the following four objectives.

1.3.1 Literature Review

In order to generate a beneficial recommendation, the problem itself must first be fully appreciated. The first stage of the research, therefore, must be dedicated to gaining a greater understanding of what process modelling entails.

The investigation will be conducted in the form of a literature review. This will include the current thoughts of academia, current practitioners and pioneers in the field of process modelling. It will look at how modelling has evolved over time to become more than simple flow diagrams. Although the research will take a general overview of the practices involved in business process modelling, it will be predominately focussed around the presentation techniques adopted by process modelling packages currently available.

To gain a greater understanding of the problems presented by presentation issues, visits will be arranged with industrial contacts. This will provide a greater understanding of the problem and allow a list of requirements for any possible solution to be formed. Visits will also be arranged to the software vendors in order to discuss the issues surrounding the presentation capabilities of current tools.

1.3.2 Benchmarking Software modelling & presentation techniques

Due to the diversity of modern business needs, there is now an equally large number of process modelling packages available on the market, which claim to meet the specific requirements of every business (Sodan, 2002). Although there are similarities between many of the packages, there are clear market leaders. The first task of benchmarking will be to evaluate the different techniques used to model business processes, identifying the strengths and weaknesses within each approach (Zairi, 1994).

As well as the way in which data is captured and stored, the packages also differ through the means in which they present this data to the end user. Through our discussions with industrial partners it has become clear that model presentation is a key issue, and can often be a deciding factor when it comes to selecting a suitable package.

Identifying good practice in model presentation is therefore invaluable, and will be accomplished through benchmarking the various methods currently used (Hewitt, 1995 and Watson, 1993)

The benchmarking study should highlight the best way in which to capture and store business processes and the most effective way in which to communicate this data with the target audience.

1.3.3 Develop a methodology to transform Business Process Models into a customised format.

Subsequent to the benchmarking process a suitable package will have been selected based upon the strengths of its modelling techniques as well as its flexibility to embrace further development.

The first stage of this development will be to understand what data from the original model needs isolating, and the method in order to achieve this.

Once the relevant data has been captured, the second stage of development will involve the transportation of this data out of the original tool into a new environment.

The third stage will be to develop the visualisation aspects of the new model. How will the information be displayed and what method will be used to do this. The benchmarking study should provide recommendations to allow this stage of the development to be completed.

It is expected that any development will utilise web-based technologies as the market leading packages offer web publishing capabilities. The ability to communicate process models over the Internet or Corporate Intranet has become increasingly necessary due to the national and often international nature of modern business (Aris, 2002).

1.3.4 Design and construct a prototype tool, which can then be validated and refined.

Once a methodology has been developed, the next step is to design and construct a prototype tool. The design phase will be conducted with original user requirements acting as a major point of reference. It will also be important to incorporate the lessons learnt about the presentation techniques obtained through the research conducted.

Once a solution has been developed it is crucial that any new model created gives a true representation of the original model. This is not to say that every element in the new model should be kept the same, as a simplification of the original model may be required. It is important, however, that the new model does not present any inaccurate data to the end user, and that data is not corrupted through abstraction.
As the solution has been developed through co-operation with industrial colleagues it will be important to gain their opinions on the on the functionality of the final tool. Any suggestions or modifications to the prototype tool can then be considered.

Chapter 2

Literature Review

2.1. Introduction

Through discussions with several industrial partners currently working on reorganising the way in which the manage businesses processes, it became evident that their was a reoccurring issue which was limiting the success and expansion of process modelling within these companies.

This limiting factor involved the presentation of large-scale business process models and the subsequent interpretation of these models.

With this questions in mind, an in depth literature survey was carried out, in order to establish the current thoughts in academia, current practitioners and pioneers in the field of process management, about the role of processes modelling and current best practices.

The literature survey considers the following topics in the field of Process Modelling and related areas.

- Process Orientated Approach
- Attributes of a Process
- The roots of Process Management
- The evolution of Process Modelling
- Summary of the Modelling market
- The problem of visualising complex models

2.2. Process Orientated Approach

Many companies have adopted a Process Orientated view of their operations (Hammer 1993), This has been carried out with the idea of replacing a traditional functional viewpoint, which for a long time was established as the norm. By adopting this new view of their organisation, companies hope to benefit by achieving greater integration between their business operations.

(Davenport, 1993) describes a process as being " *simply a structured measured set of activities designed to produce a specified output for a particular customer or market"* Significantly, Davenport (1993) in this statement describes this set of activities as being structured, as it is this characteristic that adds value. Each activity in itself should add value to the product or service, but the correct sequencing of these activities will be of further benefit to the company.

All processes begin with an event that is typically external to the organisation, such as a request or order, which triggers a chain of activities within an organisation. After these activities have been performed by the organisation the process is ended with the delivery of a product or service.

This idea is illustrated in the following diagrams;

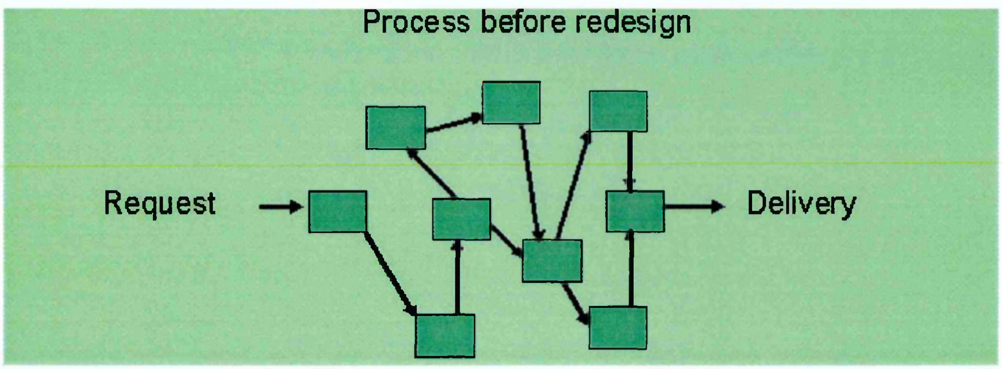


Figure 2.0 (Sodan, 2002)

This diagram shows a typical representation of the flow of activities within a business unit. The process flow can often be disorganised and unplanned. This lack of planning can mean that processes are consistently going back and forward between organisational units with little value being added at each stage. Within this type of system inefficiency also arises as there is often large waiting times between one activity to the next, in many cases on closer inspection some activities may prove to be completely dispensable.

In many businesses, the processes performed have simply evolved over time, creating a ' way of doing things round here' approach to process management. The reorganising of these processes within a company, however, could potentially make them more competitive and more profitable, by bringing order to what was a confused system containing wasteful processes;

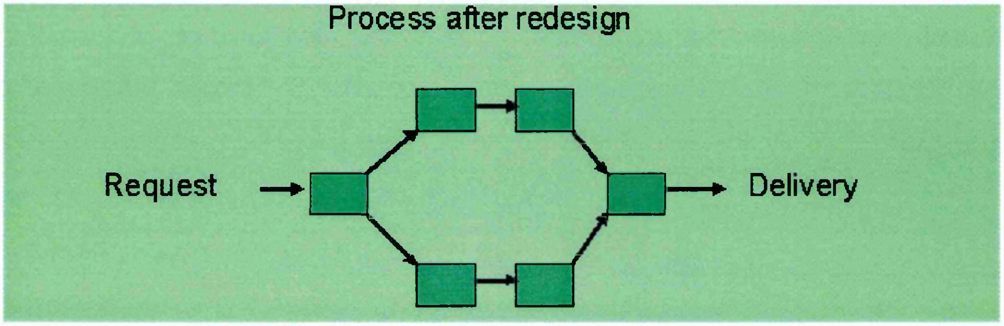


Figure 2.1 (Sodan, 2002)

The importance of conceiving purposeful process within business therefore, can not be underestimated, to quote Michael Hammer (1996) " *The time of the process has come. No longer can processes be orphans of business, toiling away without recognition, attention and respect. They now must occupy center stage in organisations. Processes must be at the heart rather than the periphery of companies' organisation and management. They must influence structure and systems. They must shape how people think and the attitudes they have.*

The benefits to a business of analysing and reordering their processes can be experienced throughout the company (Davis, 2002);

- Productivity can be raised. It is estimated that productivity typically improves initially by 30-50%.
- Customer service can be improved as the number of errors within the system and the process lead-time is reduced.
- A more efficient use of resources can be found, as wasteful processes or eliminated, freeing up staff and machines.
- Staff morale can also be raised, by removing frustrating processes such as repeating the entry of data.

2.3. Attributes of a Process

In figure 2.1 the processes within a business are divided into individual blocks, representing a specific activity carried out within the business. If a traditional functional viewpoint were being utilised, this representation would be acceptable as a complete image of the processes within the organisation.
However with a process orientated view of their operations, this image is no longer a comprehensive representation.

A process can be viewed from a variety of different perspectives depending upon which area of the business it is viewed from, and the type of data that is required from that process. The information contained within a process can be extremely varied in order to encapsulate all areas. Professor John A. Zachman (1987) presented a framework describing the varied nature of data contained within a process, some of which are now described;

- **WHAT** – The specific data referring to what activities are occurring at each step within a process.
- **How** – The information referring to how these activities will performed. (The functions which are carried out by the company)
- **Where** –The information referring to the location in which this activity takes place and the relevant logistics data.
- **Who** – The information referring to the responsible party for that activity, whether it is a business unit or an individual.
- **When** - The information referring the timing of the activity, creating a schedule of events.
- **Why** - The information referring to business strategy, creating a list of business goals or business plan.

If the amount of data within a process is so great, and its content so varied, then the traditional functional viewpoint of a company is no longer enough. This theoretical view of business processes was seen by Curtis et al. (1992), who suggested a conceptual framework for business processes. This framework suggests that there are four perspectives of a business process.

- *The functional view*, which shows the activities performed within a process. It describes the functions that are being carried out by the employees. (The Zachman (1987) framework WHAT)
- *The Behavioral view*, this relates to when the process is being performed, and how it is being carried out. For example an activity could be going through a feedback loop or a iterative process etc. (The Zachman (1987) framework HOW and WHEN)
- *The Organisational view*, this shows where and by whom the activities are executed and what physical communication mechanisms and storage are used. (The Zachman (1987) framework WHERE and WHO)
- *The informational view*, this shows the information details or entities that are being manipulated by the process. In this view both the data structure and its relationships are considered.

If any type of manipulation of business processes is to take place, it is vital that any technique incorporates the process characteristics, and the subsequent perspectives of the business process that are created.

2.4. The roots of Process Management

From outset of this chapter the importance of process within modern business has been established. However, the idea of reengineering business processes is far from a modernistic concept. In fact the Reengineering of processes can trace its origins back to management theories developed as early as the nineteenth century.
Frederick Taylor (1885) suggested in the 1880's that managers use process reengineering methods to discover the best processes for performing work, and that these processes be reengineered to optimize productivity. He described the purpose of reengineering as; "making all your processes the best-in-class."

A short time after this in the early 1900's, Henri Fayol (1949) originated the concept of reengineering as; "To conduct the undertaking toward its objectives by seeking to derive optimum advantage from all available resources".
Although at this time the level of technology was not there to support these early concepts, people were appreciating how important it was to plan their processes.

Nearly 100 years on, at the beginning of the 1990's, companies were being presented with new economic, legislative and particularly competitive challenges, which were making them think about how efficient their processes were.
It was around this time that the term Business Process Reengineering (BPR) came into being.
It was around this time in the early 1990's when Michael Hammer and James Champy (1993) published their best-selling book, "Reengineering the Corporation", and BPR really reached its peak. The authors described BPR as;
"The fundamental rethinking and radical design of business processes to achieve dramatic improvement in critical contemporary measures of performance such as costs, quality, service and speed".

Their ideas would radically redesign and reorganise the processes within a company "wiping the slate clean" as they put it. They believed that this was necessary to lower costs and increase quality of service.

In order to achieve these goals, they suggested seven principles of reengineering:

1.To organise around outcomes, not tasks.
2. To identify all the processes in an organisation and prioritize them in order of redesign urgency.
3. To integrate information processing work into the real work that produces the information.
4. Treat geographically dispersed resources as though they were centralised.
5. Link parallel activities in the workflow instead of just integrating their results.
6. Put the decision point where the work is performed, and build control into the process.
7. Capture information once and at the source.

A key theme that came out of these principles was the importance of identifying and capturing information in some way.
Other visionaries in the BPR world also recognised that acquiring a clear definition of the 'as-is' business process, and then developing an understanding about how the process may be re-engineered, is a crucial stage in any BPR project (Fitzgerald 1994, Bevilacqua 1992, Davenport 1990, Carr 1995).
Due to the ideas of these early visionaries, the demand for tools and techniques to model business processes was created, and this demand was very quickly met.

2.5. The evolution of Process Modelling

Process modelling is a vital step within BPR. Although new software packages have extended the capabilities of processes modelling, the capture and documentation of company processes is still regarded as the first and most important step in the BPR activity.

Dr. Jay Bal (2002) in his paper “Process Analysis Tools for Process Improvement” states that the early modelling stage has three major goals;

- To achieve a full understanding of the process to be re-engineered, so as to clarify its objectives and characteristics.
- To create a shared vision and understanding among the re-engineering team.
- To have a basis for starting the redesign.

Since the creation of Process modelling, a variety of modelling techniques have been developed to support the process, some of which have become established industry standards.

As IT systems became more powerful and software became cheaper, more and more computer based modelling packages came onto the market. These tools offered increasingly sophisticated database, visulisation and analysis capabilities, and often incorporated allot of the established modelling techniques.

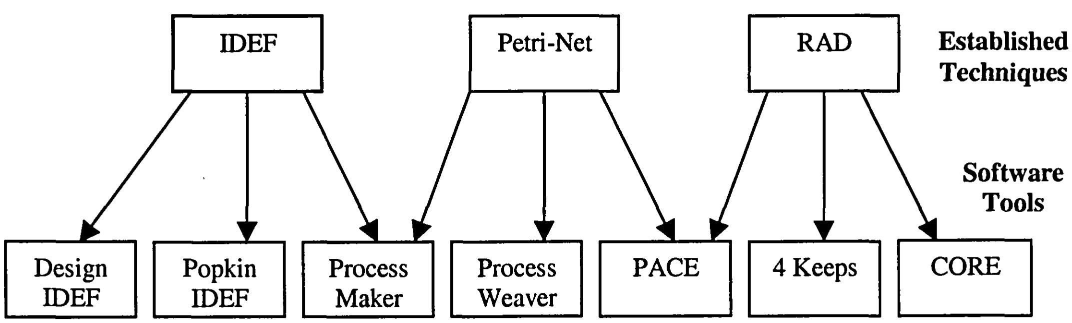


Figure 2.2: Established Modelling Techniques.

2.5.1 Established Modelling Techniques

Over the past twenty years a great number of modelling techniques have been developed through academia and by software vendors. Many of these techniques were designed to meet a specific problem and their limited scope meant that they were never adopted as industry standards.

IDEF	Bachman
Petri-net (CPN)	Gantt
Yourdon (DFD)	Object Oriented
UML	Soft Systems
Booch	Meta Modelling
Rumbaugh	Flow Chart
Shlaer-Mellor	ABC
Coad/Yourdon	RAD
Martin	Workflow
Chen	Simulation
SSADM	

Table 2.3: Established Modelling Techniques, (Hommes, 2003)

Dr Jay Bal (2002) discuses that there are many tools available for use in process modelling, however, he also suggests that there are currently just a handful of techniques in favor and subsequently incorporated into software tools.

This idea is supported by a survey conducted by DISA (1995), which concluded that IDEF modelling was found to be the most frequently used technique, with 37.4% of all organisations using them in some form. The survey also showed that only a small number of modelling techniques were used by the majority of organisations.

The techniques that are described below are some of the more popular modelling methods that were identified by the study, and have since been incorporated into a variety of software tools as their standards.

2.5.2 IDEF Models

The first technique identified is the IDEF family of modelling methods. This has probably become the most widely adopted industry standard, with many of the current market leading software packages adhering to the IDEF basic principles.

IDEF was founded in the mid-1970's as a direct consequence of the American Air Force's need to improve their manufacturing operations. As a result of this need the Integrated Computer-Aided Manufacturing (ICAM) program was established. One of the main problems the new program faced was the requirement to model processes, data, and dynamic (behavioral) elements of their manufacturing operations.

This problem was overcome when the ICAM program created the Integrated DEFinition methodology or IDEF as it is now called. This new methodology was designed to provide a structured and uniform approach to analysing a company, capturing "as-is" process models, and for modeling activities within the company. This uniform structure to the "as-is" model could then be used as a basis for process improvement.

IDEF is often referred to as a family of modelling standards, as it comprises of a number of different modelling techniques (all very similar) which together encompass the entire organisation.

IDEF Standard	Function Performed
IDEF0	Function Modeling
IDEF1	Information Modeling
IDEF1X	Data Modeling
IDEF2	Simulation Model Design
IDEF3	Process Description Capture
IDEF4	Object-Oriented Design
IDEF5	Ontology Description Capture
IDEF6	Design Rationale Capture
IDEF8	User Interface Modeling
IDEF9	Scenario-Driven IS Design
IDEF10	Implementation Architecture Modeling
IDEF11	Information Artifact Modeling
IDEF12	Organization Modeling
IDEF13	Three Schema Mapping Design
IDEF14	Network Design

Table 2.4: IDEF modelling family.

Table 2.4 shows the complete list of IDEF modelling standards. Some of these standards are more relevant than others, when looking at process modelling. For process capture and analysis the key techniques are:

IDEF0

The IDEF0 is one of the most widely used tools for functional modelling. It uses a "top-down" hierarchical method of modelling, which provides a description of functions and processes originally designed for the manufacturing industry.

The IDEF0 technique allows the modeler to create a view of the process, inputs, controls over the process, outputs, and the mechanisms acting on the process, ordering them into a collection of diagrams, text and glossary, which are all cross-referenced to each other.

The hierarchical technique used allows the processes in the diagrams to be further decomposed to show lower-level activities. This break down makes IDEF0 a very suitable tool for the visualisation of complex and often large scale manufacturing systems. IDEF0 is commonly used to show complex systems as it provides a structured representation of the functions, information and objects which are interrelated in a manufacturing system (Kusiak et al 1994).

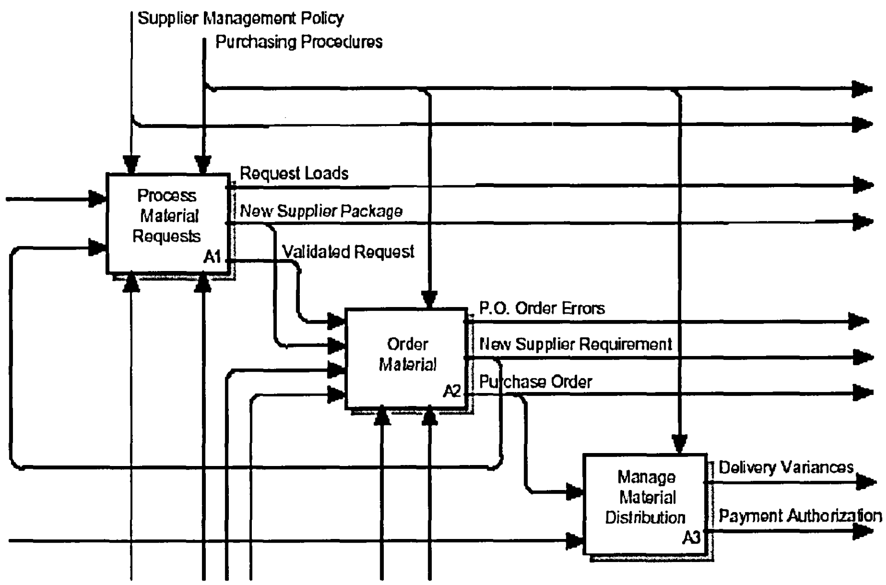


Figure 2.5: IDEF0 Model

IDEF1

The IDEF1technique is used for information modeling. The main aim of this is to capture the conceptual views of an enterprise's information. This means that all the information needs of an organisation can be captured, communicated and analysed.

The technique was not developed to be a database of company information, rather to analyse the existing information systems in an organisation, determine the problems and plan out the information needs of any proposed or 'to-be' system.

The basic building blocks of an IDEF1 model are entities, attributes and relationships. The entities are represented by boxes, in which are entered the characteristics of the entity. Lines and diamonds represent the relationship that exists between these entities (the nature of the relationship is entered in the diamond).

The benefits of using such a model are that it provides a stable structure with which to control the "constantly changing requirements of manufacturing information" Dr. Jay Bal (2002).

IDEF1x

IDEF1x was created as an extension of the IDEF1 model. It is used for data modeling, as it captures the logical view of the company's data. It is considered as an extension of the IDEF1 model as it can be used to design a database of information, once the information system requirements are known (obtained from the IDEF1 model).
It is a commonly used technique, as it has a better graphical representation than the IDEF1 model as well as being easier to understand due to the greater depth of information that it stores.

IDEF3

The most significant modelling technique concerning business process modelling, was the creation of IDEF3 diagrams. These models were specifically created to show a sequence of activities that are carried out by an organisation. It is particularly useful as it allows experts who operate within a process, to document their intrinsic knowledge of that particular process. It differs from the other IDEF models previously described, as it captures the description of what a system actually does.
The most important part of the IDEF3 model from a process modelling perspective, is the process flow description.
This process flow description is constructed up of "units of behavior", links and junctions boxes. A unit of behavior is used to show a function or activity occurring in a process. The relationship between activities is modelled using three kinds of links;

- Precedence links – which show the sequence of the activities.
- Relational links – this shows the existence of some sort of relationship between two activities.
- Object flow links – shows the participation of an object between two units of behavior instances.

If a process splits along two separate paths, it can be shown using one of three junctions and (&), or (O) and exclusive or (X). Echoes of this notation can be found within many of the most popular software packages.

2.5.3 Role Activity Diagrams (RAD)

Although IDEF in particular became a very successful method of modelling, there was an opinion that the IDEF0 and IDEF1X models did not capture the behavioral aspects of a business process in sufficient detail (The Zachman framework 1987, *The Behavioural view).* As a consequence of this Role Activity Diagrams or RAD's were created, in order to support the IDEF models.

When used in combination RAD's and IDEF models can be used to create a complete picture of the organisation. The high-level and cross-functional view of a process, which the IDEF model provides, is supported by the more in depth image of the RAD, which shows the interaction between individual activities.

Unlike an IDEF model a RAD shows the dynamics of a processes, and are more concerned with the people within an organisation. It portrays an individuals role, what activities make up this role and their interactions, together with external events and the logic which determines the sequence of the activities (Ould, 1995).

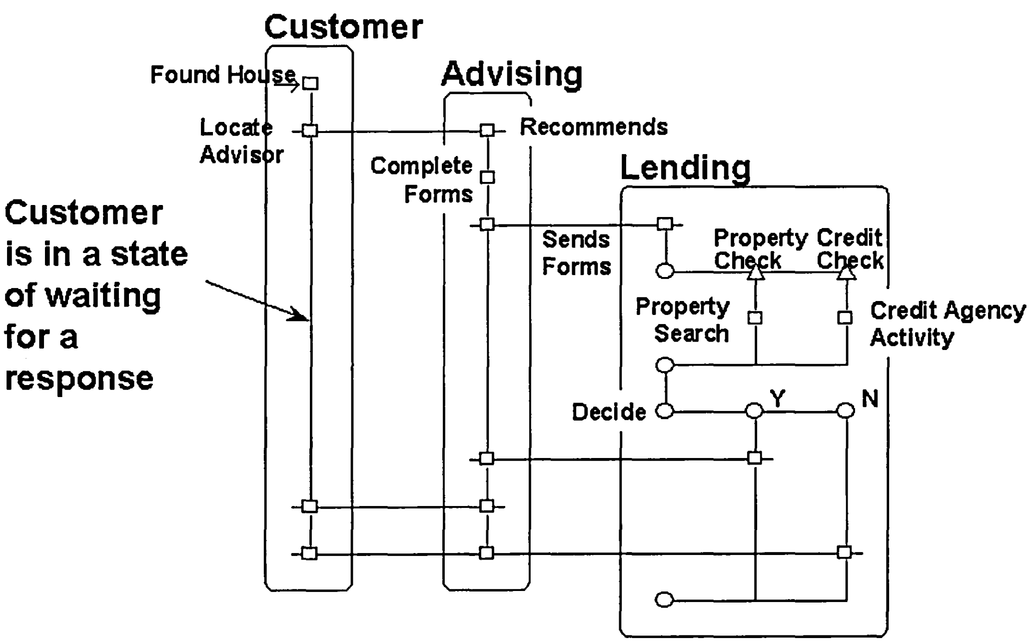


Figure 2.6: RAD Model

2.5.4 Petri – Net Models

Petri – Net Models are a graphical tool like IDEF and RAD's in that they use flow charts and block diagrams to represent procedures, processes and machines within an organisation.

From diagram 2.7 it can be seen that they consist of places (circles*)*, transitions (rectangles), and *arcs* that connect them. Input arcs connect places with transitions, while output arcs start at a transition and end at a place.

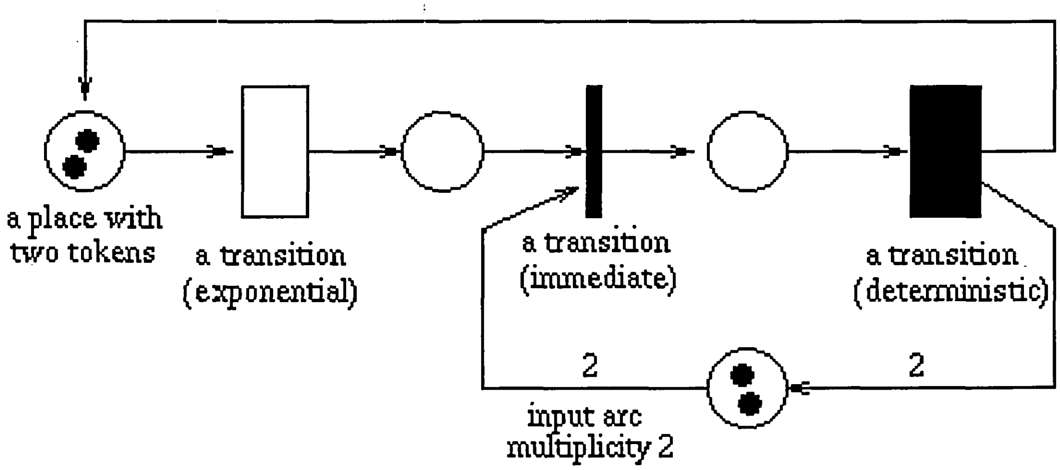


Figure 2.7: Petri – Net Model

They differ from other modelling techniques in that they can be used to describe, analyse and study business processes (Van der Aalst, 1996) by using Petri nets tokens to reflect the dynamic nature of a process. The tokens are used in the diagram to simulate the dynamic and concurrent activities of systems, so that aspects like delay within a process can be modelled. This can be achieved, as it is possible to set up state equations, algebraic equations, and other mathematical models governing the behavior of a system, to work with the Petri net model.

2.6 Software Tools

By utilising one or combining a variety of the modelling techniques, described in the previous section, it is possible to capture process data, sequences and even the behavioral aspects of an organisation. However, if Dr. Jay Bal's (2002) major modelling goals are revisited;

- To achieve a full understanding of the process to be re-engineered, so as to clarify its objectives and characteristics.
- To create a shared vision and understanding among the re-engineering team.

It is impossible to say that these targets have been achieved through any individual modelling technique.
A primary objective of any business process model must be to communicate, therefore a model must be visual and the visual representation must be easy to understand with little explanation.

The processes involved in modern business are complex and numerous, and the recognized modelling techniques often reflect this in their own complexity. The techniques have complicated methodologies, which to the untrained user make little sense. A modelling tool should be used to ease some of this complexity by reducing large processes to manageable and logical tasks.

As a result of this, and the increasing capabilities of computer software, a whole range of modelling tools have appeared in the modelling market. The tools themselves vary in sophistication, but can be loosely categorised under two headings;

1. The static modelling, based on diagrammatic modelling techniques, which provide a qualitative description of the existing or envisaged process. In static modelling the focus is on describing processes and the resources required to execute them.

2. The dynamic modelling, based on discrete-event simulation, results in a quantitative model which can be used to gather performance statistics. In dynamic modelling, the focus is on evaluating the dynamic performance of a process throughout a specified period of time.

The categorisation of software tools can be further broken down to represent the diverse range of capabilities available.

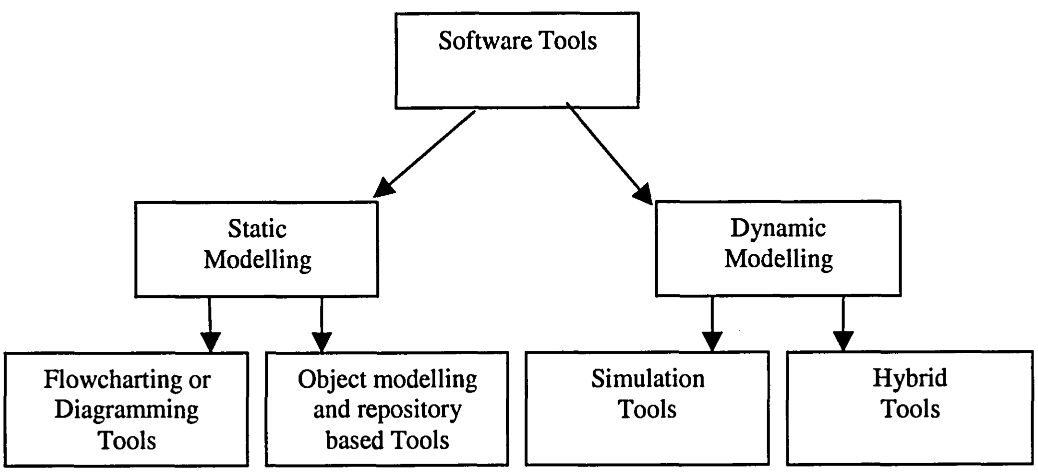


Figure 2.8: The categorisation of software tools

2.6.1 Static Modelling

The development of the process modelling market has been rapid, creating a broad spectrum of package capabilities, and as a consequence the customer has been left confused. The market is cluttered with bespoke packages offering sophisticated tools for a specific market, and at the other end of the spectrum simple drawing packages have been marketed as a real solution to process modelling problems.

The least complex form of modelling are the diagramming or simple flowcharting tools that provide the basic functionality required to portray a process as a picture. Law and Kelton (1991) defined a static model as "...a representation of a system at a particular time, or one that may be used to represent a system in which time simply plays no role". This is fundamentally what a flowcharting tool is used for.

These tools often come with templates that contain pre-created icons and images that are easily recognisble to everyday business use. It is important to say at this point however that a simple process diagram does not, on its own, constitute as a business model. For some modelling packages on the market this would represent the limitation of their usefulness, and so can not in truth be called a business process-modelling tool.

2.6.1.1 Flowcharting or Diagramming Tools

It is often said that a picture is worth a thousand words, in processes modelling this statement is true, as the diagram itself simplifies large and complex processes into easy to follow steps.

A simple flowcharting tool shows a basic representation of a real life business situation, abstracting from this situation the aspects of interest. The abstraction process is a selection of the relevant aspects of the situation for the purpose of analysis. The key to a good flowchart is the ability to determine what is relevant in the model and what is not.

As an abstraction of the real process, it is true to say that the models are incomplete and even inaccurate, this does not however limit their usefulness. The reduction of complexity through abstraction allows a greater understanding that might otherwise have been gained.

Flowcharting tools have one major advantage in that they are easily understood by almost everyone within the organisation. They fulfill their role by capturing the most important features of a process, such as where decisions are made, and then presenting this information in a way that is recognisable to all users.

The reason that these basic flow charts are so easy to understand is that they often utilise widely known standard symbols. Many of the market leading packages utilise the American National Standards Institute (ANSI) standard flowchart symbols.

At their most basic, all flowcharts consist of shapes (usually showing the activities), lines (the flow) and text (a description of the activity). Most of the tools in this sector support these basics. It is not strictly necessary to use boxes, circles, diamonds or other such symbols to construct a flowchart, but these do help to describe the types of events in the chart more clearly.

The main drawback of using a flowcharting tool however is that they do not show organisational responsibility for particular process, and therefore fail to capture the behavioral aspects of the organisation. Flowcharting tools still make up a large sector of the modelling market, as many companies have not made the next leap in process modelling capabilities. Typical flowcharting products include Visio Professional from Microsoft and ABC Flowcharter from Micrografx.

2.6.1.2 Object modelling and repository based Tools

To fulfill Law and Kelton's (1991) definition of a static model, a modelling tool must do more than capture the simple actions and decisions. They must store the information about a system at any particular point.

True modelling tools often include the ability of mapping. Mapping tools extend the functionality of drawing tools by including spread-sheeting functions that allow the entry of basic data and often-simple calculations.

These tools often include methods to validate the structure of the diagrams being produced and have the ability to search and report on the data being stored.

What truly makes modelling software such a useful tool is the inclusion of some sort of storage facility. Modelling tools are often referred to as object and repository based. This refers to the ability to store data related to the objects that form the process being modelled. Using a database at the core of the software means that the data can be manipulated, searched and reported on to meet the users requirements. Some tools have a fixed database structure whilst others allow a degree of customisation of the structure. Usually the tools that allow the user to customise the structure through the creation of further objects provide extended analytical capabilities and so prove to be more flexible.

These three key features make up the basis of a business process modelling tool.

1. Produce diagrams that capture and simplify business processes.
2. Mapping tools to allow basic data capture.
3. Built around some sort of database.

In short, business-modelling packages are a database of business information captured and presented in a structured way.

This type of model also has its roots in paper based modelling. Object modelling packages often use a high-level IDEF0 model as a base, identifying the core business activities and resources of an organisation. The object model can then be used to identify the specifics of the organisation, such as process relationships and dependencies.

2.6.2 Dynamic Modelling – simulation tools

Banks (1999) described a dynamic model as follows"....simulation models represent systems as they change over time." He went on to give on example of this definition, by using a bank, which opens at 9am and closes at 4:30pm. During this time period the system itself changes, dynamic calculations have to be run with data that reflects the changes over time. This type of model gives a truer representation of a system as it can include dynamic events such as waiting times, machine breakdowns and the changes in utilization over time.

Compared to static modelling, tools that use dynamic simulation are relatively new, and their use limited to specilised projects carried out by simulation experts. In the past there they have mainly been used as a tool to help management to justify major capital investments, particularly in the manufacturing industry.

There are a limited number of companies using this technology, particularly in this country, despite the evidence of major cost savings, the technique is viewed as a specialist and expensive activity.
At present the vendors of simulation tools are trying to produce products which are easier to use and can be beneficial to a variety of industries. Recently their efforts have been successful with an increasing number of users, however the tools still tend to be used for one off projects and not on a day to day basis.
Simulation represents the most complex form of modelling and hence is found in only a few packages.

2.6.2.1 Hybrid Tools

Some of the market leaders in the static process modelling sector have recently started to appreciate the benefits that a dynamic tool can offer.
All though a customer may not wish to have a dedicated simulation tool, they would like some of the capabilities that they offer.
A limitation of the static tools is that they cannot be used to predict the dynamic performance of a process. It is therefore difficult to establish business performance data against which future performance can be measured.
The solution would be to link the static model created by the organisation to the quantitative facilities of a dynamic model. This would allow the company to investigate dynamics within the organisation such as process time, utilisation of resources and costs.

There are two ways in which this new hybrid tool can be seen in current packages.

Firstly there is the in built tool, which consists of the static model tool with a more restricted version of the simulation system in built. The simulation capabilities are often very limited within these packages, however they do not suffer from inflated prices.

The other option is to create a static model that has the capabilities of interfacing with another simulation tool. The advantage of such a system is that you have all the capabilities of a dedicated simulation tool, however you do have to pay for both products.

These systems are intended to provide a complete answer for modelling business processes. The qualitative features of a business are modelled using the static tool, and the quantitative features can then be investigated using the simulation tools.

At present the in built systems suffer from a lack of simulation capabilities, and the interfacing tools suffer from a lack of cohesion between the two tools.

The future of modelling will probably lie in this integration between static and dynamic tools, but until the link between them is completely seamless, companies will have to assess the benefits and drawbacks of each approach.

2.7 Summary of the modelling Market

Various authors have tried to categories the modelling market into structured groups. However, most like Hutton (2002) have warned that the packages often do not sit well in one category. They are often designed for a specialist purpose, which means that they can adopt the characteristics of various tools. Also the market is constantly changing, with some of the larger software vendors releasing add on software to increase the capabilities of a tool.

The easiest way to visualise the market at the moment can be seen in the following diagram. However it is important to keep in mind that the lines which separate the categories are somewhat undefined.

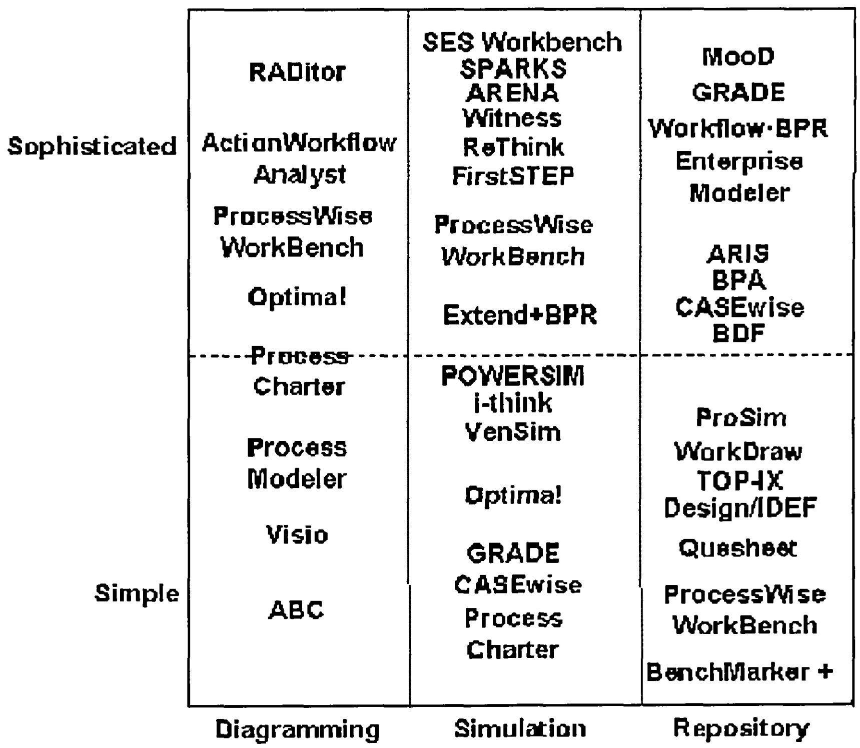


Figure 2.9: The modelling Market.

The usage of these tools is not spread evenly across the categories. Hutton (2002) states that "As a general rule the simpler the user interface and underlying methodology used by the tool, the more accessible the product is to a wider audience."

This is certainly true of the market at present, with most companies utilising a popular diagramming tool like Microsoft Visio. This type of tool is widely accepted as the models are generated easily, and the symbols that are used can be manipulated and modified to suite the user's purpose.

For many people the ease of use, and understanding of these tools, together with the fact that they are often used on familiar platforms, makes them a reasonable option. So why should companies spend more money on a package with increasing complexity?

Rob Davis (2001 p27), uses a typical business model, created with a diagramming tool as an example, to answer this question.

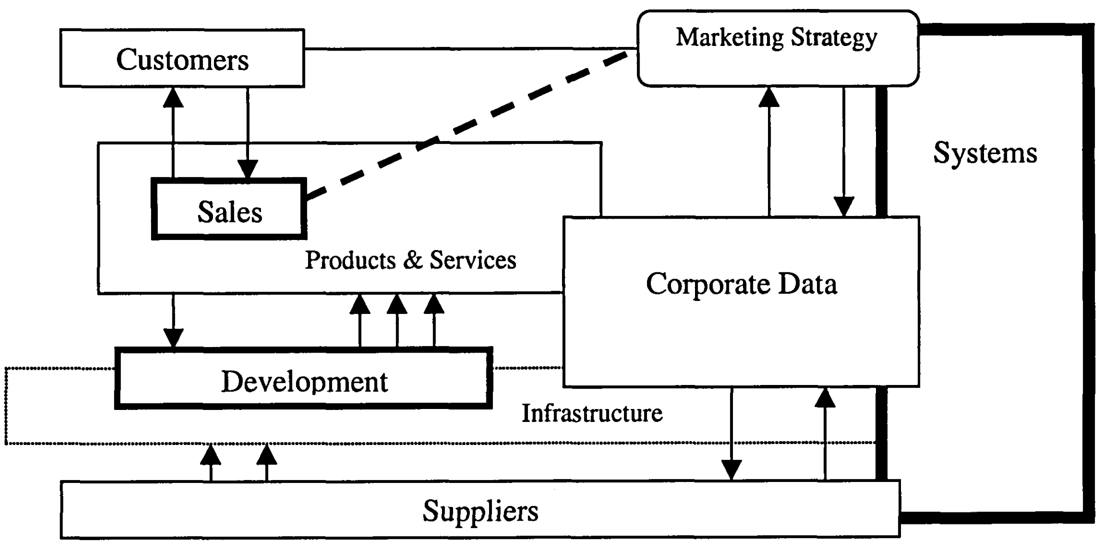


Figure 2.10: Typical business model.

Davis questions the clarity of such models. Suggesting that they are open to interpretation and have only a limited life span. Unless the creator of the diagram is present, substantial documentation will be needed to explain what the boxes mean, what the arrows represent etc, negating the value of a simple diagram. If the diagram is used months later will it still have meaning, or has the information been lost.

The characteristic, which separates a simple diagram from a model, is that the model is built around a method. Therefore each building block, connecting line and label is used in a constructive and pre-conceived manor. This standardisation of the model format means that once the methodolgy has been learnt, the models can be understood by anyone within the organisation with little explanation.

The repository system that is used also means that the building blocks of the model can be stored and reused within other models. This means that different viewpoints of the organisation can be generated. Another benefit of the repository system is that all knowledge and data within an organisation can be stored in one place. This database can then be queried in order to gather information, such as who is responsible for a particular task.

The advantages of a repository system are not just theoretical, examples can be found in industry of the success of the modelling system over a simple drawing package. Thomas R.Gulledge (1999) commented after using a modelling package for use in the U.S Navy ERP pilot program, "You cannot maintain business process configuration in a drawing tool. Business process objects are shared across business processes. A change in one object is often reflected in many places. Drawing tools are used when there is no requirement to manage over time".

The advantages of a process-modelling package can be summarised as follows:

- Encourages standardisation – by enforcing a method.
- Improves quality and rigor of process design.
- Provides a single, consistent record through a single repository.
- Encourages the use of a common, well-understood, process vocabulary.
- Allows multiple viewpoints.
- Supports reuse.
- Facilitates feedback from the end users.

2.8 The problem of visualising complex models.

The majority of the literature available on business modelling supports the implementation of a sophisticated repository system to capture the nature of a business in its completeness. The evidence in industry would also support this theory as many companies have had great successes using this type of method.
The majority of the case studies and product reports, however, are far from independent publications. The literature available is largely made up of biased product promotions and case studies published in collaboration with the software vendors.

After discussing the day to day use of one such product with an industrial partner, it became evident that there were problems surrounding the complexity of the methodology.

BT are a large organisation with over 100,000 employees, which in turn means that the effective design and management of the internal business process is crucial to the success of the organisation. The company decided that since a period of restructuring in 1999, the company was in need of a single tool to model the existing and emerging business processes. After a substantial evaluation and selection process, the modelling tool Aris would be used as the sole product for the task.

After some time it was decided by the company, not to mandate the use of the tool, as this forced change might create resentment of the new tool. Instead they decided to champion the tool in a pilot project, there by convincing other business units through example. In order to do this the ARIS Modelling Techniques Team was created, to be a dedicated group of experts trained in the ARIS methodology.

The results within the business unit itself were excellent, however one factor became clear, "In order to produce these models we had needed to learn almost everything there was to know about ARIS" Colin Paton (2002).

People without the formal training on the tool could not understand the complex methodology and the detailed diagrams, which were often several pages long. They did not like the rigidity of the tool, the rules that had to be followed and the unappealing uniformity of the diagrams.
The problem was not only internal. Btexact were publishing all of their process models for external customers in the ARIS format, and many of the same problems were being raised. Several clients inquired if they might have their diagrams published using a package they were used to.

It became evident that this was not an isolated problem and that many other companies had discovered that ARIS was only successful if it was implemented on a corporate scale, involving a comprehensive training scheme. The problem being if training had not been provided, the diagrams would prove too specialised leading to confusion about a process.

Davide Ruozi (2001) who used the ARIS suite to re-engineer a product development process for a mixing plant highlighted this problem. In his final comments about using the package he states; "we can observe that the ARIS Toolset permits to produce a more complete representation of the process using several models, but these ones are more difficult to read and understand".

If the purpose of a model is the reduction of complexity through abstraction, are these modelling packages fulfilling their role, or simply adding to the complexity of a system? The question that needs investigation is whether or not the complex nature of process modelling packages, leads to visualisation problems for the end user?

Chapter 3

Benchmarking Study

3.1 Introduction

Within the previous chapter, several questions were raised about the complexity and the subsequent functionality of modern business modelling packages.

In order to answer some of these query's, further investigation about the use of such packages is required.

It was therefore decided that a benchmarking study of a select handful of modelling packages should be carried out.

3.2 The benchmarking Process

The practice of benchmarking is typically associated with the measurement of business performance, through comparison with the best in class. Although the process is generally used on a business unit or corporate scale, it can be a very effective device for the comparison of business tools.

The Xerox Company (2001) used this technique on both a large and small scale within their organisation. It was used for the "Continuous process of measuring our products, services and business practices against the toughest competitors and those companies recognised as industry leaders".

There are four main approaches to benchmarking currently being utilised in industry today (M.Zairi 2001).

- Internal benchmarking – A way of establishing good practice within an organisation by comparing the various operations that take place on a company wide scale.
- Competitive benchmarking – This is the comparison of a specific product or service with its main competitors, by looking at a product/services characteristics or functionality.
- Generic benchmarking – This is the comparison of all functions within a business operation. This is achieved by comparing all functions and processes with those best in class.
- Functional benchmarking – This is the comparison of specific functions with the best in industry and best in class. It is a more focussed approach to benchmarking and does not have the scope of generic benchmarking.

It is the competitive approach to benchmarking that will be applicable for the comparison of process modelling tools. By comparing the characteristics and functionality of the best in class tools, any functional gaps between the packages should be become evident.

The practice of benchmarking by best in class comparison has been a success for many companies. Therefore it is fitting that the benchmarking of modelling tools should be based upon the success of another benchmarking study.

After a successful competitive benchmarking study Xerox (2001) published their approach to benchmarking. The early planning and analysis stages of this study will form the basis for the authors benchmarking study.

1. Identify what is to be benchmarked
2. Identify comparative companies
3. Determine a method for data collection
4. Collection of data
5. Discussion of results.

3.3 Identify what is to be benchmarked

There have been a number of independent reports carried out, focussing on the modelling software market. Most notably the industry recognised Gartner (1997) report and the commercially available Sodan (2002) report. These reports help potential users, by giving general information about a tools specific market, key features and customer support.

The questions that have been raised in this report, however, require a more detailed observation at a specific aspect of a modelling package.

This aspect has the broad heading of model visualisation, which collectively combines a variety of model functions, methodologies, key features and restrictions. Due to the broad range of issues covered in model visualisation, the Author has divided this main category into a number of sub headings.

Benchmarking and assessment criteria

Main categories

Model Methodology - This has two main areas of interest, the underpinning methodology used by the package as well as the rules and restrictions governing the creation of the models. This is an important category as it establishes which of the packages utilises the complex methodologies that can either add value to a tool or can make it confusing. If there were a methodology present it would also be useful to see what procedures are present to validate the model, so that consistency is maintained.

Model & Data Management – This area is primarily about with the way in which data is stored. If a package uses a complex repository system, how is that data maintained and then presented to the user.

Presenting data – This important section is concerned with the way in which data is presented to the user. This includes the page layout, standards conformed to, navigation techniques and filtering methods.

Shapes & Lines – To allow the manipulation of graphics it is important to equip the user with powerful manipulation functions. This section takes a detailed look at the building blocks of the diagram and the methods used to simplify the complexity of the models.

The assessment criterion within these general headings is made up of more detailed information about the packages. Each of these general headings can then be further broken down for investigation. The complete breakdown of the benchmarking process now follows with explanations of certain criteria where necessary.

3.4 Benchmarking the aspects of model visualisation

Model Criteria	Explanation
	Model Methodology
Is a methodology utilised	Recognises the degree to which a methodology is utilised by the package. A sophisticated and well-planned methodology can add value to a package by promoting rigor to the modelling process.
Is this methodology unique to the package	The methodologies are either unique to the package or based upon an industry standard. If they are unique the models will be difficult for the untrained user to understand.
Is it clear to understand	As a follow up to the previous question, would the presence of such a methodology course problems to the user?
Does it add value to the product	It is commonly accepted that the complex methodology packages are superior to simple diagramming tools. But to what degree does the methodology add value to the tool.
Are there rules to building the diagrams	This measures the degree to which rules govern the creation of a model.
Are they clear to understand	If there are rules, this measures their clarity.
Do they add value to the product	In many cases the complexity of the rules acts to the detriment of the tool.
Are there syntax and semantics checks for verification	If there are strict rules governing the tool, are there measures present to maintain consistency.
Is freeform used	The alternative to methodical modelling is the use of freeform. Models can be improved or further abstracted according to the desired perspective of the user if they are not restricted by a methodology.
Is the tool oriented towards a strategic method	A tool will often lean towards a certain view of the organisation. Often multiple views are supported. This question aims to find the degree to which the strategic method is used.
Is the tool oriented towards a process method	This question aims to find the degree to which the process method is used.
Is the tool oriented towards a organisational method	This question aims to find the degree to which the organisational method is used.

Is the tool oriented towards a data method	This question aims to find the degree to which the data method is used.
Is the tool oriented towards an object oriented method	This question aims to find the degree to which the object oriented method is used.
Navigation techniques	
Multiple page set-up - off-page connectors	This is important because most models are not conveniently fitted onto one page. The ability to have off-page connectors that help you navigate from a point on one page to a point on another page helps when trying to visualise a model.
Shape numbering	In large, complex models, finding a particular shape can be problem. Being able to uniquely identify a particular shape can help with the tracking of a process. Not all tools support this type of automated shape-numbering. Instead, they allow the user to enter a number as part of a text field. This however means that there is no unique way to identify that shape. This causes problems when trying to sort and select information by shape number.
Active Navigation around the diagram	The scale of complex business models can often leave the user lost within the diagram. Active navigation tools allow the user freedom to move around the diagram.
Links to charts and files	Many of today's flowcharting software packages will allow you to create a link between a shape or line on the flowchart and the supporting documentation.
Model & Data Management	
Is a repository system used	This measures the degree to which the tool is structured around a repository or central database system.
Simple storage or active	This measures the complexity of the storage system being used.
Data fields Present	Data field refers to the ability to associate information, such as cost, time, duration and utilisation, with the shapes that represent each activity on the process flowchart. This data can appear on the flowchart so that you can easily see the relationship between the process step and its cost, cycle time or other process metrics.

Data fields Simple or Detailed	This measures how detailed the information within the data fields can be.
Database clean up present	This is a method of measuring database consistency and accuracy. Database clean up procedures, remove old and invalid objects.
Presenting data	
Vertical layout	Each tool will have a preferred layout, which is the way in which the objects are arranged on the page. The vertical layout follows the process from top to bottom of the page with departmental responsibilities being added where appropriate. This question measures the degree to which the package utilises this layout.
Horizontal layout	The horizontal layout follows the process from left to right of the page with departmental responsibilities being added where appropriate. This question measures the degree to which the package utilises this layout.
Swimlane layout	The swimlane layout can use either the vertical or horizontal methods. The difference being each department, e.g. manufacturing and HR is sectioned off on the diagram, and the process flows between these sections.
Is a filtering system used	A method filter enables the user to restrict the data available on the model according to the amount of detail they wish to share. The data is still within the tool but the visibility of certain objects and data sources can be restricted. This question aims to measure the degree to which a method filter is used by the tool.
Does it aid understanding	This measures the degree to which the method filter aids the understanding of a model.
Are explorer concepts used	Explorer concepts are a method of storing, accessing, sorting, and selecting models and objects in a tree structure. This measures the degree to which this application is used by the package.
Are UML Diagrams used	As discussed earlier, many tools are built upon industry standards. This measures the degree to which the model is built upon UML diagrams.
Are Event driven process chain Diagrams used	This measures the degree to which the model is built upon Event driven process chain diagrams.
Are IDEF Diagrams used	This measures the degree to which the model is built upon IDEF diagrams.

Are Petri-net Diagrams used	This measures the degree to which the model is built upon Petri-net diagrams.
Shapes & Lines	
Are ANSI standards used	As previously discussed ANSI standards are a recognisable group of shapes, used by many modelling tools. This measures the degree to which these standards are utilised.
Are the shapes linked to the methodology	This measures the degree to which the shapes used in the model are linked to the methodology adopted by the tool.
Can the shapes be formatted to aid understanding	This measures the flexibility of the tool by allowing the model shapes to be formatted.
Automatic line routing	Documenting complex process flows can quickly lead to the "spaghetti diagram" effect. This is the effect you get when there are so many overlapping shapes and lines that you can no longer decipher the intended process flow. Fortunately, the addition of several clever capabilities in today's advanced flowcharting software can help ease this trouble. A program's automatic line-routing capability can mean different things depending on the vendor.
collision avoidance	Collision avoidance simply means that shapes cannot be positioned over other shapes, and shapes cannot be placed over lines so as to obscure the intended meaning of the flow path. If a user attempts to place one shape over another, the software automatically displaces them for clarity. Likewise, when the user places a shape over an existing flow line, the program automatically re-routes the line to accommodate the positioning of the new shape.
auto line crossovers	Auto line crossovers show line-path intersections. This is important in understanding the correct routing of the line so the process steps are not misunderstood.
auto insert and delete	Auto insert and delete is particularly useful in editing charts where a shape must be removed from or added to the flow. This capability saves the need for tedious deleting and redrawing of the flow lines.

Do the lines show processes flow	The lines within a model can have several different meanings. This question queries whether the lines represent the flow of process within the company.
Are the lines dependent on responses YES/NO	This question queries whether the flow of the process is dependent upon YES/NO responses.
Freedom to change colour of an object	This measures the ability to change the colours of the objects within the diagram, without effected the understanding of the system.
Freedom to change shape of an object	This measures the ability to change the shape of the objects within the diagram, without effected the understanding of the system.
Freedom to change the size of an object	This measures the ability to change the size of the objects within the diagram, without effected the understanding of the system.
Freedom to show external objects	This measures the ability to show the external objects within the system, without effected the clarity of the diagram.
Freedom to change fonts	This measures the ability to change the fonts used within the diagram, without effected the understanding of the system.
Freedom to show attributes	This measures the ability to show the attributes of an object on the diagram, without confusing the overall model.

3.5 Identify comparative companies

The selection of the packages for evaluation is not a simple task. As discussed previously the market is littered with bespoke packages offering sophisticated tools for a specific market, and at the other end of the market, simple drawing packages being marketed as a real solution to process modelling problems.

In order to gain a broad-spectrum five business process-modelling packages will be selected for evaluation, focussing on their capabilities, limitations and most importantly the way in which they present data to the user.

At present there are an estimated 200 modelling tools available on the market. Removing the more bespoke packages, such as the market-specialised products and the dedicated simulation tools can drastically reduce this number.

This then leaves the more generalised or 'complete' packages. Included in this group are the sophisticated repository based packages as well as some of the simple diagramming tools. This diverse group of unspecialised yet functional packages, are the tools to be evaluated.

As previously mentioned, this versatile group of packages is the subject of an annual report produced by the Gartner (1997) research and consulting group. Within this report, Gartner (1997) review the capabilities of each package as well as any new developments within the tool itself. This information is then used to generate a market positional diagram identifying the leaders, challengers, niche players and visionaries within the modelling market.

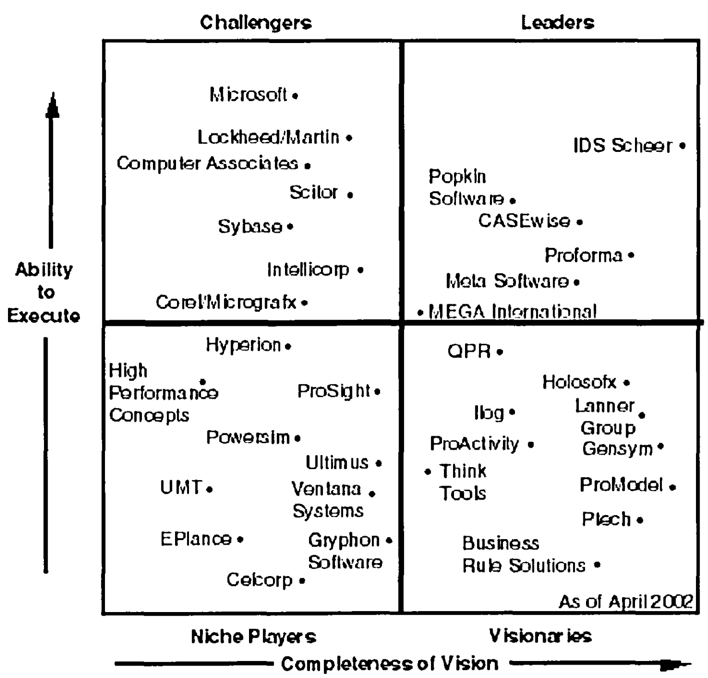


Figure 3.0: Gartner (1997) diagram showing the modelling market

The Gartner (1997) research highlights thirty of the leading modelling packages. From this table five packages have been selected for evaluation. These packages have been selected from the leaders and challengers groups, as the niche players and visionaries tend not to be established in the market and typically lean towards the bespoke industry sectors.

The five packages selected for evaluation have been chosen for a variety of reasons:

- Well-established commercial products (Aris and Popkin being the market leaders for many years)
- A willingness to be included in the study
- In-house expertise (within Sheffield Hallam University).
- Good technical support (from web sites, help files or contact with the company)
- Flexible packages to suit many industries
- Previous experience of the author (Particularly Aris, Popkin and Visio)

A brief introduction and background to the five packages selected for evaluation follows, focussing on their position within the market and the vision of the company.

Vendor : IDS Scheer

Product name: Aris Toolset

History: Professor August-Wilhelm Scheer founded the company in 1984. With its base in Saarbrücken, Aris is a well-established tool with over 15 years of experience in the modelling market. Developed at the University of the Saarland, IDS Scheer has grown into a successful global player and in its 15-year company history, business volume has risen continuously by an average of 36% annually, with consistently positive results.

Corporate strategy: IDS Sheer believes that Aris can offer a complete portfolio for the development, implementation, operation and evaluation of business processes. This is achieved by providing a methodology to model different views of the business in a structured way.

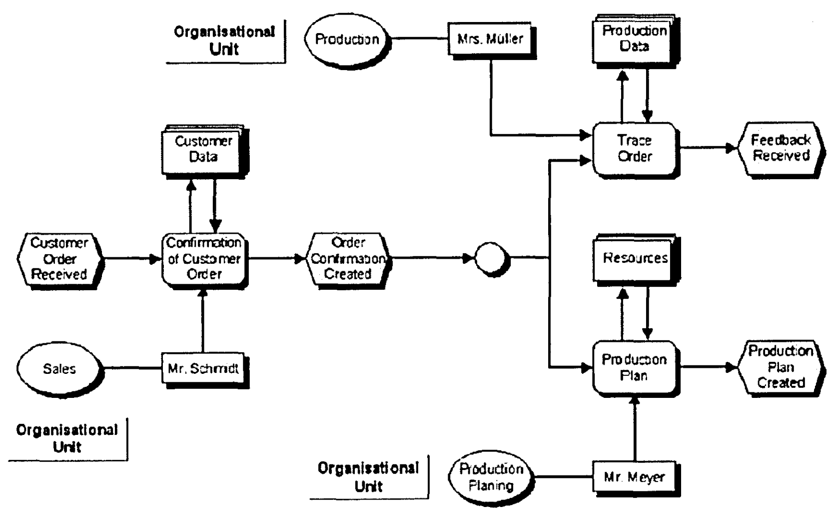


Figure 3.1: Example of Customer Order Model using Aris

Customer Base: ARIS Toolset is the world's best selling process modelling tool, with over 3,000 clients in more than 50 countries.

The company has an impressive list of company's within its customer base, they include names such as DaimlerChrysler, Deutsche Telekom, Goodyear, Lufthansa, Nestlé, IBM and Volkswagen.

Vendor: Popkin Software

Product name: System Architect

History: Jan Popkin established the company in 1988, based on his recognition of the need for tools and techniques to utilise the software industry's technical and managerial resources. Since 1988, Popkin Software has developed and produced a portfolio of products that have evolved into the company's current offering, System Architect.

Corporate strategy: Popkin Software is focused on providing the market with a comprehensive suite of tools that meets the entire needs of an organisation at each stage of the business development or re-development process. In order to do this the package utilises many of the industry-recognised standards such as IDEF and UML modelling.

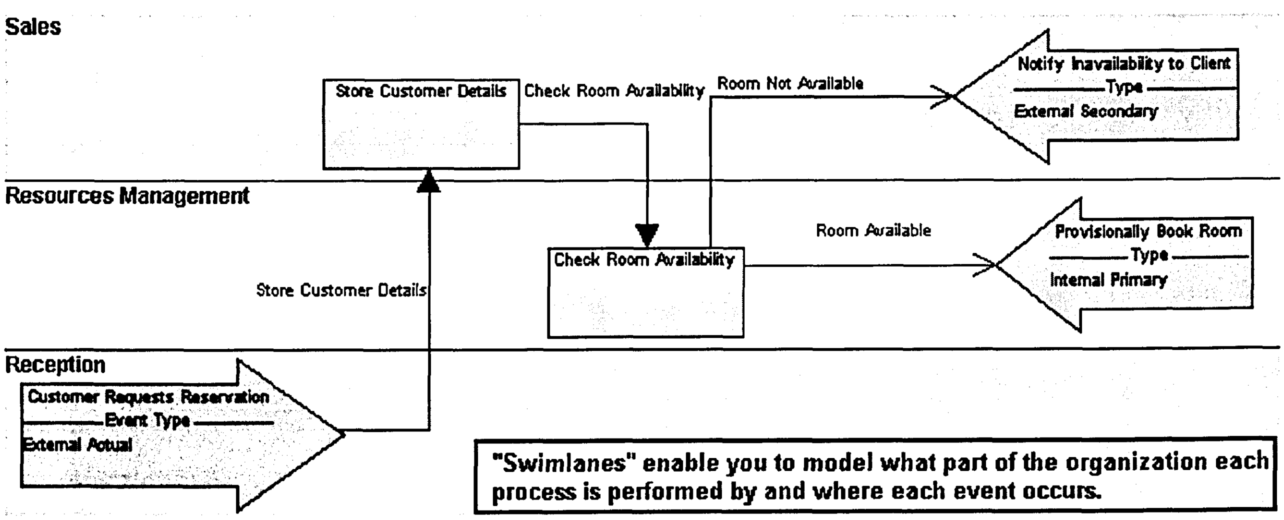


Figure 3.2: Example of Customer Order Model using Popkin

Customer Base: Popkin's customer base is inclusive of many different industries from manufacturing to banking. Within these industries the typical size of company's can range from small business to global players. Examples include; Abbey National, British Airways, Glaxo Wellcome Inc and Sony.

Vendor: Corel

Product name: iGrafx

History: The Corel Corporation was founded in 1985 in Toronto Canada. The company has earned an international reputation for innovation in software design following the success of their CorelDRAW® package, which was launched in 1989. In recent years they have used their expertise in the presentation of information, to create new software to simplify and accelerate the exchange of information and ideas. This has lead to the creation of the iGRAFX suite.

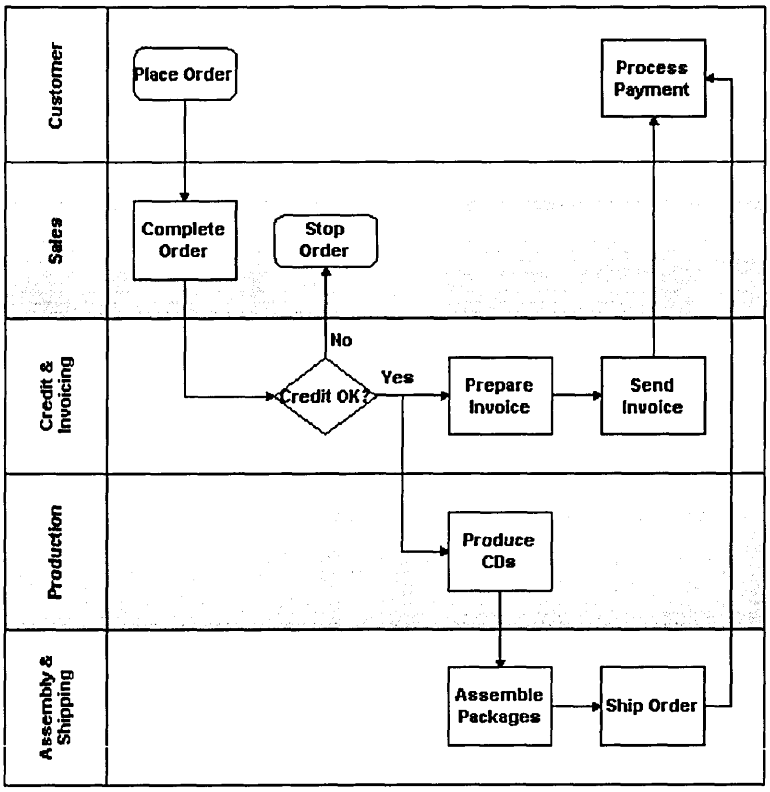


Figure 3.3: Example of Customer Order Model using iGrafx

Corporate strategy: Within the iGRAFX solutions there are a range of integrated products that allow the user to visually analyze, define, communicate and improve a companies business processes. These packages can be bought individually are as a suite that work seamlessly together, depending on the needs of the customer.

The iGRAFX suite includes; FlowCharter 2000 Professional, Process 2000 and IDEF 0. Unlike Aris and Popkin, the iGRAFX package does not offer a complete solution in one tool. Each part of the suite is specialised to meet specific needs.

Customer Base: Through the established and well-respected name of Corel, iGRAFX has built up a solid customer base, including such names as NASA and Ford.

Vendor: Proforma

Product name: Provision

History: Proforma is a privately owned American company, which has its base in Michigan. It is a relatively new company to the market, having been established in 1994. Within this short time period, however, it has established itself as a real competitor to the market leaders, being recognised as such in the much respected Gartner report.

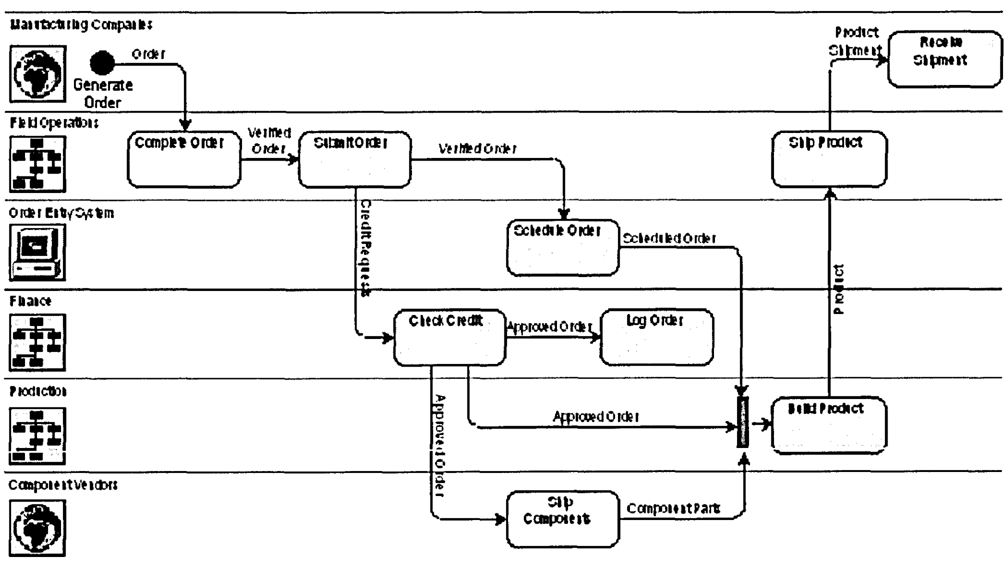


Figure 3.4: Example of Customer Order Model using Proforma.

Corporate strategy: In a similar way to the iGRAFX suite, Proforma consists of several smaller, more specialised tools. When used as a collective suite, the tool aims to capture a comprehensive view of the organisation.

The company outlines its strategy in a four-part approach;

- Understand the processes of the entire enterprise.
- Continuously improve competitive performance measures such as timeliness, cost and quantity.
- Align technology with business in a common framework through an integrated modelling environment.
- Implement with confidence by using simulation to experiment with change before implementing significant initiatives.

Customer Base:

Proforma boasts thousands of customers across the globe, representing nearly every industry. Some of the more notable partners include JD Edwards, Anderson and IBM.

Vendor: Microsoft

Product name: Visio 2002

History: In 1990 a software company called Shareware Corp was established in Seattle by a group of developers. After several experimental programs, Visio 1.0 was released in 1992. The tool was an instant success due to its flexibility and extensive array of unique features. Several versions were later released making the product such a success that in 1995, Shareware Corp. changed its name to Visio Corp.

In 1999 the company had its most successful year, for two reasons. Firstly Microsoft Inc. acquired Visio Corp. through a merger, and at almost the same time, Visio Corp announced the release of Visio 2000. The combination of Visio's sophisticated yet easy to use approach, with the marketing power of Microsoft has lead to there being several million users of Visio products worldwide.

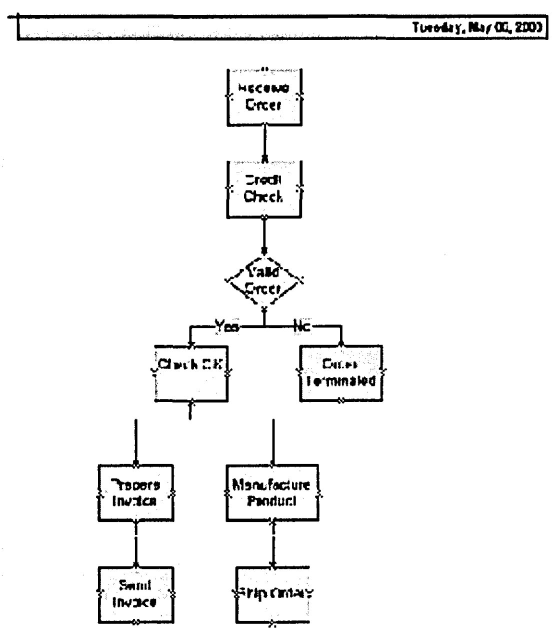


Figure 3.5: Example of Customer Order Model using Visio.

Corporate strategy: Visio was an obvious selection for the benchmarking study due to the market share it retains. However out of the five packages for comparison, it is the one that least conforms to the description of a modelling package. It is not sold as repository for corporate information or as a method to enforce uniformity in modelling.
Its strategy is to help a business visualise, document, and share ideas with attention-grabbing process flowcharts, organisation charts etc. The emphasis is on presenting data in an eye-catching way, which will appeal to the target audience having maximum impact.

Customer Base: Visio has the largest of customer bases in the survey, with several million users worldwide.

3.6 Determine a method for data collection

At this stage the specific aspects of the benchmarking process together with the packages selected for comparison, have been established. The next task in the benchmarking process is to devise a method of comparison that can be applied to the five packages.

There are a number of methods to capture data and compare competitiveness between companies, proposed by benchmarking experts. The Authors preferred method is an adaptation of the value-added ratio proposed by M. Zairi (2001). These ratios are used to determine the degree of competitiveness of each organisation (Software Company) by relating performance to results.

A specific example of one such ratio is the Indicator for Commercial Competitiveness (ICC) score. Although the details of this ratio are not applicable to the visualisation study, the format and method of comparison can be used to form the basic principles of the study.

Within the ICC study each aspect for comparison is given a score, rating between 1-5. The higher the score the better that aspect rates in that particular field.

This type of scoring system has some issues. Mainly why does the inclusion of a certain feature make that package more valuable. Also how are the scores awarded. In certain cases a beneficial feature might be present or not. In this instance the point awarding system is simple, 5 points for present 1 for absence. A more subjective approach has to be taken when a feature may be present within a package to a certain degree. An example of this can be seen with the criteria "Are ANSI standards used by the package". Many of the products within their product information will claim that ANSI standards are utilised within the package. After using the packages, however it can become clear that although distinguishable ANSI objects are present within the model, the benefits of clear recognisable objects have been lots through complex methodology and page layout. In this example although ANSI objects are present, the package would not be awarded the full five points.

The scores allocated to each field are subject to the discretion of the individual carrying out the benchmarking study. After some experience with each of the packages as well as discussions with users and the software company's, the Author has gained good working knowledge surrounding the best practices of modelling software. Therefore it is possible and credible to conduct the study based upon the opinion of the Author.

An example of this can be seen in the use of a methodology. It is the Author's opinion that a methodology adds value to a package by promoting rigor into the modelling process. Therefore a package would score highly in this category if a sophisticated and useful methodology were used.

However the same package might achieve a lower score in the presentation category, if that methodology restricts the clarity of the diagram.
Due to the categorisation involved in the benchmarking study, it is expected that each tool will score higher in certain areas, highlighting that tools area of expertise.

3.7 Collection of data

Evaluated Package	ARIS	Popkin	Corel	Proformer	VISIO
Model Methodology					
Is a methodology utilised	5	4	3	4	2
Is this methodology unique to the package	5	2	3	3	1
Is it clear to understand	2	1	2	2	1
Does it add value to the product	4	1	3	3	1
Are there rules to building the diagrams	5	4	3	3	1
Are they clear to understand	2	1	3	2	4
Do they add value to the product	5	2	4	3	2
Are there syntax and semantics checks for verification	4	4	2	3	1
Is freeform used	1	1	2	1	5
Is the tool oriented towards a strategic method	1	5	1	1	1
Is the tool oriented towards a process method	5	2	3	3	2
Is the tool oriented towards a organisational method	4	4	1	2	4
Is the tool oriented towards a data method	2	5	2	2	3
Is the tool oriented towards an object oriented method	2	3	5	2	2
TOTAL	47	39	37	34	30
Navigation techniques					
Multiple page set-up - off-page connectors	4	4	1	2	1
Shape numbering	4	3	1	2	4

Active Navigation around the diagram	5	2	2	1	4
Links to charts and files	3	3	2	2	5
TOTAL	16	12	6	7	14
Model & Data Management					
Is a repository system used	5	5	2	3	1
Simple storage or active	5	4	1	2	1
Data fields Present	3	5	2	3	3
Data fields Simple or Detailed	3	5	2	2	2
Database clean up present	4	3	1	2	1
TOTAL	20	22	8	12	9
Presenting data					
Vertical layout	5	1	1	3	5
Horizontal layout	1	5	5	2	5
Swimlane layout	1	1	4	4	5
Is a filtering system used	4	2	1	2	1
Does it aid understanding	4	2	1	1	1
Are explorer concepts used	5	5	2	3	2
Are UML Diagrams used	2	5	1	2	1
Are Event driven process chain Diagrams used	5	3	2	3	3
Are IDEF Diagrams used	2	5	1	3	4
Are Petri-net Diagrams used	1	1	1	1	3
TOTAL	30	30	19	24	30
Shapes & Lines					
Are ANSI standards used	1	1	1	1	5
Are the shapes linked to the methodology	5	4	2	3	1
Can the shapes be formatted to aid understanding	1	1	2	1	5
Automatic line routing	2	2	2	2	5
collision avoidance	4	4	2	3	5
auto line crossovers	5	5	1	5	5

auto insert and delete	1	1	1	1	5
Do the lines show processes flow	5	2	3	3	3
Are the lines dependent on responses YES/NO	1	4	4	3	4
Freedom to change colour of an object	1	1	2	1	5
Freedom to change shape of an object	1	1	2	2	5
Freedom to change the size of an object	1	1	2	2	5
Freedom to show external objects	2	2	2	2	5
Freedom to change fonts	5	5	5	5	5
Freedom to show attributes	2	2	1	3	5
TOTAL	37	36	32	37	68

TOTAL SCORE	150	139	102	114	151

3.8 Discussion of results

Package 1 – Aris Toolbox by IDS-Scheer

As the current market leader of modelling packages, it was unsurprising to find that the Aris tool scored very highly in the benchmarking study. With closer inspection of the results however, several areas of interest have been revealed. Within the model methodology, navigation techniques and Model & Data Management categories, the tool scored very highly. This is because Aris is a well planned out repository-based system, utilising a unique methodology that captures most aspects of a business.

As predicted, however, the use of this sophisticated methodology has lead to some sacrifices in model clarity and visualisation aspects. This can be seen as the tool's scores or much lower for the Presenting data and Shapes & Lines categories. The rigidity of the Aris method means that models cannot be customised to aid understanding, without affecting the interpretation of the process. This is a real problem for the tool, as due to the size and complexity of the diagrams some degree customisation would be of great benefit.

Package 2 – System Architect by Popkin Software

System Architect from Popkin is the main competitor to the Aris package. Predictably, therefore, the tool is similar in benefits and limitations. It too has a complex central repository and methodical approach to modelling. It fact the tool could be described as too complete, as Popkin endeavours to capture every angle of business life. This has lead to an unfocussed approach to modelling and a great deal of unnecessary complexity.

Each model reflecting a different view of the business appears to have its own set of rules. In some cases industry standards such as UML and IDEF are conformed to, but there seems to be no pretext as to why they are used in some models and not others.

Popkin, like Aris, also suffers from a lack of flexibility. This means that when the diagrams get too large or represent a complex system, the models can become indecipherable.

Package 3 – iGrafx Process 2000 by Corel

As a single part of a suite, Process 2000 offers a more specialised approach to modelling. The tools real strength comes from its powerful analysis functions, which can isolate wasteful processes within a system in a dynamic way. The model visualisation aspects, however, are not so accomplished. The tools preferred swim-lane layout, together with a confusing and unstructured methodology, lead to disjointed models that are not obvious to the untrained user.

Package 4 – Provision by Proforma

The Proforma package did not score highly in the benchmarking study, as it performs only moderately in all categories. The methodology it utilises adds little value to the tool, and it also restricts the freedom and creativity of the modeller to create clear representations of the company.

Package 5 – Visio 2002 by Microsoft

Visio 2002, is a major challenger to the established and more structured modelling packages. Together with Aris, this tool scored very highly in the benchmarking process, although for contrasting reasons.

Visio achieved only very low scores in the model methodology and Model & Data Management categories. This is because Visio does not utilise a strict methodology and has a very unstructured and simple repository system.

The models, therefore, do lack a degree of uniformity, which if used on a corporate scale could reduce standardisation and remove the rigour and quality of process design (all the assets of the Aris package).

Visio makes up for its lack of structure, however, in the visualisation aspects it has to offer. The models that can be developed on Visio are highly visual and appealing to the user. The models can be customised to add a personal touch, which can make the diagrams seem for familiar. This is important especially if an idea is complex. Visio aids with the reduction of this complexity through the abstraction of detail and the presentation of eye-catching models.

3.9 Benchmarking Conclusions

The study has highlighted the significant best practices in process modelling, as well as uncovering several areas for further development. As a complete tool for process design, Aris is a highly capable package. It collates data in a structured way, in just enough detail as to prove beneficial, without stifling the user in over complexity. The methodology it uses is well planned out and consistent through every view of the organisation. There can be no doubt that this package would be an invaluable tool in creating and documenting the process that occur within a modern business.

The purpose of a modelling package, however, must also be to create a shared vision of the organisation. As a result of this benchmarking study it can be seen that strict methodological packages like Aris can not provide this shared vision. In order to gain a complete understanding of a system using Aris, it would be essential for any user to be fully trained in the specifics of the modelling method.
Allot of the best practices for visualisation aspects, therefore, can be seen in the Visio package. The ability to customise a model, so that greater understanding can be achieved, should also be an essential aspect to any tool.

The ideal solution, therefore, would be a modelling package with the structure and method of Aris, with the presentation capabilities of Visio. In the absence of such a package, a more creative solution must be found.

Chapter 4
Methodology

4.1 Introduction

The purpose of this chapter is to describe the research work carried out in order address the problems surrounding Model Presentation identified by the benchmarking study. The chapter begins with a brief description of the structure of the packages highlighted in the benchmarking study (Chapter 3.9). This is followed by a detailed analysis of the methods available to overcome the issues identified in Chapter 3.9. The analysis will include:

- Proposed solution
- Selecting Model Area
- Exporting data from Aris
- Capturing the relevant information
- Transferring data into Visio format (Mapping building blocks)
- Importing data into visio

4.2. Structure of the Aris Software

Aris derives its name from Architecture of Integrated Information Systems. It is the use of a central Repository system combined with a methodical approach to model creation that separates Aris from simple drawing packages. Repository based tools provide a structured framework on which to build knowledge about the various views of an organisation.

Rob Davis (2001) explains this idea by continuing with the architecture analogy. He explains that an office can be viewed from a certain viewpoint, typically the physical size of the building, how many people work inside it and perhaps how computers support this office.
There are, however, many more view points of this office to be considered, such as the data that flows between departments and the organizational hierarchy.

In order to describe these views efficiently and completely, Aris's founder Professor August-William Scheer created the Aris house vision of an organization.

The Aris house represents the five different views in which business models can be structured into.

- Organisational View – static models of the structure of the organisation, including: people resource in hierarchical organisation charts, technical resources (e.g. equipment, transport, etc.) and communications networks.
- Data View – static models of business information. Includes: data models, knowledge structure, information carriers, technical terms and database models.
- Function view – static models of process tasks. Includes: function hierarchies, business objectives, supporting systems and software applications.
- Output (Result) view – dynamic models which show the outputs, results and deliverables which are produced by the system.
- Process (Control) View – dynamic models that show the behavior of processes and how they relate to the resources, data and functions of the business environment. Includes: Event-driven Process Chains, information flow, materials flow, communications diagrams, product definitions, flow charts and value add diagrams.

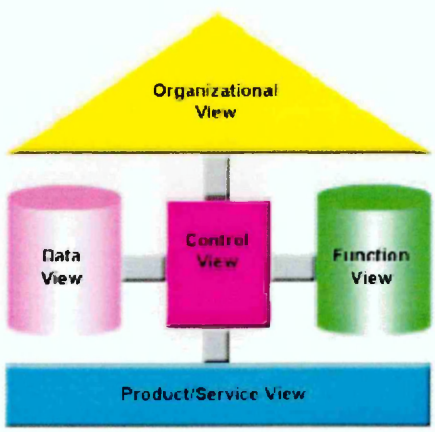


Figure 4.0: The Aris House

This architecture or framework is often represented in diagrammatic form Fig 4.0. From this diagram it is clear to see that central to the structure of the Aris house is the control or process view. All other areas of business are either direct outcome of (result view) or resources for this central area.

As explained to great extent in chapter one, the process view is the most important and complex area of a business. It is where all the other views come together to form a comprehensive picture. This idea is better explained by Mathias kirchmer (2002). The control view shows who works on which functions using which data and in which operational logic to produce which deliverables.

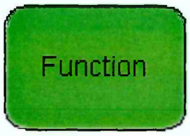
Central to the process view of Aris, is the Event Driven Process Chain, which is the main method of modelling within Aris. The Event Driven Process Chain is a Dynamic model that brings the static resources of the business to organise them into a sequence of processes that add business value to a project.

Considering the central role that the Event Driven Process Chain plays within Aris, it will be important that any practical integration between the packages focuses on this method of modelling.

There are four main object types that make up the Event Driven Process Chain models, *Events, Functions, Rules* and *Resources.*

Event boxes within Aris represent the changing state of the world as the world as a process proceeds. They can be summarised as follows:

- External changes that trigger the process to start (Customer order received)
- Internal changes of state as the process proceeds (Product manufactured)
- The final outcome having an external effect (Order delivered to customer)



The function boxes in Aris represent the activities or tasks carried out by the business as part of a process.

Following the strict rules of Aris, the Event box must be followed by a function, then by an event, continuing on in sequence until a chain is formed. When the two boxes are used in sequence, they form a very detailed and logical flow of events and subsequent activities that need to be performed.

Rules – Processes consist of more than just sequential steps. Aris has a complex system of coping with branches, decisions and triggers within the model. There are nine basic rules than can be applied, each having a slightly different usage depending on whether they follow or precede functions.

Resources – This broad object type represents several hundred individual objects. They can be anything within the organisation that supports a process. This could be an organisational unit, external person or even documented knowledge.

For every object that can modeled within Aris (over 300 in total), there is a corresponding symbol that can be used in the model in order to represent that object. A database is stored within Aris that contains the object and its corresponding symbol.

The use of the Aris repository system means that the Event Driven Process Chain captures the process in even more detail by storing information about objects, models and databases in a properties facility. The property information includes the appearance of an object, its configuration and specific attributes.

4.3 Structure of Visio software

Due to the simplicity of the Visio tool, there is no complex system architecture to describe. Visio is a collection of modelling techniques, brought together in order to provide the user with an abundance of choice with which to model their systems.
With an absence of rules and restrictions the user is left with somewhat of a blank canvas on which to start modelling. This freedom in itself can create some immediate problems for the user:

- What shapes should be used to indicate steps in the process?
- How should the model be orientated on the drawing page?
- How should the model be formatted so that it's effective, clear, and attractive, and conveys the process instantly to others?

Visio overcomes these issues by providing the user with modelling templates in order to add some degree of rigor to the models created.

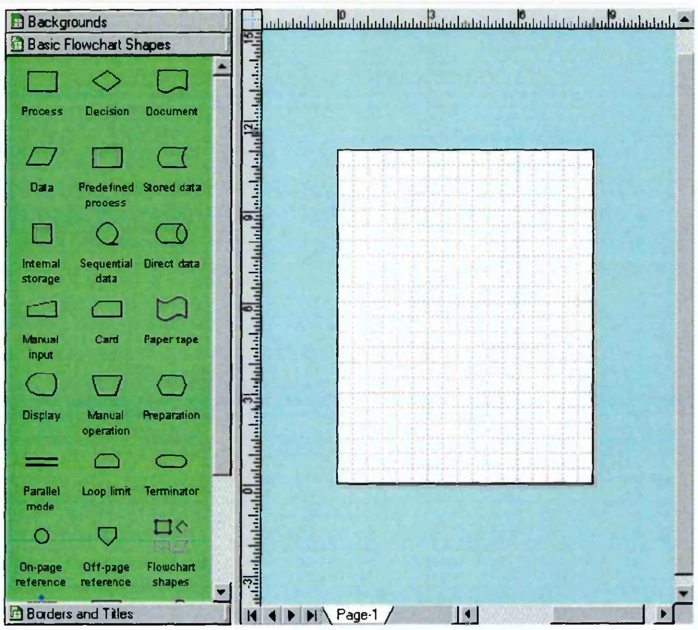


Figure 4.1: Visio Template & Drawing Screen

The model template as seen in fig 4.1 provides stencils (the green area), which contain pre-drawn shapes. A model is then created by moving these shapes onto the drawing page provided, by using a drag-and-drop operation.
There are a variety of model templates covering a wide range of modelling techniques, such as; flowcharting, TQM and IDEF. Each template provides the correct stencils in order to satisfy the requirements of a specific model type.

Like Aris, each template provides a database that contains the objects available for modelling and its corresponding symbol. The most commonly used template would be the basic flowcharting model. This template consists of Three stencils, the first contains shapes representing flowchart symbols (standard ASCI shapes from chapter 1), such as Process and Decision. The other two contain pre-designed backgrounds, borders, and titles so that the model can be clear and attractive to the eventual recipient.

4.4 Proposed Solution

The results from the benchmarking study suggest that the solution to the visualization problems of Aris and the unstructured nature of Visio might be overcome by creating a bridge between the two packages. This bridge would allow the user to define what data was truly necessary from the complex Aris model, and then transport this data into the Visio format. Once the data has been transported, it could then be presented in a more user friendly way.

This solution aims to create a clearer representation of a business model by abstracting from the Aris model the aspects of interest. This is not a simple transference of data from one package to another, therefore, there will be a number of obstacles to overcome.
The main problem to resolve is that of data exchange between the packages. Although both products do have the ability to work in parallel with other tools, they were never designed specifically to work with each other.
There are a number of stages that need to be completed to overcome this problem. Diagram 4.2 shows these stages, the operating environment in which they occur as well as the supporting information needed to complete each stage.

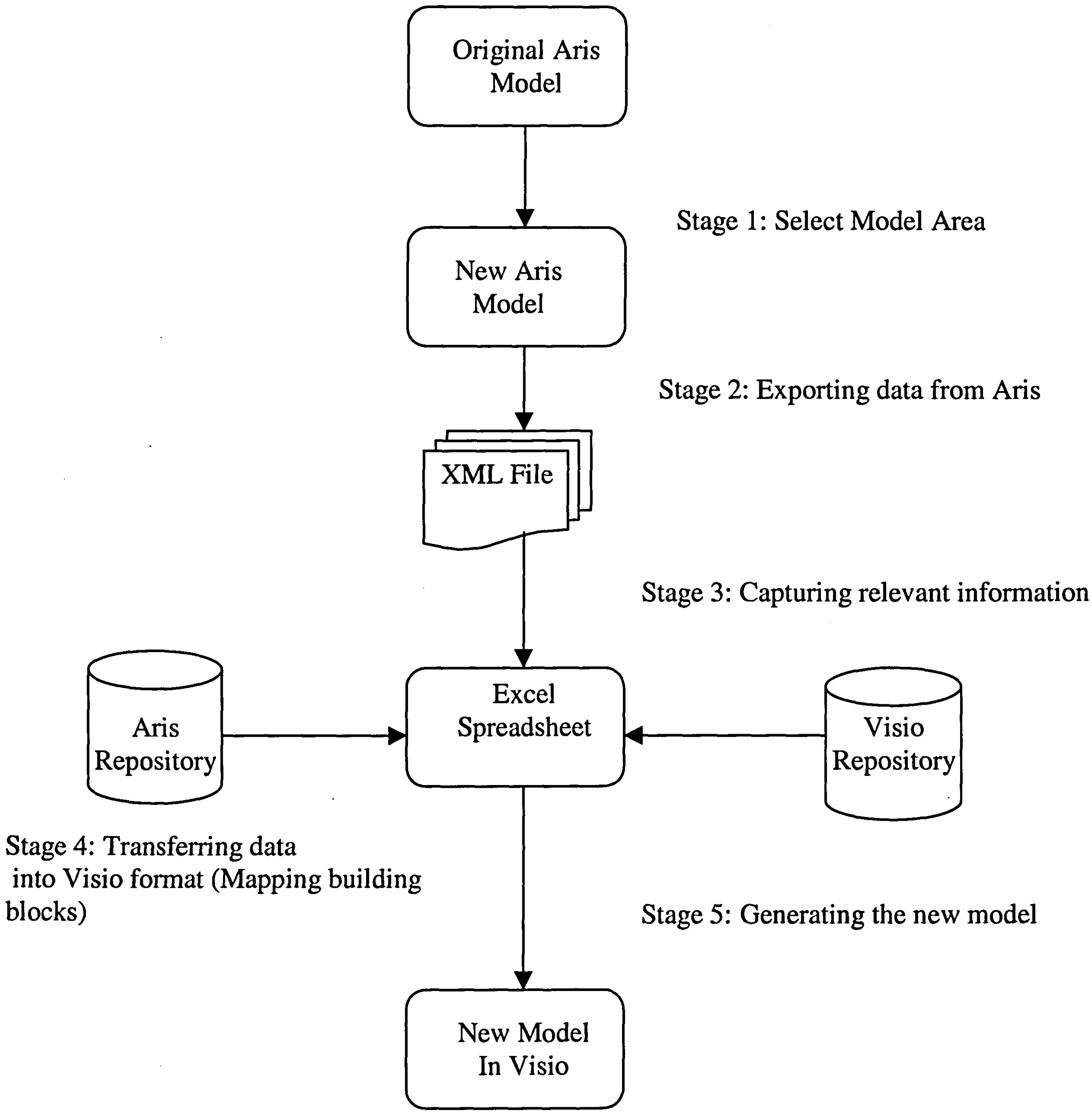


Figure 4.2: Solution Stages

The individual stages shown in diagram 4.2 will now be discussed in detail.

4.5 Stage 1 : Selecting Model Area

One of the problems with Aris, identified by this research is scale and complexity of the diagrams. A typical Aris model can be several pages in length, representing a process that includes a variety a people and resources. To the untrained user these models are of little value, as it is difficult to isolate a group of functions within a large process and often the symbols used mean little to them. A key objective of this research, therefore, was the ability to capture a specific area of interest within the model, and include only the resources that where applicable to that user.

For example, if a sales process within a large organisation was modelled, a member of the accounts department might only play a small role. For their part, they would not need to see the entire sales process or all the technical resources that support their functions. All that is required are the functions they need to perform, presented in a way that is clear.

This example highlights that a method of isolating the relevant data is required. Unfortunately there is no tool within Aris to perform this specific function. It is possible however, to overcome this problem by utilising an existing function within Aris in an unusual manner.

The select function within Aris is a useful tool for highlighting groups of objects within a model. Once a selection of objects is made, assignments such as function responsibilities can be allocated with one click of the mouse, instead of editing every individual object in turn.

This tool can be adapted to fulfil the requirements of this stage. After selecting the objects and connections for the new model, a user can simply use the <Ctrl> C command to copy the selected area, so that it is available to paste (<Ctrl> P) Into a new model.

This adapted feature allows the user to isolate only those events, functions, connections and resources that are required within the new model.

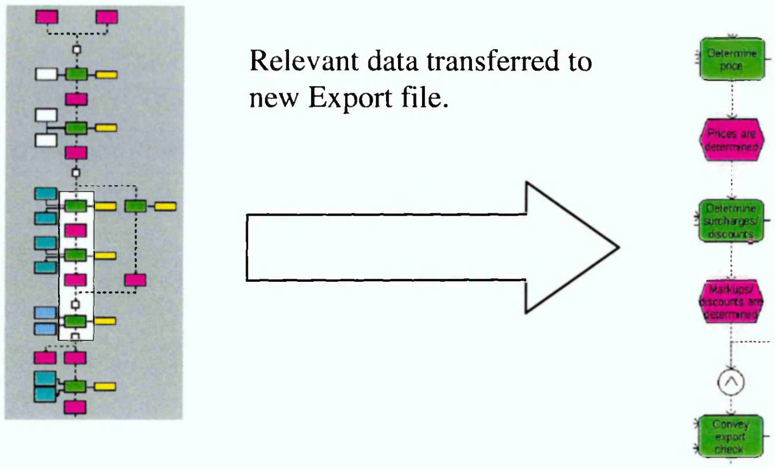


Figure 4.3: The export of Selected Area

The new model can then be transferred into a purposefully created export file, ready for the next stage.

4.6 Stage 2: Exporting data from Aris.

There is no direct method available to transfer data from Aris to Visio. It is therefore, necessary to split the process up into stages. The first of the transfer stages is to export the information that describes the model and the data that is stored within it. There are two main ways to create a document containing the model information.

- Create a Report – The Aris reporting function creates a structured document in various formats including Microsoft Word, Excel and HTML. The Reports often break models down so that they can be used for the analysis of a system. Although they do give clear understanding about the data contained in a model, they do not include any information about the structure of the model itself.
- Model Export function – The model export function allows not just the model data, but also the model definition to be exported from Aris. This function was initially created so that a model could be sent to other users, who could then use the import function to add the model to their system. This would allow a safer transfer of data over a communications network, as the traditional binary file format may be corrupted by some e-mail systems.

The model Export function is the obvious choice to use in first stage, not just for the model definition but also for the structure of the document it creates. Aris uses Extensible Markup Language (XML) to export the data into an ASCII file.

XML is a relatively new method of defining the structure of a document and then transferring it. It has enjoyed great success in the developer community due to its many applications in web technology.

The success of XML is largely contributed to its simplicity and adaptability. It consists of three things, Elements with Attributes organized into a tree structure.

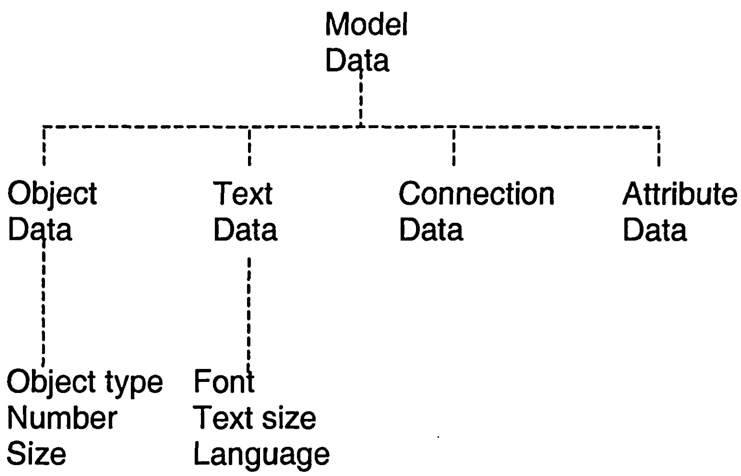


Figure 4.4: XML tree structure.

Focussing on the Aris export file, this tree structure can be seen as a hierarchical group structure, that organizes the model into separate file sections. The top level of the hierarchy contains model creation data, descending through to the lower levels such as format of the text used. The file is separated into 23 separate sections (See Appendix 1). When combined together the files contain a complete break down of the model and the database from which it came. The following files contain the specifics about the structure of the model. As Aris has its origins in Germany, the text within the exported code is in German. A translation is provided.

- Gruppen (groups)
- Modelle (Models)
- Spalten (columns)
- Objektdefinitionen (object definitions)
- Kantendefinitionen (connection definitions)
- Textdefinitionen (text definitions)
- Objekte (Objects)
- Kanten (Connections)
- Schriftarten (Fonts)
- Texte (texts)

The tree structure is then expanded upon, as each of these files has attributes associated with it.
The strict tree structure present in the exported file will be of great value in the second stage of the data transfer.

4.7 Stage 3: Capturing the relevant information

With the model data and definition exported from Aris, the next stage in the process will be to capture the relevant data stored in the exported file. The new model to be created in Visio, will be of a reduced complexity, therefore, only a fraction of the data exported will be needed for its creation. A tool must be used to search through the detailed file in order to capture the structural definition of the model and the model data that is deemed relevant.
Although the exported file is not visually appealing (see Appendix 2), its tree structure does lend itself favorably to this searching process.

There are a number of tools that can be used for searching through a file and retrieving data. In section 4.7.1, however, it is established that a Microsoft Excel spreadsheet will be used to import the data into Visio. This limits the choices available, as the tool must run through Microsoft products.
The main "backbone" programming language to most Microsoft applications is VBA. (Albright, 2001). VBA is a most suitable tool for this process as it provides many of the typical programming functions found in all programming languages, as well as providing a in built user friendly environment in which to work.
VBA can be used to read through the exported XML file, selecting the appropriate data, by completing routines written in the VBA code.

4.7.1 Excel spreadsheets

In the final stage of this process will be to import the converted Aris data into the Viso active drawing screen. Viso provides the facility to dynamically generate Visio models from static data stored outside of the package. This data can be stored in a variety packages, typically Microsoft applications like Access or Excel.
By utilising a Microsoft application it will be possible to use pre-generated VBA subroutines to generate the Visio model from a simple spreadsheet or database.

For the purpose of this report the spreadsheet method will be used, largely due to the experience of the author with developing systems using Excel. It is worth noting, however, that the process would work equally well with an Access database.
When importing data from a spreadsheet, Visio provides a standardized template that must be populated. The template contains the minimum amount of data necessary in order to generate the new model, as well as the potential to add user variables.
There are two workbooks that need to be populated, the Blocks sheet and the Connectors sheet.
It is important at this stage to remember that some of the data being imported into the spreadsheets is not in a format that can be read directly into Visio. A mapping process must take place to match up Aris objects with Visio objects, and in some cases remove or simplify data for the new model. The capturing of relevant data and the mapping process will occur simultaneously within the finished solution. To gain a greater understanding of the two processes, however, the author will explain them separately, making simple references when the other process is involved.

4.7.2 Block Sheet

Shape ID Number	Shape Description	Visio Template	Shape Text
100	Event	Basic Flowchart Shapes.vss	A
101	Function	TQM Diagram Shapes.vss	B

Figure 4.5: Block Sheet.

The specific rows that can be seen in fig4.5, contain the information about the objects that will be present in the new model.

Shape ID Number – This is a unique number associated with a specific object. It originates from the ID number given to the object in Aris. It allows an object to be assigned distinct properties. For example, there may be many Event boxes within a process, but by allocating that object as Event box 100, it can be easily identified. The other function performed by Shape ID Number is to provide object-positioning data within the Visio model (the detail of this function is explained further in the connector's sheet). The number itself is retrieved directly from the exported model data. As this number does not contain model property data it does not need to be converted into Visio format.

Shape Description – At this stage an object within Visio has been created, and a unique shape number assigned to it. The next stage is to instruct Visio of what the object is i.e., Event, Process, Decision. This information is retrieved by VBA from the Aris export file. The data is then mapped against the Aris/Visio object database (see 4.8), and the equivalent Visio object is imputed into the Block sheet.

Visio Template – This row simply instructs Visio of where the object identified in the previous stage can be found within the Visio template databases. This is achieved by including the Visio template information within the Aris/Visio object database (see fig 4.12).

Shape Text – This is the text that is present within all model objects. With the exception of Aris rules (see 4.8), the transformation process should not change this data, therefore, it is retrieved directly from the Aris export file and inputted into the block sheet.

4.7.3 Connector Sheet

Connector ID	From Shape	To Shape
100	100	101
101	101	102

Figure 4.6: Connector Sheet.

The Connector Sheet contains the information required to link the objects together in the correct sequence, so that the process flow can be visualized.

Connector ID – This gives a unique number from to the connecting line so that Visio can identify it.

From Shape – Once the line has been identified, the next stage is to instruct Visio of the point of origin of this line. This is achieved by adding the Shape number.

To Shape – The final stage is to instruct Visio of the end point to the line. This is also achieved by adding the Shape number of the connecting object.

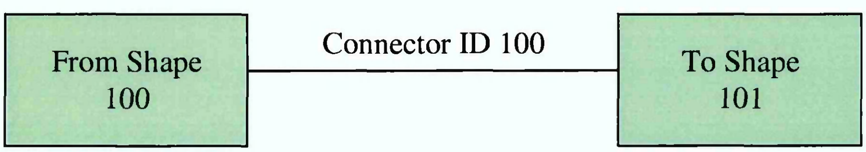


Figure 4.7: The connection of objects.

4.8 Stage 4: Transferring data into Visio format (Mapping building blocks)

At this stage, data has been exported from Aris, and the relevant information has been located and removed. This data, however, is still in an Aris format. A transformation process needs to take place, in order to convert the building blocks of Aris into Visio.

As discussed earlier, both the Aris and Visio tools contain a database of objects that can be used in the models and their corresponding symbols.

A mapping process must be conducted that matches the building blocks of each package together.

For the purpose of this research the EPC objects from Aris and the Basic flowcharting objects from Visio will be used. Although, by completing the relevant mapping process, almost any model in Aris could be matched to its equivalent model in Visio.

Aris models when compared with Visio can be described as high level. This modelling term means that an Aris model shows a process and its resources in a greater amount of detail than its Visio counterpart, which can lead to problems. Although there are obvious object to object links between the two databases, decisions have to be made about how to best represent Aris objects that do not have direct counterparts in Visio.

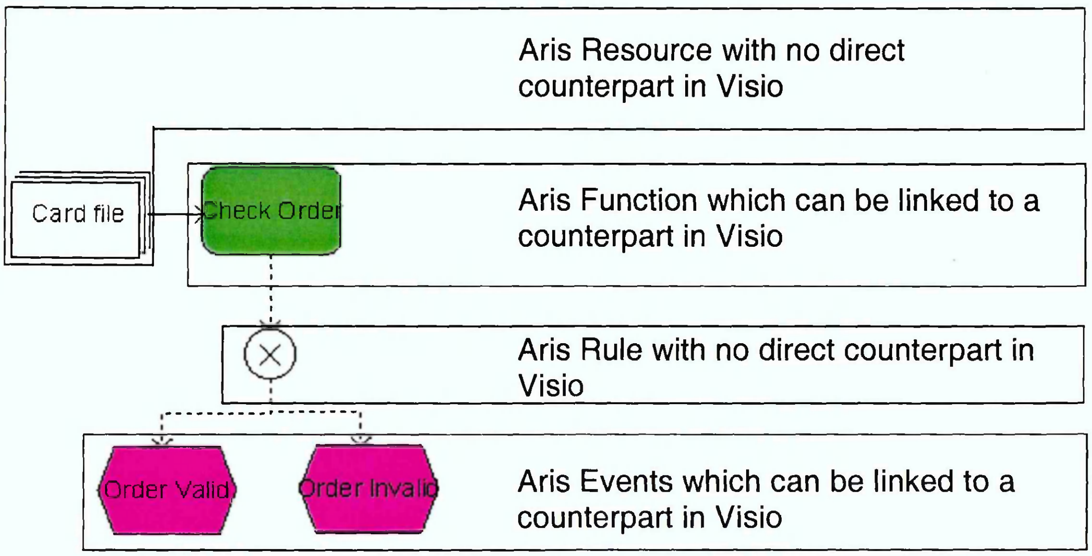


Figure 4.8 The similarities between tools

In example 4.8 the problem of correlation between the models occurs when a rule within Aris is reached. There are nine separate rules within Aris, whereas in Visio there is only one object to cope with branches, decisions and triggers within the model.

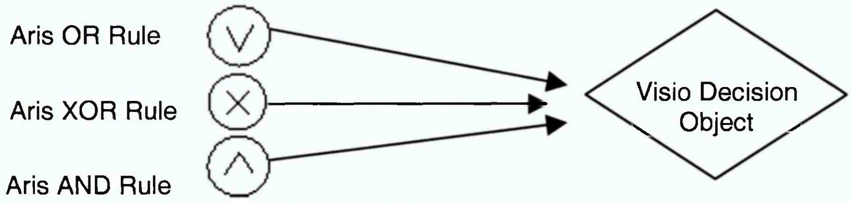


Figure 4.9: The Aris rule problem

This problem can be overcome by writing a VBA procedure that recognises the occurrence of an Aris rule, then generates a standard Visio decision object containing text that explains the rule. For example:

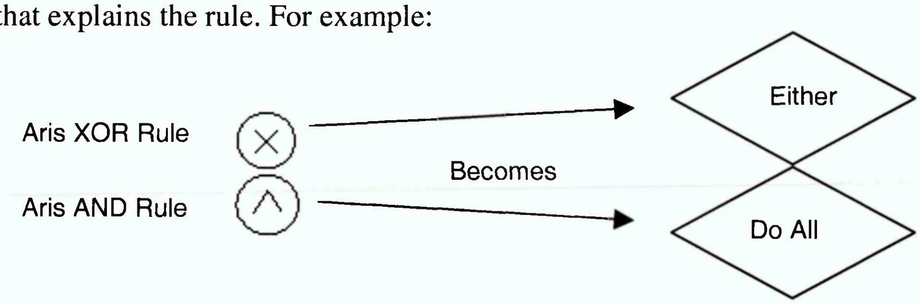


Figure 4.10: Aris rule solution

The Aris database also contains a significant number of resources such as different storage and technical facilities that can not be found within Visio database. This degree of detail, however, is unnecessary in the Visio model. The mapping process, therefore, can be used to group together some of the Aris resource objects under a broader heading within Visio. This can be seen in example 4.11.

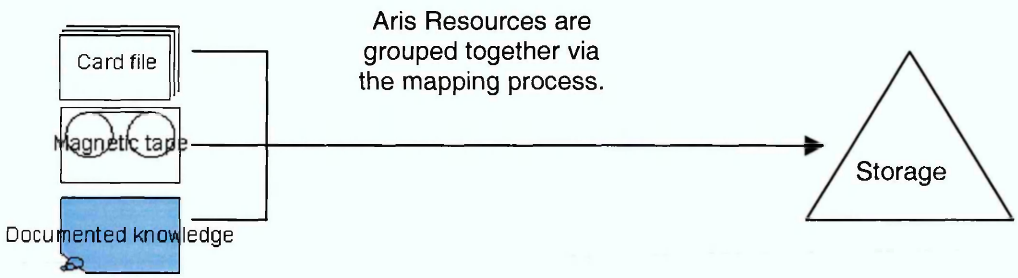


Figure 4.11: Resource grouping

This process combined with the obvious object to object links, will generate a new database containing the Aris objects, its equivalent Visio object and a reference to where this object can be found in the Visio databases. This will be named the Aris/Visio object database

Symbol No	Master Name	Visio Stencil Name
1	Event	Basic Flowchart Shapes.vss
335	Function	TQM Diagram Shapes.vss

Aris Object

Name of Visio Object

Visio Database reference

Table 4.12: Aris/Visio object database.

With the use of this database and the VBA procedures, it is possible to either map Aris objects directly to Visio objects or simplify Aris objects into a more understandable Visio format.

4.9 Stage 5: Generating the new model

To generate the model the user simply selects the Import facility on the Visio toolbar then chooses to Import data from an existing spreadsheet.

A dropdown menu allows the user to select the appropriate file, which launches the Excel spreadsheet.

To read the data from the exported Aris file into spreadsheet, the user would simply click on a command button. The command button is supported by a VBA sub-routine, which tells Excel the appropriate file to open in order to populate the spreadsheet. Once the spreadsheet has been automatically populated, the closing of the Excel application then triggers the import sequence. The new model is then displayed in the Visio drawing window.

Chapter 5
Experimentation

5.1 Introduction

The purpose of this chapter is to conduct a practical example of the data transformation/transportation methodology outlined in chapter 4. This will include all of the key stages described within in the method. The methodology itself takes part within three different software systems, with data transfer linking each environment.

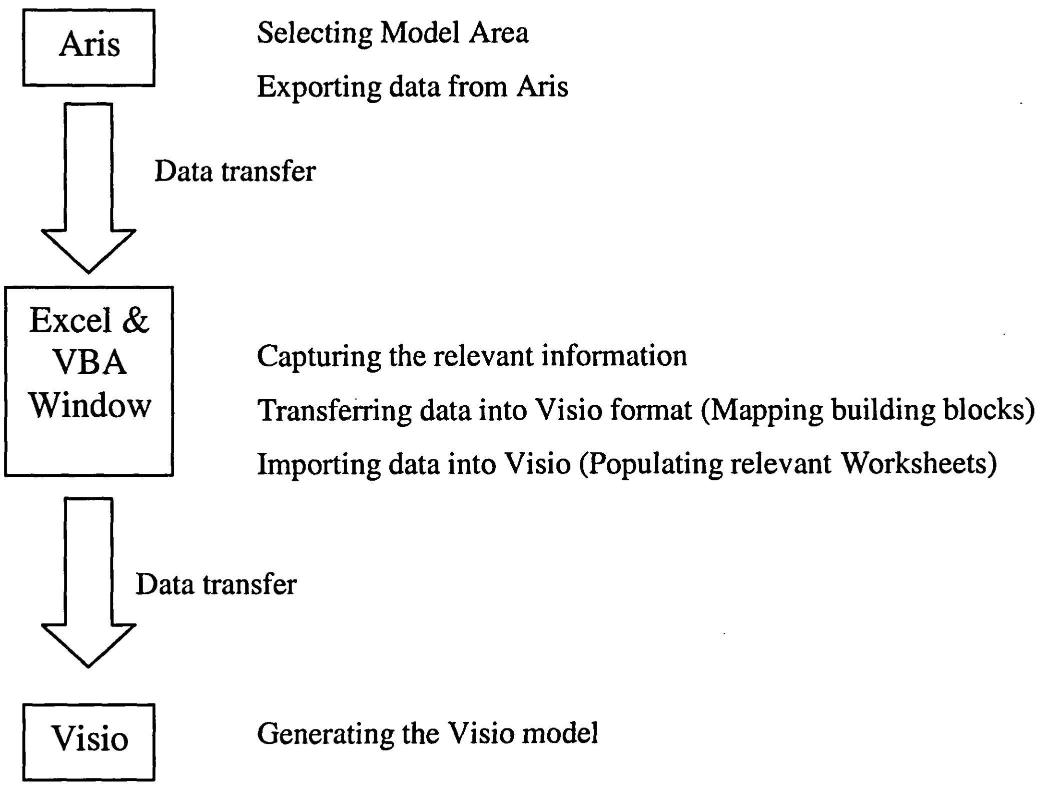


Figure 5.0: Data transfer between Software Systems.

Due to the practical nature of any experimentation processes, it will be impossible to describe the stages outlined in the method, in the same logical sequence. This is because many of the stages occur simultaneously, therefore, a new approach to describing the stages will be taken. The clearest way to do this is to describe the stages as they occur from the user's perspective, showing the movement of data between the different operating environments.

5.2 Experiment A

The example used for this research focuses on a busy sales department within a large manufacturing company. A large scale Aris EPC model is created to show all the activities and resources present within the sales process. The model itself is several pages in length, including many contributions from departments outside that of sales. This example focuses on one such contribution.

The administration department plays a small but important role within this large process, and they require a model defining the responsibilities that they have.

The example used in this case has three main aims:

1. To select the specific objects related to this part of the process, from the EPC model.
2. To simply the data selected through a process of data transformation and mapping, leaving the selected data in a Visio format.
3. Finally, to generate the new model in the correct sequence within the Visio drawing screen, where it can be edited to create a clear and attractive model.

5.3 Aris Software System - Selecting Model Area

A section of the sales process EPC outlining the area required for transformation is shown in fig 5.1.

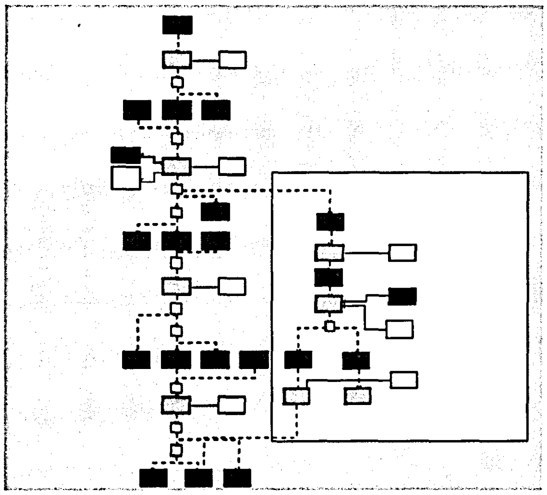


Figure 5.1: Selected Model Area

Using the select function the required area is selected from the EPC and copied into a model screen within the database called *Export*. At this stage any resources that the user deems unnecessary for the new model can be removed simply by choosing not selecting them. The new model ready for export can be seen in fig 5.2

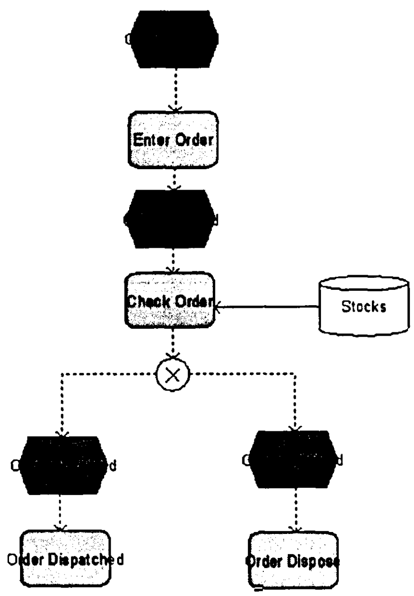


Figure 5.2: Removed Model Area

5.3.1 Aris Software System - Exporting data from Aris

To export the model from Aris the user simply runs the model export facility, selecting the model they wish to transport and the file name given to the new exported XML file, *model* in this example.

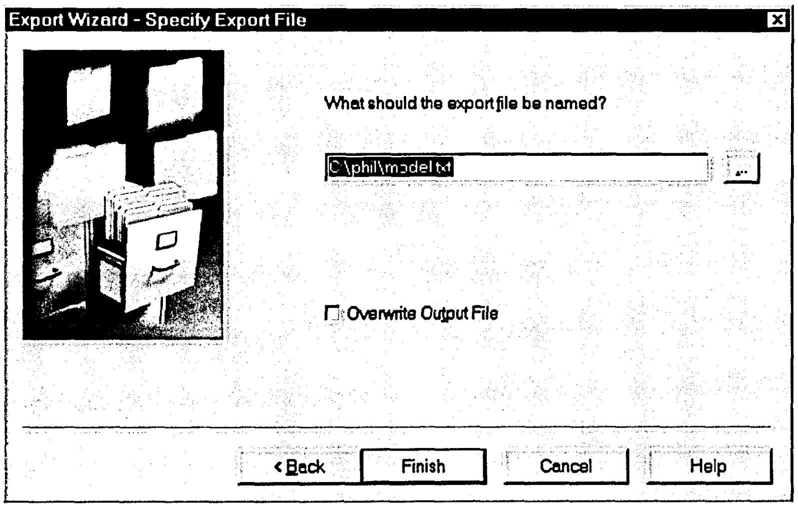


Figure 5.3: Model Export Screen

The new XML version of the model has now been created and stored within the computer. At this stage the Aris application can be closed.

5.4 Visio Software System – Starting the model generation process

The introduction to this chapter explains that allot of the stages occur simultaneously, often as a direct result of a coding routine. For this reason it is unnecessary to open the Excel application at this time, as this will occur automatically. The next stage, therefore, is to open a new Visio drawing screen and use the model import function. This allows the user to select the data source they wish to use as the basis from the new model. Selecting an existing Excel file called *Import* will trigger the blank block sheet and connector sheet to be opened.

5.5 Excel Software System

The Excel workbook, *Import,* consists of four worksheets.

- Worksheet 1contains a command button that triggers the transformation process.
- Worksheet 2 contains the block sheet information.
- Worksheet 3 contains the connector sheet information.
- Worksheet 4 contains the Aris/Visio object database.

When Excel is opened the only Worksheet the user comes into contact with is the command button trigger, to start the process. When this is pressed the worksheets needed by Visio to create the model are automatically populated.

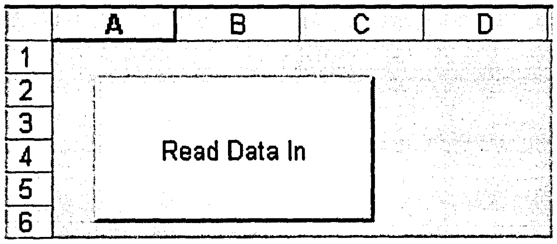


Figure 5.4: Command Button

5.5.1 Excel Software System – VBA Window

The VBA code forms the backbone to the transformation process. Through the use of VBA it is possible to:

- Capture the relevant data from the XML file *model*
- Transfer the data into Visio format by mapping the building blocks (if required)
- Finally, populate the relevant Worksheets so that the data is ready for import into Visio.

5.5.2 Populating the Worksheets

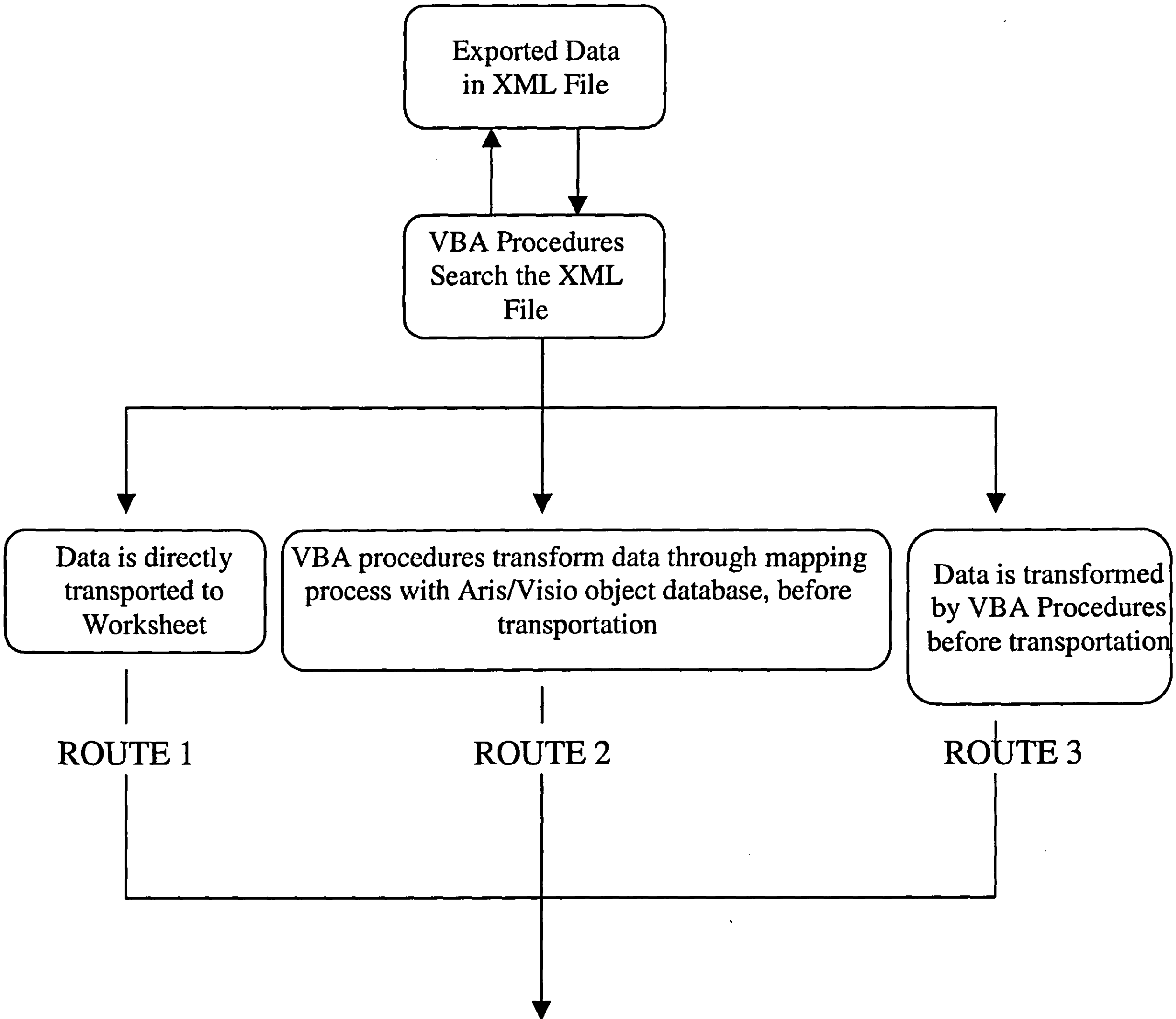
In order to populate the two blank worksheets (block sheet and Connectors sheet), VBA procedures search the new *modelin* file to locate the relevant information.
As explained in chapter 4.6, the XML file has a hierarchical tree structure, containing the model data in various structured sections (or branches). The VBA procedures select the appropriate branches, and then proceed to find the relevant data within these branches.

The transportation of the data that is found within the XML file is dependent upon the suitability of its format. There are three possible transportation routes for this data.

1. The data can be in a format suitable for Visio (typically Shape text). It can therefore be directly extracted from the XML file, and transported into the relevant cell within the worksheet.
2. Frequently the object data contained within the XML file is in an unsuitable format to be transported directly into Visio. If within the Visio template, however, an equivalent object exists, the data can be mapped against the Aris/Visio object database to find a suitable Visio object. This object data can then added to the relevant cell within the worksheet.
3. Occasionally the Shape text data within the XML file is in an unsuitable format to be transported directly into Visio (typically text contained within Aris rule objects). In this instance VBA procedures are used to recognise the unsuitable text and

automatically convert it into a format suitable for Visio. This text data can then added to the relevant cell within the worksheet.

The selection of data from the XML file and subsequent population of the worksheets is illustrated in fig 5.5.



Shape ID Number	Shape Description	Visio Template	Shape Text
100	Event	Basic Flowchart Shapes.vss	A
101	Function	TQM Diagram Shapes.vss	B

Unpopulated block sheet and Connectors sheet

Figure 5.5: Selection, transformation and transportation of data.

As stated in section 5.4, all of the coding routines and the subsequent worksheets generated by them, are hidden from the user. Once the Command button is pressed on spreadsheet one, Excel can be closed down.

5.6 Visio Operating Environment – Completing the model generation process

Closing the Excel application acts as a trigger within Visio to complete the Model Import process. The new Model showing the responsibilities of the administration department within the sales process is then automatically generated within the Visio drawing screen.

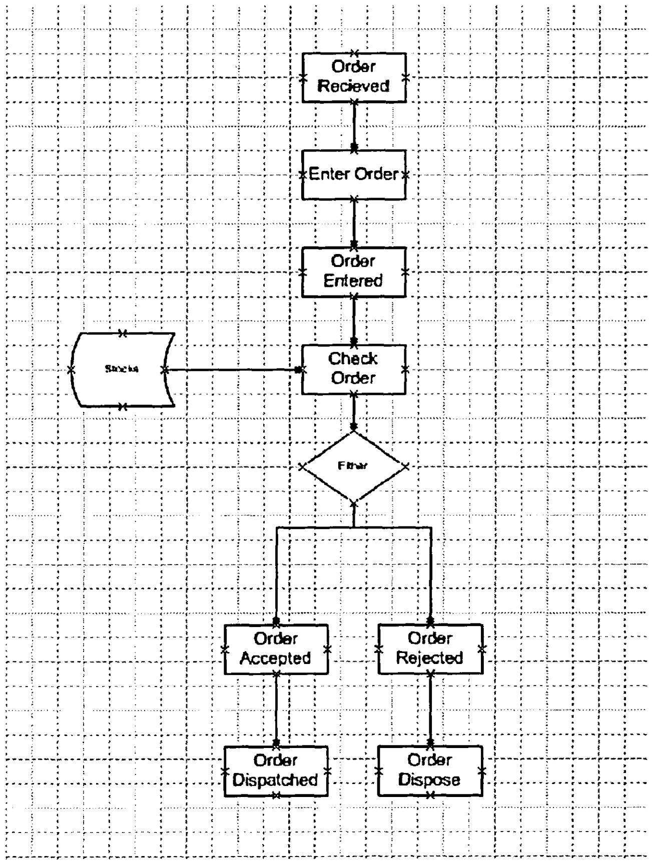


Figure 5.6: New model within Visio

The new model can then be used in this unformatted state, or various graphics can be added to suite the target audience.

5.7 Further Experiments

The degree of success and limitations of Experiment A will be discussed in detail in Chapter 6. To allow a comprehensive evaluation of the transformation/ transportation process, however, it is necessary to conduct further experiments. This will allow the tool to be tested against the various possibilities and scenarios that a complex process model might present.

Within Aris there are Four main process scenarios that are typically identified:

1. Straight Chain – this is simply a straight chain within a process. It will contain an Event followed by a function followed by an Event etc.
2. Process Split – this is a when the process splits in two more than one chain, often after a rule, such as a decision. Experiment A contains an example of a process split.
3. Process convergence – after a process has spit into several chains, it is sometimes necessary for these chains to converge back into a single chain. This is a process convergence.
4. Loop – A loop returns a process to an earlier stage in the chain to re-run that part of the process again.

Several example models were created in Aris to represent each of these process scenarios (except process split as this has already been tested). The examples used do not contain any resources, as it is the ability of the tool to recreate the process logic that is being tested. The examples are designed on the assumption that the segment of the process being transformed/transported has been selected from a larger business process model.

Any issues are limitations identified by these experiments will be discussed in detail within Chapter 6.

Experiment B – Straight Chain

In this example a simple Process chain is selected for transportation from a larger Aris model. The selected Aris chain and the subsequently generated Visio model are shown in fig 5.7.

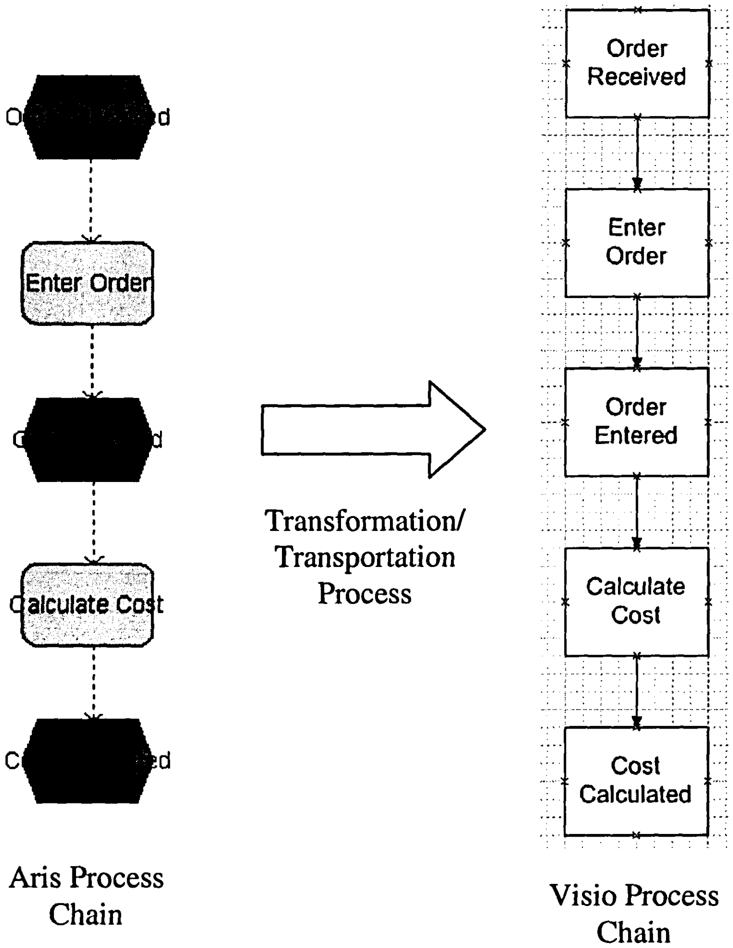


Figure 5.7: Straight Chain

The Process Chain was successfully transformed into the Visio format and the model was recreated in the Visio drawing screen in a logical sequence. The connections between the objects are correct, and the layout of the model has not been altered.

Experiment C – Process Loop

In this example, the need to cope with more complex process flows and decisions has lead to the introduction of a process loop. As explained earlier, a loop returns a process to an earlier stage in the chain. In this example several Aris rule objects are also included.

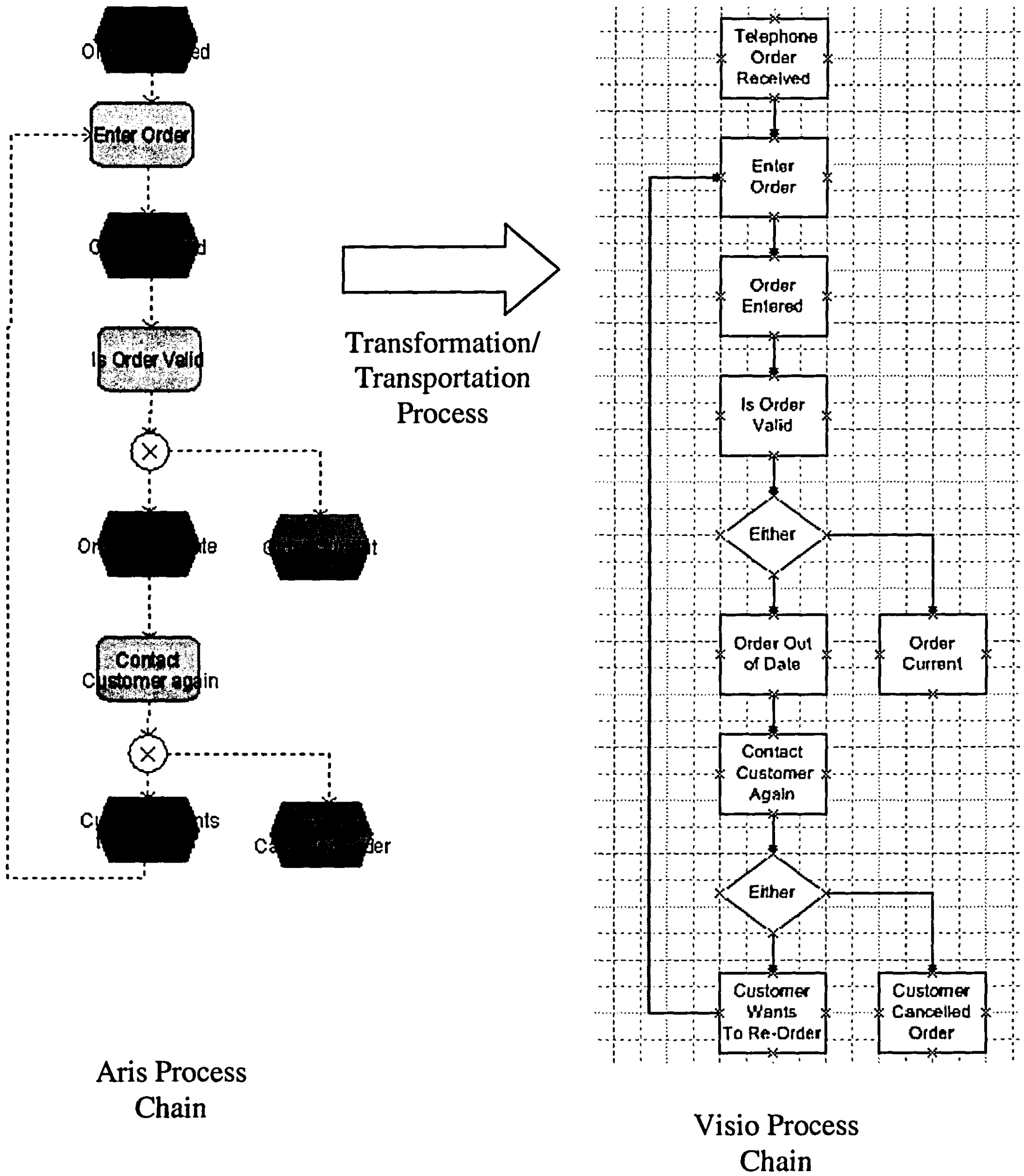


Figure 5.8: Process Loop

The new model has been successfully generated in the Visio drawing screen (Figure 5.8). The inclusion of a process loop does not cause a problem to the transformation transportation process. The objects and rules have been successfully transformed into the Visio format, and the layout of the new model is in a logical sequence.

Experiment D – Process convergence

The result of an Aris rule is often to send the process down one are more alternative paths. Often these paths reach their logical conclusion i.e. a dead-end in the process chain. Sometimes, however, it is necessary to join the paths back together at some point to complete the process. The following Example illustrates this scenario.

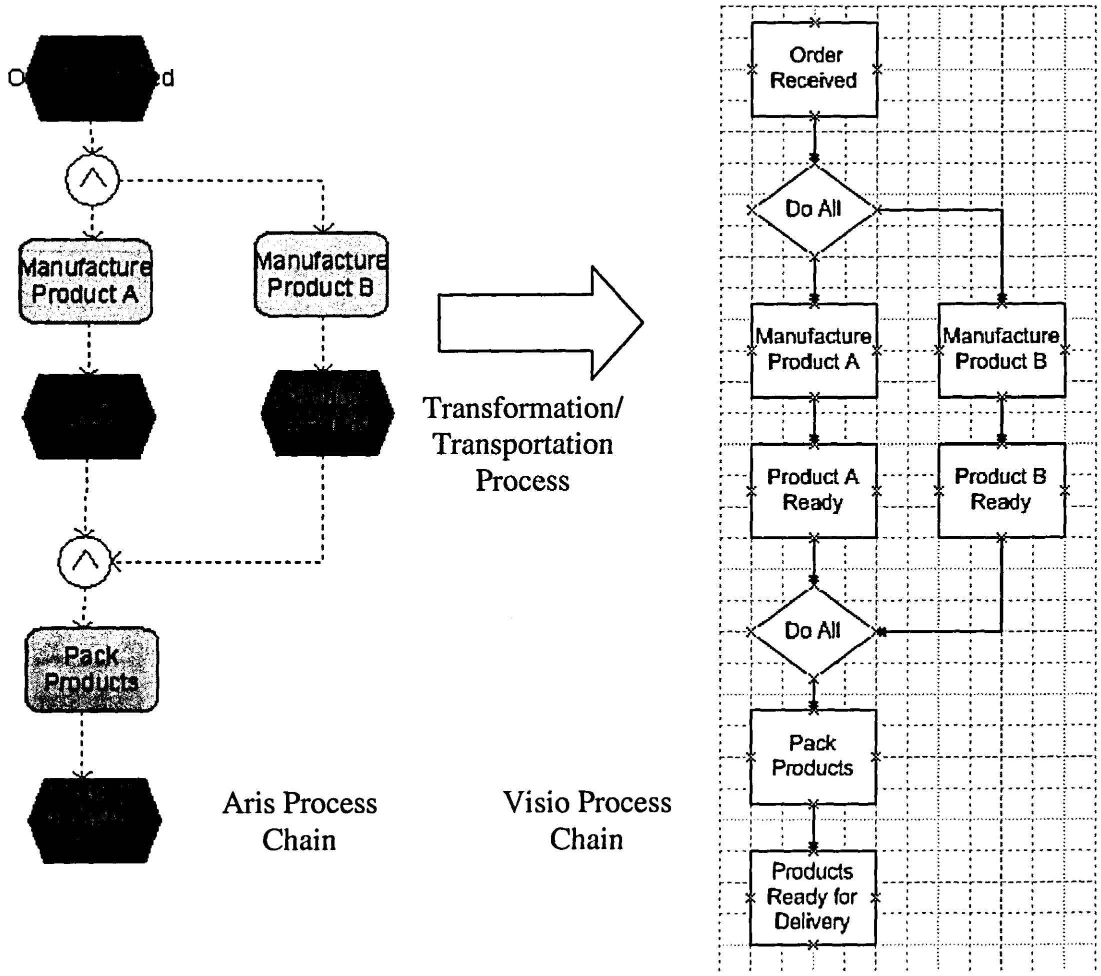


Figure 5.9: Process convergence

The new model has been successfully generated in the Visio drawing screen (Figure 5.9). The objects and rules have been successfully transformed into the Visio format, and the layout of the new model is satisfactory. There is however one aspect of the new model, that has not been a complete success. The previous examples have not only been successfully transferred, but the models have had a logical sequence. In this experiment, however, a problem with this sequence has been established. In Aris, when two paths are brought back together the join is made using the same Rule object that was used to make the original split. This repetition of the Aris 'And' rule in Experiment D means that the object is taken across into the new model where its inclusion is no longer necessary. The inclusion of this extra object might be considered as a limitation to the process, and will be discussed in greater detail in Chapter 6.4.2.

Chapter 6

Results

6.1 Introduction

The previous two chapters have described a methodology for transporting and transforming model data from Aris, together with experiments conducted from the user's perspective, which test the success of the original methodology.

This Chapter will predominately focus on results obtained from Experiment A. This will include the success of the transportation/ transformation tool, the validity of the new model and any limitations to the process. To allow a comprehensive evaluation of the process, any limitations obtained from the further experiments conducted are also included.

6.2 Success of the transportation and transformation process

At the beginning of the experimental phase three main aims were identified. These were objectives that needed to be met in order for the transportation of the model to be considered a success.

1. To select the specific objects related to the administration department, from the sales EPC model.
2. To simplify the data selected through a process of data transformation and mapping, leaving the selected data in a Visio format.
3. Finally, to generate the new model in the correct sequence within the Visio drawing screen, where it can be edited to create a clear and attractive model.

After conducting the experiment, each objective can be re-visited to see whether the transportation and transformation process has fulfilled its original goals.

6.3 Effectiveness of the Selection process

The Original sales EPC model used in the experiment was a typical large-scale business process model. It encompassed many different departments and company resources. The aim, therefore, was to show that it was possible to isolate those events, functions, connections and resources that the user considered valuable enough to be in a new model. In the model used in the experiment, there were two objectives that the Selection process must achieve:

1. Firstly, it was necessary to select a chain of objects (Events, Functions and Connections) from the EPC that were relevant to the administration department.

2. It was then important to look at the resources and allocations attributed to the Events, Functions and Connections, to see whether they were appropriate for the new model. This process is entirely at the users discretion and, therefore, the detail contained within any new model can be adjusted to suit the target audience.

Using the adapted select function described in Chapter 4.5, it was indeed possible to fulfill the two objectives described above. The chain of objects related to the administration department was successfully isolated from the main body of the EPC.

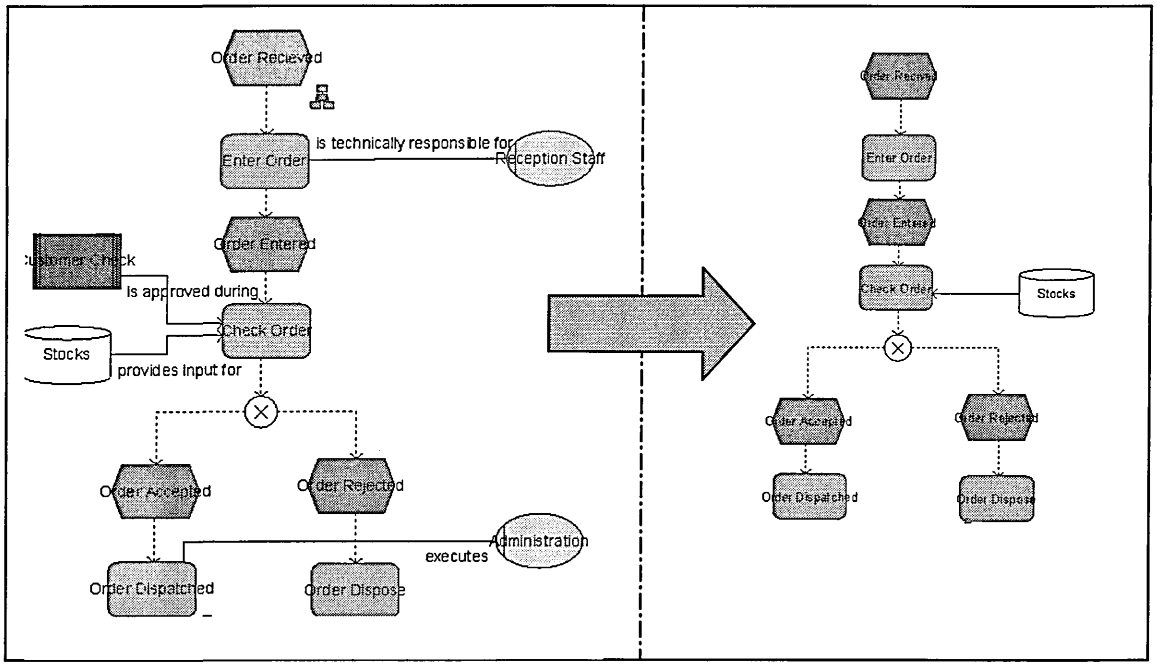


Figure 6.0: Diagram showing the selected objects.

Figure 6.0 shows the success of the selection process in achieving the second objective. Two function allocations, a resource and two irrelevant connections were successfully removed from the model at this stage.

6.3.1 Validation of the selection process

It is important to remember that the objects selected for removal were chosen at the authors' discretion. This was done in keeping with the goals of experiment i.e. the reduction of complexity. This is meant to reflect the typical selection process the user might adhere to. It would be prudent to mention at this point that the success of the transportation/transformation process does not rely on the removal of these objects, and would in fact work just as well with them included.

The resulting model created by this process is an abstraction of the original model. In Chapter 2.6.1.1, the abstraction process is described as being the selection of the relevant aspects of a situation for the purpose of analysis. It goes on to say that this reduction of complexity through abstraction allows a greater understanding of a system than might otherwise have been gained.
This was certainly the aim of the selection process, however, it is important to consider the possibility that important data might have been lost through the abstraction process.

This is a contentious issue, as some might say that by simply picking and choosing objects from the original model, the Model creator is not portraying a true image of the existing system. This leads to the question, is their justification for leaving out information within a model?

One idea that might justify the removal of data is the thought that models are created in order to achieve something. Hutton (2002) discusses in great detail how every model has a purpose and an intended audience. He went on to say that it was the purpose of the model and its intended audience that would dictate the choice of modelling techniques used. He was, at the time, describing the level of detail necessary within a model.

This is applicable to the object selection process, as the user could adjust the model to fulfill a certain purpose or to cater for a distinct audience. Looking back at the experiment conducted this idea has been adhered to. The objects that have been removed would not effect the target audience i.e. the administration department, therefore, the model is being adjusted to suite the intended audience.

6.3.2 Limitations of the selection process

As well as looking at the success of the selection process it is important to highlight any limitations to the process, and discuss how they might impair the effectiveness of the tool.

Limitation 1 – Within the experimental phase it has been demonstrated that it is possible to select chains of objects and their related connections and resources. It would, however be impossible to selectively remove an Event or Function that is in the middle of a process chain.

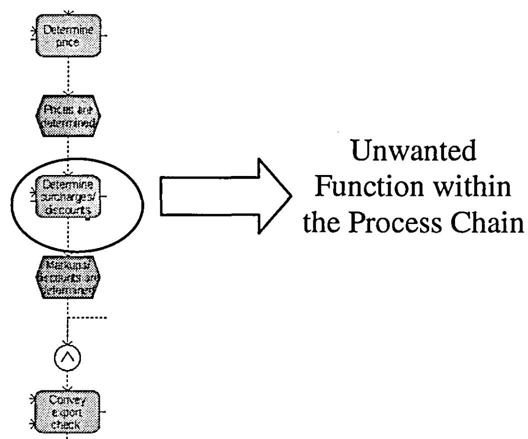


Figure 6.1: Diagram showing the removal of a function.

The removal of a Function or Event as illustrated in fig 6.1 by the selection process would not be a problem. The unwanted object would simply be left out of the selection area. The problem would arise later on in the generation of the Visio model. As discussed in Chapter 4.7.2, each object has a unique Shape ID Number. One of the functions of this object identifier is to act as object-positioning data for Visio. If a Function or Event within a process chain is removed, then any objects that are connected to that removed Function or Event will have lost their connection point.
The program that has been written cannot automatically change the connection points to link up the diagram.

Although this must be considered as limitation, the act of removing a Function or Event from the middle of a process chain would be unadvisable. This act would most likely disrupt the sequence and subsequent logic of any model, there by removing any value to the transportation process.

Limitation 2 – The second limitation is the quantity of data available for transportation. At the end of Chapter 4.2 the properties facility within Aris is mentioned. This feature of the Aris repository allows a great deal of information about an object to be stored within a central database. This data, however, can not be captured by the selection process, and hence can not be included in the new model.
This is not considered to be an important problem, as the selection process is meant to be reducing the complexity of the new model, not simply transporting identical data from one tool to another. Even if the object properties could be transported with the model, the structure and simplicity of the Visio repository could not cope with the volume and detail of data being transferred.

6.4 Effectiveness of the data transformation and Mapping process

The purpose of the data transformation and Mapping process as described in Chapter 4.8, is to reduce the complexity of the Aris model and transform the data into a Visio format. This was achieved by completing one of the following methods:

1. Simple mapping – If an object in Aris could be linked directly to an object in Visio, then a simple transformation process could take place using the Aris/Visio object database discussed in Chapter 4.8.
2. Object grouping - The mapping process can be used to group together some of the more complex Aris resource objects under a broader heading within Visio (Chapter 4.8.).
3. Object transformation – If an object in Aris does not have a direct counterpart in Visio, then VBA procedures can be used to transform the Aris object into a meaningful Visio object (Chapter 4.8.).

The data transformation and Mapping process generated two spreadsheets containing all the information in the correct format to generate the Visio diagram.

Shape ID Number	Shape Description	Visio Template	Shape Text
100	Event	Basic Flowchart Shapes.vss	Order Recieved
101	Function	TQM Diagram Shapes.vss	Enter Order
102	Event	Basic Flowchart Shapes.vss	Order Entered
103	Function	TQM Diagram Shapes.vss	Check Order
104	Decision	Basic Flowchart Shapes.vss	XOR operator
105	Event	Basic Flowchart Shapes.vss	Order Rejected
106	Event	Basic Flowchart Shapes.vss	Order Accepted
107	Function	TQM Diagram Shapes.vss	Order Dispatched
108	Function	TQM Diagram Shapes.vss	Order Dispose
109	Stored data	Basic Flowchart Shapes.vss	Stocks

Table 6.2: Completed Block Sheet

Connector ID	From Shape	To Shape
100	100	101
101	101	102
102	102	103
103	103	104
104	104	105
105	105	108
106	104	106
107	106	107
108	109	103

Table 6.3: Completed Connector Sheet

As can be seen by Table 6.2 and 6.3 the two spreadsheets were successfully populated, ready to generate the new Visio model.

6.4.1 Validation of the data transformation and Mapping process

The data transformation and Mapping process has changed the appearance of Aris objects, to that of Visio ones. Where a direct object to object link was not available between the two tools, a transformation process took place so that the new Visio model would be understandable i.e. Aris rules.

The transformation of data between the two tools can be justified, as the simplification of a model requires not only the reduction of data quantity, but also the translation of data into a familiar form.

Importantly, models need to reflect the natural language of an enterprise as it is essential for the reader to see familiar business concepts clearly reflected (Hutton, 2002).

If the transformation process does not convert the Aris object, then the "language" of the model remains foreign to the end user. Hutton (2002) concludes that the symbols and language used in a model should be understood by the intended audience.

Once again, whether the transformation of data from one format to another is a valid process, is a contestable issue.

Some might say that the mapping process rather than transforming model data, actually corrupts the data. It is this corruption of data that must be avoided. The process of simplifying a model is meaningless if the new model has been altered so much by the transformation stage, that it no longer represents the original model.

It is the opinion of the Author that the data transformed has merely been simplified to suite the intended audience and not corrupted. The Experiment performed can be used to demonstrate this.

Simple mapping – This process has matched like to like objects between the tools, so no corruption of data is present i.e. Event box in Aris to Event box in Visio.

Object grouping – This process has grouped a specific storage devise in Aris i.e. computer database, to a more generalised storage object in Visio.

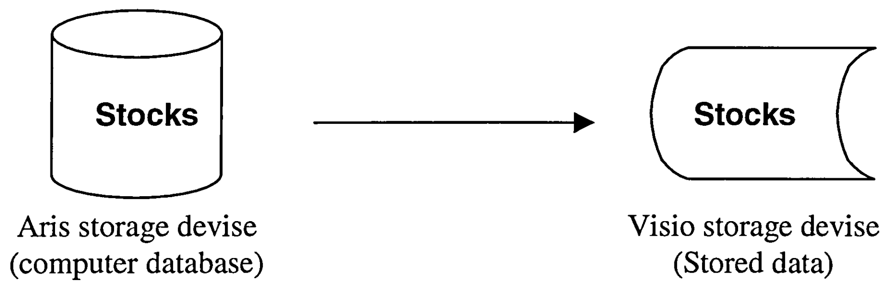


Figure 6.4: Diagram showing object grouping

The transformation process has not corrupted the object, as the essential quality of that object remains the same. The name *Stocks* is still used in the Visio diagram, so the consistency between the two models is maintained.

Object transformation – In order for the intended audience to understand the new model, the transformation of both object symbol and text was necessary in some cases i.e. Aris rules. As with Object grouping, the Aris rule symbols were grouped under the generalised heading of Visio Decision. This process can be seen as simplification and not corruption of data.

The text that originally accompanied these rules was very much part of the Aris methodology, which the new model, was trying to escape from. If a user were not familiar with Aris then they would not understand the new model.

The text was therefore transformed, giving the new model clarity and logical process flow. This must be seen as a reduction in model complexity and not a corruption of the original model meaning.

6.4.2 Limitations of the data transformation and Mapping process

The data transformation and Mapping process for Experiment A must be considered as a success as the original aim of simplifying model data and leaving it in a Visio format, was accomplished.

A limitation to this process, however, was found in Experiment D. Due to the Aris methodology, the convergence scenario (5.7) created a repetition of the 'Either' rule, which could lead to some confusion when reading the Visio model. A spilt in the Aris process chain is brought back together with a repetition of the rule that caused the creation the original split. Unfortunately there is no way of identifying the second occurrence of the rule, and so this object is transported to the Visio model. This is a minor problem to the comprehension of the overall model, but must still be considered as a limitation to the process.

Another limitation that might be considered is the degree of subjectivity within the mapping process itself. The act of matching the various objects together as well as interpreting was is meant by the original model may be dependent upon the individuality of the programmer.

This limitation is lessened to a certain extent due to the strict methodology of the Aris tool. As there are so many rules and restrictions within Aris there is very little scope for misinterpretation of the models. As long as the programmer has a good understanding of Aris principles, the translation of a model into a new format should be a logical and therefore less subjective process.

It is still important, however, that good contact is maintained throughout the design and production stages of the tool, with the original model creators, to avoid misinterpretation.

6.5 Effectiveness of the model generation process in Visio

Once the Model data is in a format that can be read into Visio, the final process is to import the model to the Visio drawing screen.

The most crucial aspect of this process is the sequence and positioning of objects within the Visio drawing screen. When the model is generated in Visio it would be of great benefit if the objects were:

- Set out in the correct sequence
- Spaced equally
- Had untangled connection lines
- Any splits, loops or convergence's within a process chain displayed in an intelligible way.

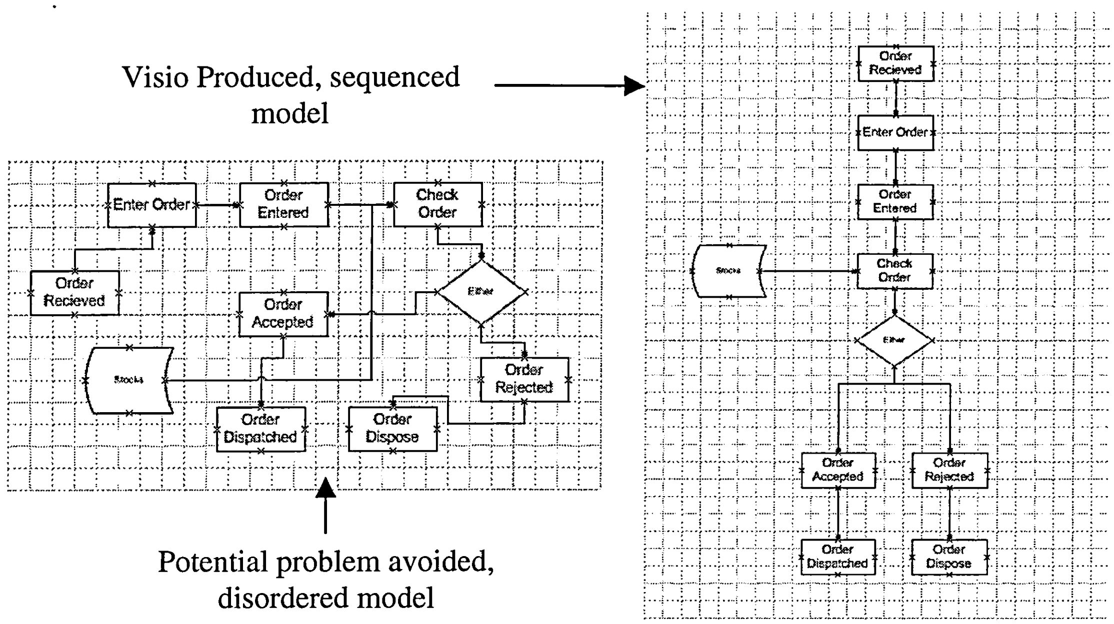


Figure 6.5: The generated Visio model

As can be seen in fig 6.5 and through out all the experiments conducted the sequence and positioning of objects within the Visio drawing screen have been displayed in a comprehendible manor, allowing the flow of process logic to be seen.

6.5.1 Validation of the model generation process in Visio

As a function available through Visio, the import process was the only stage of the experiment that was not strictly regulated by the Author.
Although there is model positioning data available within the Exported XML file, this information is not included within the import spreadsheets. There is, therefore, no way of determining how the model will be interpreted and subsequently displayed with the Visio drawing screen.

In order to reduce the risk of generating models without sequence, the most important preventative step is to populate the import spreadsheets correctly. This at least will guarantee that the right objects or linked together.
Fortunately, as Visio like Aris is based around the logical flow of process, it is automatically geared to the production of this type of model. In fig 6.5 it can be seen that presence of a decision box is recognised by Visio and the appropriate action i.e. a logical split in the process chain is generated.

Although Visio manages with the model generation process proficiently, any small errors in object positioning could easily be overcome within the Visio drawing window.

6.5.2 Limitations of the model generation process in Visio

The major limitation of the model generation process in Visio has already been established in the validation section. The lack of a principal control over the look of the new model must be considered as a limitation, especially as such tight constraints have been applied throughout the rest of the transportation/transformation process.

The impact of this limitation however, is limited and the severity of the problem can be avoided through careful selection of import data.

6.6 Feedback from Industry

Although the transformation/transportation of Aris models appears to be successful, it is important to remember that the demand for this solution came from a real problem within industry. The solution itself has been achieved through cooperation with industrial partners, so it was hoped that the final tool would achieve its original goals.

The conclusions of the Benchmarking study (Chapter 3.9) suggested that a tool was needed to simplify Aris models and present them in a user-friendly way. It was also deemed desirable to keep some of the rigor found within Aris models and interpret this into the new Visio model.

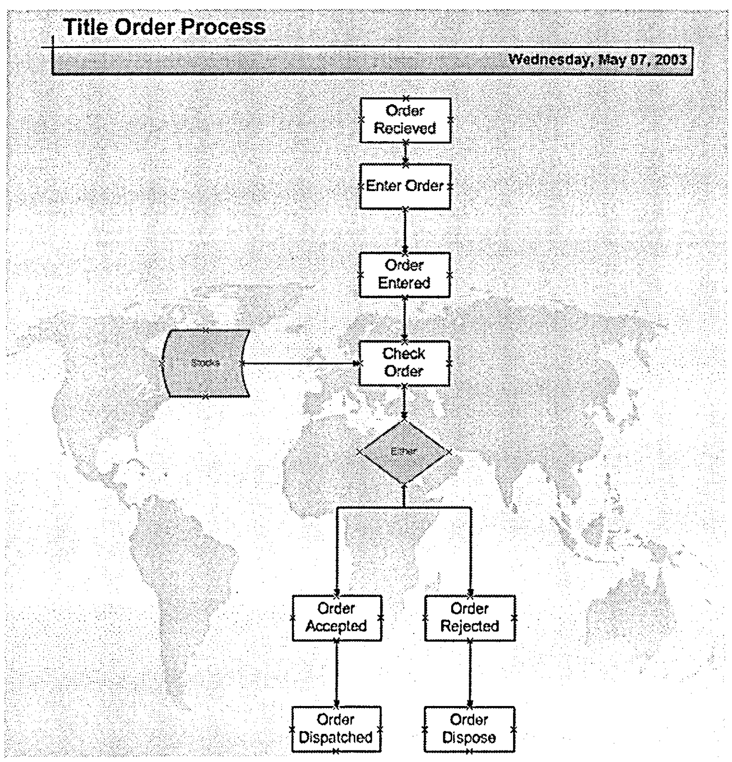


Figure 6.6: Edited Visio model

Contacts at BT agreed that this goal was achieved and that the tool was able to capture the "best practices" of both packages. The logical process flow found within Aris remained, but the model itself was in a more understandable format.

It was suggested that the tool had good practical applications, and would allow business process models to be shared across the company and beyond. The main benefits of the tool were noted:

- Quickly capture relevant areas of a large-scale business process model, and present this area in a user-friendly way.
- Allow people from within BT or external customers who are unfamiliar with the Aris methodology, to quickly grasp the logic within a system.
- Generate a true picture of a business process, yet maintaining the freedom to edit the picture to suite a particular audience.

Whilst gaining feedback to the tool, several interesting suggestions were made regarding the possible application and further development of the tool.
The solution developed currently allows people with experience using Aris, to transform their diagrams into a format suitable for the untrained user or external customer. It was suggested, however, that it would also be of value to reverse this process. This would allow external customers or untrained BT staff to construct simple models in the familiar Visio format and automatically transform them into the BT standard of Aris.

The feasibility of such a tool, however, is doubtful, as the model would have to move from low level to high level environment. The current solution is possible as it takes a very detailed and structured model and removes the areas of interest through a process of abstraction and transformation.

The reversal of this process would entail adding detail to a model and tightening the structure. This could not be achieved without the capability to input data during the transformation stage.

Although fraught with complications, the idea is very interesting and might be considered for future research.

Chapter 7

Conclusions

This summary chapter aims to bring the issues surrounding the presentation of business process models, highlighted by the research, to a definitive conclusion. The initial research conducted by the Author uncovered several issues concerning the uptake and use of business process modelling tools. Firstly a contradiction between the literature available on process modelling, and the practices of modern companies was discovered.

1. If BPR has lead to an appreciation of the importance of business processes (Hewitt 1995 and Davenport 1990), then why hasn't there been an increase in the use of modelling tools that reflects this growing awareness?

The second issue was concerned with the scale of the projects modelling tools were currently being applied to, and their restricted use within organisations.

2. Why, after a product has been purchased is the use of such modelling tools limited to one off projects?

The reasons for the slow uptake of process modelling tools could be speculated, however, the restricted use of a tool once purchased was puzzling, and thus formed the basis for the project.

The research uncovered several issues concerning the operational development of process modelling on a corporate wide scale. One of these issues was a technical problem, which would become the focus of the research conducted.

The corporate adoption of large-scale process models by modern businesses has lead to some comprehension issues. Initial research suggested that the way in which modelling packages presented business processes was the cause of the confusion, and that this was limiting the utilisation of process modelling within a company.

The question that was established by the research was, therefore:

' Does the complex nature of business process modelling packages, lead to visualisation problems for the end user?'

The following chapter will draw upon all the evidence obtained through both the research process and practical development undertaken, to provide an informed answer to the to the founding question as well as a practical solution.

In the Introduction to the research, four objectives were proposed. These objectives would form the structure of the research process, and the successful completion of each stage would provide the evidence necessary for conclusions to be made. The objectives are discussed below:

Conduct an investigation into Business Process Modelling

This initial objective was met in Chapter 2 (Literature Review) of the research. The role of processes modelling and the current best practices were obtained by collating the recent thoughts of academia, current practitioners and pioneers in the field of process management.

This extensive investigation into modern practices, particularly the industrial evidence obtained, supported the theory that there were problems with the visualisation of process models.
The broad question of visulisation was then focussed around the evidence that suggested that it was the complex nature of strict methodical modelling that was the principal cause of the problem.

Benchmarking Software modelling & presentation techniques

Once the visulisation problem was established, it was necessary to take a closer look into various tools and techniques either developed or adopted by some of the leading software manufactures. This objective was carried out in Chapter 3 (Benchmarking), of the research.

This Chapter established the idea that in order to capture company data as well as presenting this data in a user-friendly manor, no one single modelling package could be utilised. The conclusion to this Chapter (3.9) suggests that in the absence of a comprehensive tool, a method of harnessing the best practices of several tools would be the solution.

Develop a methodology to transform Business Process Models into a customised format

This contribution to the research is evident in Chapter 4 (Methodology), where a more comprehensive look into the technical structure of two chosen tools Aris and Visio, can be found. Once a greater understanding of these tools had been gained, a theoretical procedure for data capture, transportation and transformation was developed. Chapter 4 outlines a logical sequence of stages that need to be completed in order for this procedure to be successful.

Design and construct a prototype tool, which can then be validated and refined.

From the methodology developed in Chapter 4, the author designed and conducted an experiment (discussed in Chapter 5), that in part, fulfills the forth objective. Over the course of the experimental process, several issues that were recognised in the development stage were given further consideration and eventually overcome. An example of this would be the problem of transforming Aris rules into the Visio format. This issue was first discussed in Chapter 4.8, however, the precise method for resolving this problem was established during the experimental phase, and discussed in Chapter 5.4.2

Following the completion of the experiment, the results obtained were then investigated for the degree of success, validity and possible limitations. In Chapter 6 (results), therefore, it is possible to say that the fourth objective is met within this investigation process.

In view of all results and findings from the research process, the author offers the following conclusions in respect of the research described in this thesis:

- With many large companies historically supporting the traditional functional view of an organisation. The sudden move towards a process view has resulted in the rapid development of several tools and techniques designed to support this change in corporate vision.

- Many companies after realising the value of process oriented approach, have discovered that business process modelling plays a fundamental role in the development of a process oriented approach. As such, Process modeling is fast becoming an established tool.

- Problems have been identified regarding the presentation of large-scale business process models. In particular the visualisation of complex modelling methodologies utilised by some of the more successful software manufactures.

- Although some software manufactures suggest that their tool alone is sufficient for all business process modelling needs, evidence has been gathered to show that there are best practices to be found in a variety of modelling tools. This would support the idea that in some circumstances a combination of different methods should be applied in order to successfully describe a system to a specific audience.

- Through initial experiments it was established that there was no method of directly linking two tools together, and that it would be necessary to develop a custom methodology to achieve this goal.

- Through experiments it was established that there was indeed a method of linking two tools together. Through this combination, the user would benefit by combining the best practices evident within the individual tools. In short, the user has the best of both worlds, the rigor and structure of Aris is still present but the flexibility and presentation capabilities of Visio or also enjoyed.

Despite the volume of research conducted, the author acknowledges the limitations of the research covered within the thesis and thus, proposes the following issues for consideration when undertaking further research:

- The EPC model used in the experiment forms the backbone of process modelling within Aris. There are however, other views of an organisation which have their own modelling methods that might be considered. An area for further development might be the testing and possible development of the methodology to include all of the possible views of an organisation.

- The Visio model generated in the example was based upon elements drawn from the Basic Flowchart Template within Visio. There are, however, many other templates available within Aris. One such example would be the IDEF template within Visio, which allows the generation of standard IDEF0 diagrams. An area for further development might be the modification of the methodology to generate this type of standard model from the Aris format.

- The methodology was designed for transport of data from Aris into Visio. As discussed in the results section (Chapter 6.6), it would also be of great value if the process could be reversed. This would allow a simple diagram within Visio to be transformed into the corporately adopted modelling method of Aris.

- Finally, the subject matter for this research has been presentation of business process models and how the combination of tools can yield possible benefits. Further research might be conducted on the transportation of data between alternative process modelling packages. With the increase in business to business (B2B) dealings and the integration of computer systems, this suggestion takes on more significance. If companies do start adopting a corporate wide approach to modelling, then dealings between two such companies might heighten the need for model transportation/transformation capabilities. Interestingly, during this course of this research, the modelling community has addressed this very issue. BPMI (2003), the Business Process Management Initiative, is a non-profit corporation whose mission is to promote and develop the use of Business Process Management (BPM) through the establishment of modelling standards. As part of their work BPMI in collaboration with many of the market leaders of the modeling software industry, have developed a formal modelling standard which provides a standardised model that can be found within all the associated vendor tools. The idea behind this development is that companies will gain the advantages of a shared business language between customers, suppliers and partners.

In closing the Author concludes that the research and experimentation carried out on business process modelling packages has produced some valuable results, as well as raising some interesting issues that merit further research.

The research has proved that the complex nature of business process modelling packages has lead to visualisation problems for the end user. It also establishes that this issue is one of the main reasons for the limited utilisation of process modelling packages, within organisations that have access to modelling tools.

The research also provides a working solution to the established problem. The developed tool could be incorporated into an organisational modelling package, to allow a greater understanding of complex business models. This could potentially allow the corporate adoption of a modelling tool, creating a greater understanding of the processes within a business and potentially saving money through the removal of wasteful processes.

The Aris modelling suite is a sophisticated and valuable tool for the capture and methodical structuring of business processes. It is the opinion of the Author that the methodology developed extends the capabilities of the Aris tool, so that corporate modelling can truly be called a "shared vision" (Davis, 2001)

Glossary

ANSI, American National Standards Institute

ARIS, Architecture of Integrated Information Systems.

ASCII, American Standard Code for Information Interchange

BPM, Business Process Modelling

BPMI, Business Process Management Initiative

BPR, Business Process Re-engineering.

DISA, Defence Information Systems Agency

EPC, Event-Driven Process Chain.

ICAM, Integrated Computer-Aided Manufacturing

ICC, Indicator for Commercial Competitiveness

IDEF, Integrated DEFinition methodology

RAD, Role Activity Diagrams

TQM, Total Quality Management

UML, Unified Modelling Language

VBA, Abbreviation for Visual Basic Application used in the Excel package.

XML, Extensible Markup Language

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Appendix 1:XML File Content

The following information outlines two out of the twenty-three file sections contained within the exported XML file. The important Object and Connection sections are shown.

ARIS
Export/Import Interface
Objekte (Objects) Section
[Objekte]

Structure:

*ObjNum	long	Object number
ObjTypeNum	long	Associated object type
Zorder	long	Sequence number with which an object occurrence was placed in the model. Determines the sequence in which the objects are displayed (foreground/background)
ObjDefNum	long	Number of associated object definition
ModelNum	long	Model number
SymbolNum	long	Symbol used to graphically represent this object in the model
X	short	X coordinate of the upper left corner of the symbol
Y	short	Y coordinate of the upper left corner of the symbol
Texthandling		Internal to program
Pen		Pen (Color; Style, Hatch) and Use (Yes, No)
Active?	bool	0 = The object is not active, 1 = The object is active
SizeX		Horizontal extension of object
SizeY		Vertical extension of object
Brush		Brush (Color, Style, Hatch) and Use (Yes, No)
Shaded?	bool	0 = Not shaded, 1 = Shaded
Visible?	bool	0 = Not visible, 1 = Visible

Kanten (Connections) Section
[Kanten]

Structure:

*CxnNum	long	Connection number
TypeNum	long	Associated connection type
CxnDefNum	long	Number of associated connection definition
ModelNum	long	Number of the model in which the connection occurs
FromObjOccID	long	Start object (at object occurrence level) for connection occurrence
ToObjOccID	long	Target object (at object occurrence level) for connection occurrence

Zorder	long	Sequence number with which a connection occurrence was placed in the model. Determines the sequence in which the connections will bedisplayed (foreground/background)
Texthandling		Internal to program
Pen		Pen (Color; Style, Hatch) and Use (Yes, No)
Active?	bool	0 = Connection is not active, 1 = Connection is active
Diagonal?	bool	0 = Connection runs diagonally, 1 = Connection does not run diagonally. The value is transferred from the model, although it can be changed.
Visible?	bool	0 = Not visible, 1 = Visible
CxnPtCnt	short	Number of endpoints and bends for this connection
X short	X	coordinate of bend
Y short	Y	coordinate of bend