Dynamic integrated modelling of information systems and business process simulation

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Authors Note

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Some of the material in this dissertation has been disseminated as follows:

Journal Publications

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Study", Eldabi, T., Robinson, S., Taylor, S.J.E. and Wilcox, P.A. (Eds). *OR Simulation Study Group Workshop*, Horton Grange, Birmingham, 20-21 March. The Operational Research Society, pp.177-184.

Serrano, A., Eatock, J., and Macredie, R. (2000) "Integration of Computer Network and Business Process Event Discrete Simulation Models Towards a Generic Reengineering Approach", Znati, T. and Simon, R. (Eds). *Proceedings of the Communications Networks and Distributed Systems Modelling and Simulation 2000 Western Multiconference*, San Diego, California, The Society for Computer Simulation International, pp. 113-118.

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Eatock, J., Giaglis, G.M. and Paul, R.J. (1999) "Motivation for Integrating Computer Network Simulation with Business Processes Simulation", *In the Proceedings of the UK Academy for Information Systems 1999 Conference*, York, 7-9th April, pp. 407-415.

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Reports

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Abstract

Business processes and information technology are two areas that are very closely related to the sustained competitive advantage in organisations. However, investment in information technology often leads to disappointment, which may in part be due to the non-alignment of the information system domain with the business process domain.

Simulation modelling is an established technique often used in business process change projects, as it allows a comparison of different possible scenarios without the expense of physically implementing the system. However business process simulation fails to effectively capture the information systems perspective in the model. This thesis contends that by combining information systems modelling techniques with business process simulation the model will be able to capture all the four perspectives (functional, behavioural, organisational and informational) of an organisation, and the design of the business processes and the information system will be better aligned.

Initially, attempts were made to integrate business process simulation with computer network simulation in a simple two- or three-layered simulation model, but this gave rise to significant problems the most significant being the underlying assumptions of the original hypothesis. This led to a refined hypothesis in which the layered models were discarded along with the network domain.

The revised hypothesis aimed to capture the informational changes that occur in the information system and therefore combines prototyping with business process simulation. This overcomes the unsafe assumptions of the initial hypothesis about whether the system is 'correct' and provides a method of validating the design of the information system within the context of the business processes. The integrated model allows concurrent design of the information system domain and the business process domain and therefore ensures that the domains are better aligned. The framework is tested on a case study and the results indicate that it is an effective tool in the combined design of business processes and information systems.

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Chapter 1: Introduction

No method has yet been developed for fully determining how an investment in information technology can affect the business processes. This thesis contends that simulation techniques, when applied appropriately, can provide critical insights into the impact of applying IT within revised business processes.

One of the main catalysts of business process change over recent years has been the huge improvement, in terms of speed, processing power and memory, made in IT, matched only by the equally rapid reduction in cost. Investment in IT has risen dramatically in a comparatively short space of time. Companies are finding themselves under pressure to radically improve their performance, either in terms of services provided, or productivity and *"information technologies are important enablers of this change"* (Grover et al., 1994). Despite the ever-increasing ability of IT, the returns on these investments have often proved disappointing with some research studies showing failure statistics as high as 60% or 70% (Hochstrasser, 1993; Bicknell, 1996). The reasons that investments made in IT fail to achieve the expected outcomes or rewards may be due to mis-measurement, time lags between implementation and realisation of benefits, or mis-management rather than shortcomings of the technology installed (Brynjolfsson, 1993; Whiting et al., 1993; Pinsonneault and Rivard, 1998; Dos Santos and Sussman, 2000).

However, each of the suggested explanations for the failure of information technology to live up to the expectations implies that the expectation of the impact of the information technology was realistically presented at the justification stage. The reasons for benefits not being accurately identified at the justification stage are many fold; the competition to gain funding for investments causes the benefits to be inflated, or the drawbacks to be overlooked, or indeed that the effects are not fully investigated or understood. If the benefits of the project are difficult to identify but the 'gut feeling' about the investment is good the 'champion' may feel that overstating the benefits is justifiable (Lincoln and Shorrock, 1990; Ward et al., 1996;

Lubbe and Remenyi, 1999). If the overstated benefits are not realised then the disappointment experienced by companies making investments in IT will occur. If however, the benefits of an investment can be identified then the justification for overstating the benefits will be eliminated. Understanding how changes to the underlying technology will affect the business processes is the key to reducing the disappointment often experienced with investments. If there is a thorough understanding of the effects of an investment in information technology then the benefits can be accurately identified and realised, and the drawbacks can be identified and managed or used to prevent an investment that would otherwise produce disappointment.

1.1 Business Process and Information Technology Modelling

Even though IT is acknowledged as one of the main enablers of business process change, when it comes to capturing the impact that a new information system will have on current or proposed business processes existing modelling techniques appear to be unable to capture the full extent of the impact. This can lead to the expected benefits not being achieved leading in turn to the disappointments that have been reported.

This thesis contends that there are methods available that capture the business process perspective, and others that capture the information technology perspective, but few methods that effectively capture the impact of the information technology on the business processes. The aim of this research is to propose a framework that utilises existing modelling techniques and combines them to provide a technique that effectively illustrates the impact that information technology has on business processes. By combining the modelling perspectives it is purported that IT and business processes can be better aligned, reducing the often-reported disappointments in IT investment.

In order to look at why the impact of the investment in information technology on the business processes fails to be identified prior to implementation, we must first describe what is meant by the terms and then look at the relationship between the domains. In their 1998 paper, Hlupic and Robinson reviewed many authors definitions of a business process – Hammer and Champy (1993), Davenport and

Short (1990), Earl (1994) and Davenport (1993) among them – and concluded that although there was no agreed definition between the authors, there were certain elements that featured in many of the definitions. These elements generally consisted of the set of activities that make up the process, the inputs required, and the outputs in terms of value. For the purposes of this dissertation Gladwin's definition (1994) that a business process "consists of a group of logically related tasks that use the resources of the organisation to provide defined results in support of the organisation's objectives" is adopted. Information technology can be considered to comprise of two separate domains, computer-based information systems and the computer communication technology that it operates on. Information systems is a general term that can be used to mean a range of concepts from computer based automated data processing through to human based decision and control systems, which may have no element of automation. Throughout this dissertation, as the focus is on IT-enabled business process change, the term information system is used to mean computer based automated data processing and management. The communication technology that the information system operates on consists of the all the actual hardware, communication links, routers and protocols that together make up the organisation's computer network.

The relationship between the three can be considered as three layers where the computer networks (CN) form the lowest layer, and support the information systems (IS), which in turn support the business processes (BP) of the company. However the structure is not based on a one-to-one system (see Figure 1).

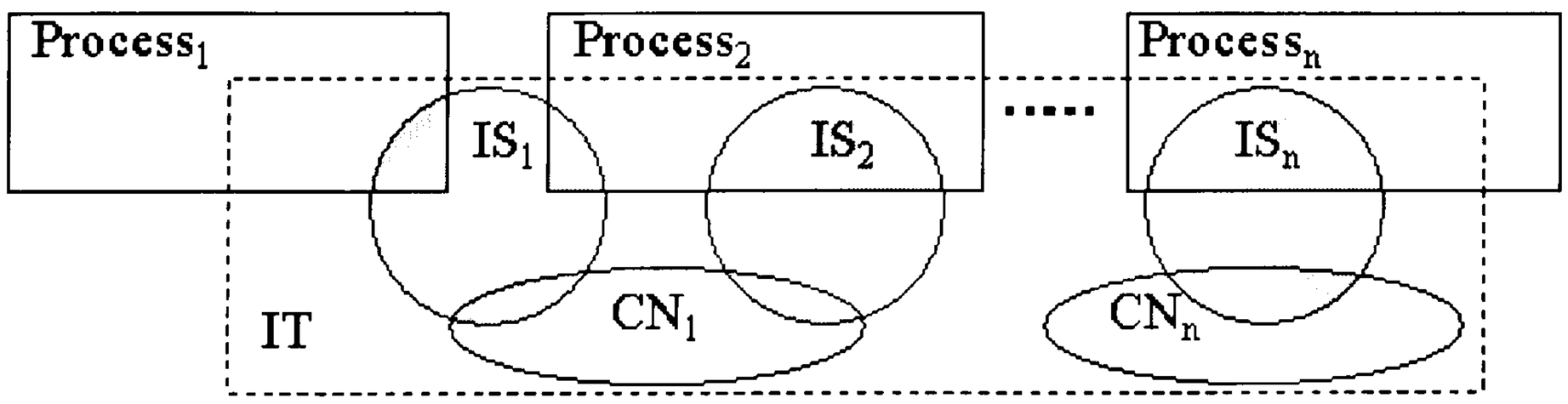

Figure 1. Business Process/IT relationship (Eatock et al., 2002)

Many information systems may run over a single network, and similarly a single information system may run over a number of networks. The trend in computer network technology and the advancements made in Internet technology over recent years has seen the size of the computer network increase to the extent that it has

become a single uniform platform. The same is true of the information systems that support the business processes. If we consider the relationship from this perspective it is easy to see how complex a system it is and how changes in one domain can affect elements in another domain, and may produce knock on effects in other areas. Considering this structure further we can see the pivotal domain within the structure is the information system level, as changes in this domain can directly affect both the business process domain and the computer network domain. If however we consider changes to the business process, this could directly impact the information systems level, and indirectly impact the computer network level and vice versa.

The structure of each of these layers and the interactions between them can be depicted by the use of models. A model in the most basic sense of the word is an abstract form of a more complex system that can be used to determine behaviour under certain conditions. The purpose of the model will determine the form that the model takes. Models can be used for a variety of purposes from simply communicating a concept through to a testing a limited function version of the final product.

The complex nature of organisational processes means that carefully designed models are required in order to understand how the interactions between the processes affect the overall behaviour of the system. The complexity of the organisational construction makes the process of modelling and experimentation difficult. Business process modelling is, as the name suggests, concerned with capturing organisational structures and interactions in a model, and then using the model to predict the effects of organisational change. There are many modelling techniques available, for example flowcharting, systems dynamics, role activity diagrams, and simulation to name just a few which are used widely in the organisational domain, each with different advantages and limitations. The purpose of the model will dictate the most suitable modelling technique to use.

Information technology modelling techniques differ depending again on the perspective of the model (Blum, 1994). If the model is designed to capture the information systems perspective then techniques such as entity relationship diagrams, prototyping and state transition diagrams are, among others, useful techniques. These techniques focus on understanding the activities being performed, by whom and the structure of the information produced. Modelling of the computer

network environment, on the other hand, uses such techniques as analytical modelling, and computer network simulation. These focus on the behaviour of the systems in terms of data communication. The choice of which technique to use when modelling information technology depends on both the perspective, either computer network or information systems, and the purpose of the model.

This research looks at a way to capture the interactions between business process modelling and information technology and specifically looks at the role that simulation modelling can offer to address the problem of capturing the business process benefits from a new information system.

1.2 Discrete Event Simulation

The basic principles of simulation are simple. The analyst makes a model of the system under review, verifies that it is a good representative model, and then operates the model under a variety of conditions designed to represent various different strategies. Analysing the result then allows the analyst to select the most beneficial strategy.

Simulation falls into two distinct areas, discrete event and continuous systems. In continuous systems events are modelled as changes through time usually by differential equations and are used for such models as geographical evolution (Paul and Balmer, 1998). Business process simulation falls into the discrete event category, where the simulation is event-driven and state changes occur only at a discrete set of points in time (Banks et al., 2001). Throughout the rest of this dissertation the term simulation is used to mean discrete event simulation.

Discrete event simulation is probably most well known in its use in the manufacturing environment though its popularity in the service industry is increasing. The general concept in building a model remains the same whichever industry the simulation is applied to. A *model* is developed that represents the system under investigation, which may be say, a particular production line. Objects or *entities*, which may then represent parts, are introduced to the model at specified time intervals. These entities then flow through the system being worked on by various different *resources*, say people or machines, in a particular order for specified amounts of time before leaving the system as a finished product. The way that entities flow through the system and how they change over time are explicitly stated.

Statistics for each of the activities and resources are produced which provide the model builder with data that enables the system to be analysed. In the service industry, rather than entities representing the parts they may simply represent documents, and instead of a finished product this may represent a signed document to confirm that the task has been carried out to the customer's satisfaction.

Once the model has been built and validated then different proposed scenarios can be modelled to evaluate the effect of making changes to the system. Comparisons of different scenarios can also be made to determine the best solution from those available. Indeed, many simulation packages now incorporate an 'optimal solution' finder which can search for feasible solutions based on attributes such as stock levels or staff levels required – depending on the context of the system – within parameters set by the modeller.

There are many advantages of simulation modelling techniques. Simulation models are dynamic and therefore can represent a system as it evolves over time. Most simulation models can be run much faster than real time – though the order of magnitude is dependent on the computer processing power and the complexity of the model – and this allows the modeller to look at the longer-term effects of change and establish if the changes will begin to cause problems in the future. For example optimising a particular process in the system may cause a bottleneck in another part of the system, but this may not become apparent for a few months. Simulation allows the model to be run for a specified time so that future consequences of the changes may be observed.

Simulation models may also be stochastic, providing random variable inputs that allow many variations or scenarios to be modelled. By utilising this trait we are able to control the variables and therefore operate the model under some pre-defined set of conditions. This allows for experimentation, and through this a greater understanding of the system is attained, allowing for improved decision making. Experimentation with various proposed scenarios means that the effects of a number of alterations can be compared against each other, without the cost and time involved of physically implementing the changes. This is the most common reason that simulation projects are undertaken as many scenarios can be compared in a relatively short space of time, and why it is a particularly often used method in analysing business process change. The nature of simulation models means that they allow a

system-wide view of the effects of the proposed changes. This allows decision makers to analyse the knock-on effects of change within the process, as opposed to only looking at the local effects. This is important because the inter-relationships between various processes modelled may not be immediately obvious, and simulation allows us to identify the indirect relationships between processes.

These are not the only advantages to be gained from simulation modelling. Building a simulation model requires an in-depth understanding of the system under analysis and simply developing the model builds up the modellers understanding and this is arguably one of the most important aspects of simulation (Paul, 2002). This advantage however is true of any modelling technique that requires a detailed analysis of the system. The model of the system can only be as good as the modellers understanding of the system, and the usefulness of the model will depend on its accuracy in representing the system. As the majority of people involved in the system will only know how their particular section of the system works, not the implied interactions with other aspects of the system, it is the modeller's task to create a model of the entire system including all the explicit and implicit interactions. Communication between modeller and client is another important aspect in the process of building the model as this ensures that both the modeller and the client gain an in-depth understanding of the entire system. The knowledge gained puts both client and modeller in a better position to suggest changes that could be made to the process to improve the overall throughput.

Simulation, especially those packages that include graphical animation facilities allow for ease of communication of results and proposed changes, not just in the form of graphs but as, say, a layout of the factory, or office. Using these communication facilities allows the analyst to demonstrate where the bottlenecks occur, and how the proposed changes can affect bottlenecks in various points throughout the system. Alternatively simulation can be used to illustrate the modellers understanding of a system, and by presenting it in this way to the users of the system, he can verify that his understanding is correct. As communication is an important aspect in any business process change project if success is to be realised the importance of this facet of simulation cannot be overlooked.

Given that simulation gives a process view of a system and has the advantages stated this puts it in an ideal position for modelling of business process change, and indeed

it is one of the most popular techniques used to achieve this. Its success in this domain has led to applying the technique to others domains.

Simulation modelling as a technique has been applied to information technology development in the form of computer network simulation (Law and M^c Comas, 1996). Computer networks are becoming more and more complex as the available technology increases and the demands of the users to utilise new technology grows. Computer network simulation offers the network designers the opportunity to develop and test their network designs without the anxiety that in the case of failure they could crash a company's entire computer system causing thousands of pounds in lost revenue. The basic concept again is the same as before, but in this case the entities that traverse the model will represent data and the resources will be the communication links and processors that make up the network. One aspect though does alter when using computer network simulation and that is the time that it takes to run the model. In business process simulation the time that it takes to complete a particular activity may be measured in seconds, minutes, hours or even days. When the model is run the computer will take a fraction of a second to advance the clock – and consequently the model will run much quicker than real-time, which is how the long-term effects of changes to the system can be monitored. In computer network simulation the times that the computer hardware takes to complete a task is measured in milliseconds, microseconds, or even nanoseconds, but when the model is run the computer will take longer than this to advance the clock, having the effect that computer network simulation is much slower than real-time. This does not mean however that an advantage of simulation is lost, as computer networks need to be tested at different levels of utilisation rather than for long periods of time, and consequently the slow run times associated with computer networks are not always an issue.

While there is evidence to suggest that discrete event simulation is a successful technique when applied to both the business process domain and the computer network domain, there is little information about how discrete event simulation techniques can be applied to the information systems level that forms the bridge between these two domains.

1.3 RESEARCH OBJECTIVES

The aim of this research is to look at the potential of simulation modelling as a technique to facilitate identification of the impact of information technology enabled business process change, in order to address the problems identified previously where IT investments fail to live up to their expectations.

Treating the problem from a single perspective instead of from the perspective of the two domains suggests that a single integrated approach may be required. Although simulation techniques are used extensively for analysis of business process change projects previous research has not extended the scope to include effective analysis of the potential that information technology changes can provide, limiting its applicability to business process change programs. Therefore this research is specifically aimed at addressing the problem by integrating models of the information technology and business process domains.

The aim of this dissertation is to present a technique that allows the design of both the business process and the underlying information technology to be integrated, in order to analyse the effects of information technology investments on business processes. The purpose of this is to identify both benefits and drawbacks as both direct and indirect consequences of implementing new technology. To achieve this goal there are a number of stages that need to be explored. Initially there is a need to demonstrate that the existing modelling techniques lack the ability to accurately assess the impact that changes to the underlying information technology will have on the business processes and to illustrate that simulation modelling appears to be an ideal tool to base further analysis on. Subsequently a proposed framework will be devised that portrays the interactions between the business processes and the information technology that indicates how using simulation techniques allows these interactions to be captured within the model, and illustrates how the design of the simulation model can verify how the information system will perform within the business processes.

It is not intended that this approach replace existing methods of information technology development but rather to be used as a complement to assess the impact of the information system design within the business processes.

1.4 RESEARCH METHODOLOGY

This section aims to provide evidence that a case study is a suitable strategy to accomplish the research objectives proposed. Any research method can be loosely classified into one of two areas, those based on observation, and those based on interpretation. Galliers (1993) labels these traditional positivist and newer post-positivist respectively. However, these two terms are not mutually exclusive, as is shown in Figure 1.

	Modes for traditional positivist approaches (observations) ←					Modes for newer post- positivist approaches (interpretations) →				
	Theorem proof	Laboratory experiment	Field Experiment	Case Study	Survey	Forecasting and futures research	Simulation and game/ role play	Subjective/ Argumentative	Descriptive interpretive (inc reviews)	Action research
Society	no	no	possibly	possibly	yes	yes	possibly	yes	yes	possibly
Organisation/ group	no	possibly (small groups)	yes	yes	yes	yes	yes	yes	yes	yes
Individual	no	yes	yes	possibly	possibly	possibly	yes	yes	yes	possibly
Technology	yes	yes	yes	no	possibly	yes	yes	possibly	possibly	no
Methodology	yes	no	yes	yes	yes	no	yes	yes	yes	yes

Table 1 A taxonomy of information systems approaches (Galliers, 1993)

The positivist approach assumes that the phenomena under consideration can be observed objectively and rigorously, and that good research can be assessed by repeatability, whereas the post-positivist approach argues that when people are involved, natural science is an inappropriate method of assessment, as different stakeholders can view the same phenomena in different ways (Checkland, 1981).

This research aims to investigate the relationship between information technology and business processes, and therefore the research strategy adopted has to reflect both the objectivity of the technology, and the subjectivity of the organisational aspects. Combining a case study with simulation techniques provides a method that can be employed for gaining a full understanding of the system, based on observation. The knowledge gained through this allows refinement of the hypothesis, and through interpretation of the findings, allowing the theory to be built on. Finally, the theory can be tested to determine whether to accept or reject the hypothesis. In this manner the simulation of a case study provides the positivist and post-positivist approaches required by the research question.

1.5 OUTLINE OF DISSERTATION

The dissertation is structured into seven chapters. Having introduced the key concepts and explained the objectives of the research in this chapter, the next one

(chapter two) provides the background and initial basis of developing a hypothesis. It does so by taking a more in-depth look at the current practices of business process, information systems (IS) and computer network modelling. This will highlight the advantages and limitations of the techniques available; and explore both the need to integrate these domains and the difficulties associated with this integration.

The obvious approach to integration uses a simple two- or three-layered simulation model assigning each of the domains to an appropriate layer. In chapter three an exploratory case study is used to validate and refine this hypothesis; and to explore the advantages and disadvantages of each layering strategy.

All of the strategies explored give rise to significant problems and, based on the case study results, chapter four questions some of the assumptions underlying the original hypothesis. This leads to a refined hypothesis that discards the layered model and the network domain. In this new modelling architecture the IS domain is represented by an abstract state or sequence machine without the precise temporal elements needed in a discrete event model. The hypothesis also relaxes the requirement for the new IS function to be "correct" opening up the possibility that this might be an output of the modelling process rather than a given precursor.

A second, extensive, case study is presented in chapter five to demonstrate the application of this revised framework. The analysis of this case study (chapter six) shows it to be more effective than the layered approaches and explores the remaining limitations identified within the case study.

The last chapter (chapter seven) summarises the results obtained and restates the final hypothesis. This is re-examined in the broader context of IS supported business process design and possible avenues for further research and development are suggested.

Chapter 2: Supporting Contextual Research and Integrated Modelling

The aim of this chapter is to look at the techniques and tools available for modelling business processes and information systems independently. A comparison of the different modelling techniques is made, and appropriate techniques are for dynamic integrated modelling are identified. Previous research into combining business process and information systems modelling techniques is briefly analysed to highlight the differences between previous work and this proposed research.

2.1 Business Process Modelling

An organisation consists of many different elements that interact in a complex manner. The concept of a business process is used to gain an understanding of how the various elements interact (Smart et al., 1997). Gladwin and Tumay (1994) describe a business process as "group of logically related tasks that use resources of the organisation to provide defined results in support of the organisation's objectives". Business process reengineering demands the radical reinvention of current business process to maintain sustainable competitive advantage (Hammer and Champy, 1993) and therefore it is necessary to be able to capture how the business processes are related to each other. There are many modelling tools available to describe business processes (Abeysinge and Phalp, 1997). These methods range from formal mathematical notations through to graphical notations. There are advantages and limitations of each of the available methods. The graphical notations are generally easier to understand and communicate to the non-expert, while the formal methods may be able to be executed on a computer but are difficult to understand for the non-expert. The choice of modelling technique will depend on the nature of the project and the expertise of the modeller. The most important aspect of process modelling is not the choice of tool, but the fact that it focuses the understanding of the underlying business processes, which is fundamental to successful

implementation of technology-based change (Green and Rosemann, 2000) or business process reengineering efforts.

The model must be capable of providing information to its users, such as the activities that combined to form a single process, who performs each of the activities and the data that is manipulated. Different modelling techniques lay more emphasis on different aspects, Curtis et al. (1992) summarise the most common as being:-

- Functional – which represents what process activities are being performed
- Behavioural – represents when the activities are performed
- Organisational – which represents who performs the activities
- Informational – which represents the data that is manipulated in the activities

Curtis et al. (1992) analogise this as looking at an item from four different perspectives, but it is only when all four perspectives are combined that a complete view of the object can be visualised. Most business process modelling tools address one or more of the modelling perspectives, though none address all completely (Al-Ahmari and Ridgway, 1999). Invariably those that do address the informational aspect, do so in a very limited way. Table 2 indicates a variety of modelling techniques and illustrates the perspectives that the techniques address.

	Modelling Perspectives			
Modelling Techniques	Functional	Behavioural	Organisational	Informational
Flowcharting	Yes	No	No	Limited
IDEF0	Yes	No	Limited	No
IDEF3	Limited	Limited	No	Limited
Petri Nets	Yes	Yes	No	No
Discrete Event Simulation	Yes	Yes	Yes	Limited
System Dynamics	Limited	Yes	Yes	Limited
Knowledge-based techniques	No	Yes	No	No
Role Activity Diagrams	No	Limited	Yes	No

Table 2 Modelling techniques and the perspectives they address (Serrano, 2002)

According to Giaglis et al. (1999) only simulation modelling is able to fully address three of the four perspectives defined, the fourth perspective - the informational aspect – is only captured in a limited way. Many modelling techniques claim to cover other perspectives, but a closer analysis of the scope of the perspectives reveals that they are sub-sets of the ones offered by Curtis et al (e.g. Scheer, 1999).

The purpose of this research is to investigate how the modelling of business processes can be improved to capture the effects of information technology-enabled change. As information technology can impact on every aspect of the business a technique that captures as many of the perspectives as possible is the basis for starting the investigation, and therefore simulation appears to be the most appropriate technique as a starting point for this research.

Simulation as discussed in Chapter 1 is one of the most useful tools in business process modelling because as a result of its truly dynamic nature it can capture how activities interact with each other over time, including 'knock-on' effects of say, a breakdown in the system or a decrease/increase in resources. In this way it allows the analyst to see how the system will evolve over time, and therefore a long-term view of the effects of changes can be analysed (Banks et al., 2001), as well as allowing comparisons between different possible scenarios to determine the best course of action (Kettinger et al., 1997). It is due to these reasons that simulation is so useful in business process change projects. However, these are by no means the only benefits of simulation modelling.

One of the other main benefits is that experiments conducted on a simulation model are repeatable, which allows the effects of a single change to be analysed, then the model reset and run with a different change. This allows comparison of the two systems under *exactly* the same conditions, and therefore a realistic comparison of the effects of the changes. This would not be possible in either a real-life experiment or by using static models (Robinson, 1994; Pidd, 1998). Similarly, as the changes are being made to the model rather than to the real-life business processes, changes can be made quickly and cheaply in comparison, and the effects analysed, without either disruption to the real-life system or the possibility of disastrous results. This fact allows many different scenarios to be compared, and their effects analysed in a way that simply would not be possible in real-life experiments or by using static models.

Unlike mathematical models, simulation models are able to use both standard and non-standard distributions within the modelling process, and therefore rather than approximating the data by fitting it to a standard distribution, the modeller can use collected data ensuring the model accurately reflects reality as much as possible (Robinson, 1994). Similarly, the stochastic nature of simulation makes it well suited to handle the time-varying nature of activities that make up the processes (Bhaskar et

al., 1994) and therefore must always be a consideration in any business process change project,

The benefits of simulation are not limited to the development of the AS-IS and TO-BE models, but is also a useful tool for marketing, communication and benchmarking purposes, especially those simulation packages that are supplied with good graphical displays (Bhaskar et al., 1994; Pidd, 1998; Banks et al., 2001). Simulation models can be built at a variety of levels of abstraction depending on the requirements of the project, and as many simulation modelling packages allow sub-models to be built the various levels of abstraction can be shown or hidden as required when communicating ideas and changes to different groups of people.

The disadvantages of simulation modelling though are in terms of the cost and the time required. Models need to be built by an expert, and even so the results may be difficult to interpret. However, simulation modelling package vendors are addressing this problem by supplying packages that contain re-usable blocks of models that can be combined to form a close approximation to the overall system. Similarly most simulation packages have analytical tools to assist the modeller in interpreting the results from experimentation, so the cost and time associated with developing models is slowly reducing (Banks et al., 2001).

One limitation of business process simulation, highlighted earlier is the inability to capture the informational aspects of the system. As information technology is one of the key enablers of business process change (Davenport, 1993) and therefore an important aspect of many of the business process change projects in which simulation modelling would be used there is a need to know that the underlying technology is providing accurate and timely data to the system. Information systems design and business process change projects need to be co-ordinated in some way to provide a model that can capture all the four perspectives identified by Curtis et al. (1992) and thus provide the complete view of the system.

2.2 Information Systems Modelling

2.2.1 Design Methodologies

The progression from the feasibility study of investment in an information system through to the implementation and review stages is known as the information

systems development life cycle (SDLC), or the waterfall model. The stages in the life cycle vary depending on the author, but all have the same basic structure that consists of feasibility study, system investigation, systems analysis, systems design, implementation, review and maintenance.

There are many methodologies that are intended to assist in the design and implementation of an information system which all follow the SDLC to some greater or lesser extent. Some of the methodologies like STRADIS (structured analysis, design and implementation of information systems), JSD (Jackson system development) and YSM (Yourdon systems method) are process oriented that are driven from a top level view, while others are object oriented (OOA – Object oriented analysis) and therefore data driven, while others still are driven by the speed of the development of the application (RAD – rapid application development, and DSDM – dynamic systems development method). There are other methodologies that take the 'best bits' of a variety of methodologies and provide what Avison and Fitzgerald (2003) refer to as blended methodologies, such as SSADM (structured systems analysis and design), Merise, and IE (information engineering). This is just a selection of the available methodologies that are currently in use, while more are constantly being developed or evolving (Sauer and Lau, 1997).

A methodology is defined as a "body of methods, rules or postulates employed by a discipline" (Blum, 1994) and as such each of the methods mentioned above consists of a selection of analytical, design and developmental tools or techniques to progress through the various stages of the SDLC. The perspective from which the methodology approaches the life cycle will obviously influence the choice of technique or tool that is used. A selection of the most commonly used techniques are discussed in the section 2.2.2. The appearance of so many methodologies for information systems development indicates that there was a definite need to combine the skills of the programmers and systems analysts as organisations expanded in both size and technological capacity.

The aim of this dissertation is not to develop a new methodology, but to determine how information technology modelling and business process modelling can be better aligned. The advantages of simulation modelling, particularly the aspect of its dynamic nature, would suggest that it would be advantageous to retain the benefits of a dynamic modelling tool. It is for this reason that only two of the methodologies

available are briefly reviewed here as both claim to use dynamic modelling of information systems within the methodology.

Merise was a methodology developed in France in the late 1970's and is still widely used in France, Spain, Switzerland, and the USA. The approach has three cycles; the approval cycle, the abstraction cycle and the life cycle. The approval cycle consists of the all the decision mechanisms that exist during the development life cycle such as

- technical choices of hardware and software
- organisational decisions deciding which tasks are to be computerised and which are to be performed by humans, how resources are to be organised, and batch or real-time processing
- management decisions which concerns the functions of the information system that are essential to the organisation.

The abstraction cycle is the key difference between Merise and other methodologies. Other methodologies give different importance to the treatment of data and processes, but in Merise these are treated equally throughout the process and both are incorporated from the start. Both data and processes are modelled in three stages the conceptual, the logical/organisational and the physical/operational. The models used in these stages support both static and dynamic approaches. The conceptual framework for the dynamic aspects is based on three concepts:

- event – which may be internal or external to the system
- operation – a set of one or more actions as a reaction to an event
- synchronisation – a list of events which must have occurred before the operation can occur. `

The abstraction cycle therefore leads from a knowledge of the problem area, through making decisions relating to resources, to the technical means with which to implement them (Rochfeld and Tardieu, 1983; Imache, 1998; Avison and Fitzgerald, 2003). The life cycle involves a series of steps that are similar to SDLC, though initially include a long-range planning stage which aims to map the organisational goals with the information requirements, partitioning the organisation into *domains* for further analysis. Within each of these domains policy issues can be determined

and strategies developed for areas such as human resources, computers, software products, and methodologies to be used.

Jackson Systems Development (JSD) differs from the other methodologies mentioned in that it deals with the problem of time in modelling of information systems whereas this aspect is overlooked in other methodologies. Jackson (1983) argued that systems design was simply an extension of program design and that the same techniques can be applied to both. As a result aspects of his Jackson Structured Programming (JSP) are evident throughout the JSD approach. There are six distinct phases in JSD, the first four of which are concerned with creating a specification of the required system, and the last two with the implementation of that specification. Jackson calls these stages

- the entity action step – in which the developer defines a conceptual boundary around the real-world area of interest by listing the entities and actions with which the system will be concerned
- the entity structure step – where the actions of each entity are ordered by time
- initial model step – in which the communication between entities are described in a process model
- the function step – functions of the system are specified to produce the outputs of the system
- the system timing step – where timing constraints of the system are considered where they may affect the timeliness or correctness of the system
- the implementation step – the system developer transforms the specification into an implementable product through consideration of available hardware and software

The JSD methodology begins by creating a specification for the system, and building it up from the parts into sequential processes. The inclusion of the system timing step is where the JSD methodology differs from many other methodologies, but the dynamic nature of system is captured in the fact that the methodology produces a JSP program of the system.

2.2.2 Development Techniques

All the methodologies mentioned above use a variety of techniques to describe and develop the information system. The development techniques fall into three main categories: static; single-event or short-term dynamic; or long-term dynamic. The choice of technique will depend on the stage that the development methodology has reached, and therefore the purpose of the model. Table 3 identifies some of the currently most used techniques and classifies them as either process or data driven, and whether they are static, single-event dynamic or long-term dynamic.

	Process driven	Data driven		Static	Single event/ short-term dynamic	Long-term dynamic
Rich Picture	✓			✓		
Conceptual Modelling	✓			✓		
Cognitive Mapping	✓			✓		
Entity Relationship Modelling		✓		✓		
Data Flow Diagrams		✓			✓	
Decision Trees	✓				✓	
Structured Diagrams	✓				✓	
Action Diagrams	✓					✓
Entity Life Cycle	✓					✓
Prototyping		✓				✓
Computer Network Simulation	✓					✓

Table 3. Comparison of IS modelling techniques

Again, as the aim of the research is to align dynamic modelling of information systems with business process modelling and therefore the description of the techniques will be limited to those that have been categorised as long term dynamic. There is very little in the literature concerning the dynamic modelling techniques of information systems (with the exception of prototyping), but this may be due to the fact that, according to Curtis and Cobham's (2002) survey of development techniques employed, dynamic techniques do not feature in their list of commonly used techniques.

Action Diagrams are a way of representing the details of process logic and are used to represent both the overview and the detail levels. Action diagrams are created from a subset of natural language used to specify a sequence of actions. Brackets to indicate the group of actions that make up the sequence, which may be hierarchical in structure, bound the sequence. In this respect it is not unlike a high-level program code, and tools exist that can convert action diagrams into executable code. Similar constructs to program code are used, for example IF...ELSE loops, and linking

bracketed sequences can indicate concurrency. Data requirements are added to the diagram by bounding a set of sequences within a box, and labelling the required inputs at the top right on the outside of the box, and the outputs at the bottom right. Database operations can also be indicated by enclosing the record that the action refers to in a single box, and if a more complex operation is required within a double box (Avison and Fitzgerald, 2003).

Entity Life Cycles is one of the few techniques that attempt to address changes over time. The objective of an entity life cycle is to identify the various possible states that an entity may be in, and the processes and events that cause the entity to change from one state to another. Events are classified into three types: external; internal; or time-based and one is required as the starting point of the system to set the entity to its initial state. The processes that alter the state link the various entity states, and terminating states can also be depicted. In this it is a useful technique in identifying the possible states of an entity, and the processes that are likely to cause an entity to change state (Avison and Fitzgerald, 2003).

Prototyping is a technique that is used for testing the system prior to building the final system to ensure that what is being developed will satisfy the requirements of the user. According to Alavi (1984) "an information systems prototype is an early version of a system that exhibits the essential features of a later operational system". The prototype is then presented to an end-user, and the comments made are then used to revise the specifications to ensure that the final finished product is the system that the user requires. Prototypes fall into two categories; those that are used for experimental purposes and later discarded; and those that evolve into the final system (Alavi, 1984; Beynon-Davies et al., 1999; Curtis and Cobham, 2002). Prototypes that are intended as expendable may be required to illustrate a particular aspect of the system and therefore may be incomplete. This may be of the form of an in-depth prototype of one aspect of the system, or a limited function version of the entire system (Floyd, 1984).

One of the reasons that prototyping is such a popular technique – Fitzgerald (1998) reported that it was used by 75% of respondents using formalised systems development methodologies – is that it is possible to obtain a working version of the system very quickly. As the end-user is able to see the system as it is being developed, they are able to provide a clearer set of detailed specifications of their

requirements and should be happier with the final product. The disadvantages of prototyping, however, also arise from the fact that the initial version of the system can be produced so quickly. The end-user often fails to understand why the prototype cannot be turned into the final version of the system at the same speed, and if the programmers try to adapt the prototype into a full working system, code inefficiencies and lack of complete error checking routines may be a major drawback.

Computer Network Simulation is a technique that is used in the validation stages of the SDLC. Computer networks are becoming more complex as the available technology increases and the demands of the users grow. Consequently analytical models are no longer suitable for validation of large or safety-critical systems. The concepts of computer network simulation are identical to those of business process simulation where the benefits and drawbacks of different set-ups and protocols can be analysed without impacting the existing system. The entities that traverse the model will represent data that flows through the system, while the resources will be the communication links and the processors. Computer network simulation is truly dynamic in that the effects of the design can be tested at varying levels of network usage. Computer network simulation tends to run more slowly than real time as a consequence of the processing time being less than the simulation model takes to advance the clock, but this is not an issue as it is of more importance to check the model at different levels of utilisation than to run the for long periods of time.

2.2.3 Critique of ISDM's and Techniques

A review of the information system development methodologies illustrates that the majority are static when it comes to modelling the systems. The two methodologies that claim to model the information systems dynamically are Merise and JSD. Neither of these techniques, however, are dynamic in the sense that simulation is dynamic – simulation modelling allows observation of the system as it evolves over time, whereas the dynamic techniques offered by both Merise and JSD offer a system-view that captures how different parts of the system interact, but not how they affect the business processes in the long-term.

This is a consequence of the fact, that as the name suggests, the methodologies approach the problem from the information system perspective. Both methods are

focussed upon designing better information systems and, organisational factors, although considered important are considered at an early stage within the methodologies. In Merise when organisational issues are considered, they are used for the design of the information system and do not provide guidance on how to examine the impact of the information system on the business processes. Merise advocates the use of many modelling techniques within the methodology to support the information system design at the different stages of development and the different levels of abstraction. However, the process modelling techniques used in the abstraction cycle though valid for systems development are inappropriate for process design as they cannot address many of the process modelling needs (Davenport, 1993). Furthermore, as the various levels of abstraction are modelled using different techniques it is difficult to produce a unified model that allows the observation of the interaction between business processes and information systems.

JSD creates a specification and builds on it to produce the set of sequential processes that describe the system. In this way it builds the entire system, but the functionality of the system is added very late in the development process. The addition of the functions may require the creation of new processes and consequently that changes be made to the system specification diagram. However, again there is no guidance on how the business processes should be designed to ensure that the resulting design is the 'best' design for both the information systems and the business process domains, instead it focuses from the information system perspective only.

The techniques that the information systems development methodologies use during the development process that can be considered as long-term dynamic each have limitations of their own. Entity life cycles show the various states that each entity can take, but they only show a single entity (or group of entities) perspective. Furthermore, entity life cycles do not show concurrency between events. Both action diagrams and prototyping allow concurrency to be included, but neither technique accommodates the time delays that will be inherent in the system. Only computer network simulation accommodates the time delays of the system into the model in a truly dynamic way.

Computer network simulation is not a technique that is best suited to designing an information system, but is intended as a technique to validate the design and provide an insight into the problems of the design and possible improvements that could be

made. As the focus of this research is to analyse how information systems can impact on business processes, time delays are an inherent part of this process and therefore the effect of time that the information system has on the business processes must be taken into account. The aim therefore is not information systems *design* but rather the dynamic *modelling* of information systems and business processes to provide an integrated model of the interactions of the two domains.

2.3 INTEGRATING BUSINESS PROCESS MODELLING WITH IS MODELLING

The methodologies aim to be as generic as possible in order that they are applicable to as wide a range of projects as possible (Yourdon, 1993; Fitzgerald, 1996). This however means that as they are not tailored to individual types of project some of the components may prove to be unnecessary for particular projects leading to dissatisfaction with some aspects of the particular method (Hardy et al., 1995). Research shows that although there is a large selection of available methods many of the companies questioned in surveys did not use any formal systems development method, and of those that did the majority used custom-developed software development methods, some of which were based on an existing formalised method (Hardy et al., 1995; Wynekoop and Russo, 1997; Fitzgerald, 1998; Barry and Lang, 2003).

The fact that so many companies are using in-house development methods implies that the available development methods are not regarded as fulfilling all the company requirements of a design methodology. One typical comment taken from Sauer and Lau's (1997) survey states "our focus as systems developers is to produce a timely product, not a product that revolves around a methodology design." However, most of the research into the adoption of different methodologies is directed at the IS developers, rather than the perspective of the business user. Sauer and Lau's survey is one of the few that considers the business users response, and the overall opinion is that business users look on the methodologies less favourably than the developers. A couple of the typical comments are "they [ISD] give themselves too much time" and "[ISD] try to build a bells and whistles product". This dissatisfaction from the business users perspective indicates that although the methodologies may result in a good design of the information system, the business users feel that it doesn't fit their

requirements. This contrasts with Hardy et al's survey (1995) where the developers thought that the use of any methodology (whether formalised or in-house) increased user involvement.

One of the possible reasons that business users are dissatisfied with the systems that the developers produce is that the design of the system is not fully integrated with the business processes. It is not simply a case of designing the information system to fit the existing or proposed business processes, it involves being able to analyse how the business processes will evolve given the information system. Paul and Balmer (1994) sums this up by saying "systems are built for one (hypothetical) point in time, whereas the system must work over some time continuum." The main problem with both the methodologies and techniques used in information system design is that they do not consider time. JSD is the exception to this, but it does not consider how the system will evolve over time, just how time will be incorporated into the information systems domain, so again it is built for a single point in time.

In order to capture how the system can evolve over time we need to integrate the information systems domain with the business process domain in a dynamic modelling tool. Simulation as has been discussed is a tool that is often used in the redesign of business processes, as it can capture the interactions between various parts of the business and more importantly can be used to analyse how the business processes change over time.

2.3.1 Previous Research into Combining BP and IS Modelling Techniques Dynamically

There have a been a number of attempts to combine process modelling with information systems modelling in the past, but many of the techniques included a static model of the information system domain and therefore lost the benefits associated with dynamic modelling. The following three pieces of research were notable by the fact that they produced dynamic models of the system.

Abeysinge and Phalp (1997) tried to combine graphical with formal notations so that they were easy to understand, but able to be analytically analysed. They used role activity diagrams with the users of the system to capture and validate the process, and then mapped this to CSP (Hoare's Communicating Sequential Processes) to allow experimentation with possible process changes. However, this approach does

not address how the information system will interact with business processes and therefore is not a significant improvement on business process simulation modelling.

Painter et al. (1996) acknowledged the need that information technology and business processes need to be considered together for business process reengineering projects and proposed a methodology for achieving this using IDEF3 as a modelling tool. The IDEF3 process descriptions are used to capture process at each of the three levels; business process level, the information systems level, and the computer network level. This information is then used to generate the structure and logic of the simulation models, thus expressing the processes in a dynamic way. The use of IDEF3 as a modelling tool has some restrictions though. Table 2 shows that although IDEF3 is suitable for depicting individual systems within an organisation, it has limited capabilities when modelling the organisational or behavioural perspectives and therefore is inappropriate within the context of business process change initiatives. Furthermore, the methodology produces a complex net of models, which may not be truly integrated, and in a large-scale project may be simply too complex to follow.

Similarly, Al-Ahmari and Ridgway (1999) use IDEF0, GRAI and simulation in their attempt to provide an integrated modelling tool, GI-SIM. A modified GRAI grid is used to develop a global structure of manufacturing systems. Each activity on the grid is then converted to an IDEF0 model, with each activity being broken into sub-activities until the required level of detail is obtained. Inputs and outputs to each activity are classified according to their status in the GRAI grid. These IDEF0 models are then converted into a simulation model. The disadvantages of this technique are similar to those outlined for Painter et al's (1996) research, that the number and complexity of the IDEF0 models could make this method unviable in large-scale models, and the limitations of IDEF0 in fully capturing the behavioural and organisational perspectives of the system.

Love et al. (1987) combine simulation modelling techniques with an MRP system in order to develop control policies. The aim of this research was, however, not to create an integrated model, but rather to allow an analysis of different control strategies based on the information supplied by the existing MRP system. The two systems interacted by exchanging input and output data on a period-by-period basis. This work differs from the proposed research in that the perspective it takes is from

aligning the business processes with the information systems domain, rather than creating a truly integrated system where the two domains are designed to complement each other. By creating an integrated model the modellers can experiment with the design of both domains to fully understand the impact of changes. If, however, one of the domains is necessarily unalterable, as is the case when using the existing MRP system, then this advantage of assessing the impact of one domain on the other is subsequently lost.

2.4 SUMMARY

This chapter has looked at the various techniques available for business process modelling, and how well the techniques address the four modelling perspectives identified by Curtis et al. (1992). In order to gain a complete model of the system whatever techniques used need to be able to address all the four perspectives. Most modelling techniques, however, were limited in that they could only address one or two of the perspectives fully. Business process simulation was the only technique that could address three of the four perspectives fully, and with its proven record in business process change projects appears as the best-placed technique to try to capture the fourth perspective, namely the informational one.

There are many information systems development methodologies that each use a number of different techniques and tools depending on the stage of the process. Many of the tools that are used in information system design are static and therefore lack the benefits that dynamic modelling can offer, in terms of how the system can evolve over time. For the purposes of this research only those techniques that claim to be dynamic were considered, namely action diagrams, entity life cycle, prototyping, and computer network simulation. Of these dynamic techniques only computer network simulation effectively dealt with the time aspect of the proposed system.

As the focus of this research is to analyse how information systems can impact on business processes, the aim is to produce a dynamic model of the interactions of the information system with the business processes. As simulation is such a good tool in analysing business process change, a logical step is therefore to combine business processes simulation with computer network simulation modelling in order to expand the perspectives addressed by business process simulation alone.

Chapter 3: Exploratory Integrated Modelling: The ASSESS-IT Case Study

This chapter presents the progression of approaches that were used to provide the basis for the hypothesis presented in the next chapter. Each approach is analysed providing information enabling refinement of the process. The chapter is presented in this way to provide the reader with the understanding of the *process* of the development of the hypothesis, and to illustrate how the various stages of the process and the research evolved over time. The outcome of this particular chapter is a deeper understanding of the problem in terms of the approach chosen.

The literature review in chapter two illustrated that although information technology is widely agreed as one of the most important enablers of business process change, many of the approaches used to model business process do not address the specific problems experienced by the implementation of new technology. There is a distinct benefit in projecting the effects of information technology on the business processes if the number of disappointments experienced through the fact that information technology investments fail to live up to their expectations is to be reduced. In order to address this problem it has been demonstrated that the domains need to be considered together during the development stage and that one possible way to achieve this is through the integration of the modelling domains.

3.1 Integration of Business Process Modelling with Information Technology Modelling: The ASSESS-IT Project

As illustrated in chapter two there are different modelling techniques that can be applied to business processes but simulation has many advantages over the other techniques for this particular type of problem. The dynamic nature of simulation makes it possible to identify interactions between processes and provide a good understanding of the system. Information technology modelling on the other hand

tends to be based on static techniques, although some attempt has been made to incorporate dynamic modelling techniques in to this domain with computer network simulation. So, considering the three-layer structure, presented in chapter one, where the computer networks support the information systems which in turn support the business processes it can be noted that it is possible to model the two outer layers using dynamic modelling techniques, but the middle layer is generally modelled using static techniques.

The need to design both the business process and information technology domains concurrently has been established, and previously researchers have tried to integrate the modelling domains. The problem is that they have generally used proven IS modelling techniques to capture both the business process and information systems domain, and as these techniques are static the benefits of the dynamic techniques have been lost during the integration process.

This research looks at how dynamic modelling techniques can be used to capture the interactions of business processes and information technology domains dynamically. To achieve this an initial proposition was formed and tested using a sample case study to identify the limitations. After analysis of the limitations that the case study highlighted the proposition was refined and after a few iterations a hypothesis was formed.

This was part of a research project sponsored by the EPSRC, called ASSESS-IT, which aimed to integrate business process modelling with computer network modelling to capture the effects of information technology implementation within business processes. The first approach assumed that there was a direct link between the business process level and the computer network level, that is, if a computer network model of the proposed IT system was built the outputs from this model could be fed directly into the business process model. In order to achieve this integration the models had to be designed in such a way that the outputs from the computer network model would be compatible with the inputs to the business process model, in terms of the tasks that each model was performing. This meant adapting the usual simulation stages to integrate the models.

3.2 Steps in Building a Simulation Model

To build a simulation model there are a number of stages that must be performed. These stages have been discussed by many authors (e.g. Robinson, 1994; Paul and Balmer, 1998; Pidd, 1998; Banks et al., 2001) and, depending on the author, the names and orders of the stages vary slightly – however essentially all authors agree on the fundamental content of the various stages. The initial stage in any simulation project must incorporate defining the requirements of the model. Defining requirements entails identifying the problem to be addressed and the objectives that the model was designed to achieve. This is an important part of any model building project as it defines the focus of the model.

Once the objectives have been identified a conceptual model can be built to identify what activities occur within the process under consideration and the data that will be required by the computerised model. The conceptual model then needs to be translated into a computerised model and the data entered. Computerised models may take a number of forms, though this dissertation refers in the main to specialised simulation packages that are activity driven, the concepts remain the same however the simulation is programmed.

The first task when the computerised model is running is to verify that the model is behaving as you expect given the data and the logical structure. To do this specific examples are required that can be predicted to behave in a particular way. These examples need to be run through the model to ensure that the model reacts to the conditions of the example correctly and in the anticipated time frame with the correct level of resource usage. This stage of the model building process will probably result in some refinement to the model being required to ensure that the model is working correctly. Once the modeller has verified the model is behaving as expected, he has to validate that the model is an accurate representation of the system that it represents and that times to complete the processes and throughput figures are similar to reality. Again at this stage examples are required that mimic the variation of conditions with a similar arrival rate that would be experienced in the real system. The results from these examples need to be compared with statistics like the actual throughput of the system, the resource usage, and the distribution of workloads to determine whether the simulated system is a good representation of the actual system. Again, it is

anticipated that some refinement of the model will be required to ensure that the simulation outputs are a good enough approximation to instil confidence in future analysis work. This iteration of the verification and validation stages of the model is likely to be the most time-consuming aspect of the model-building process.

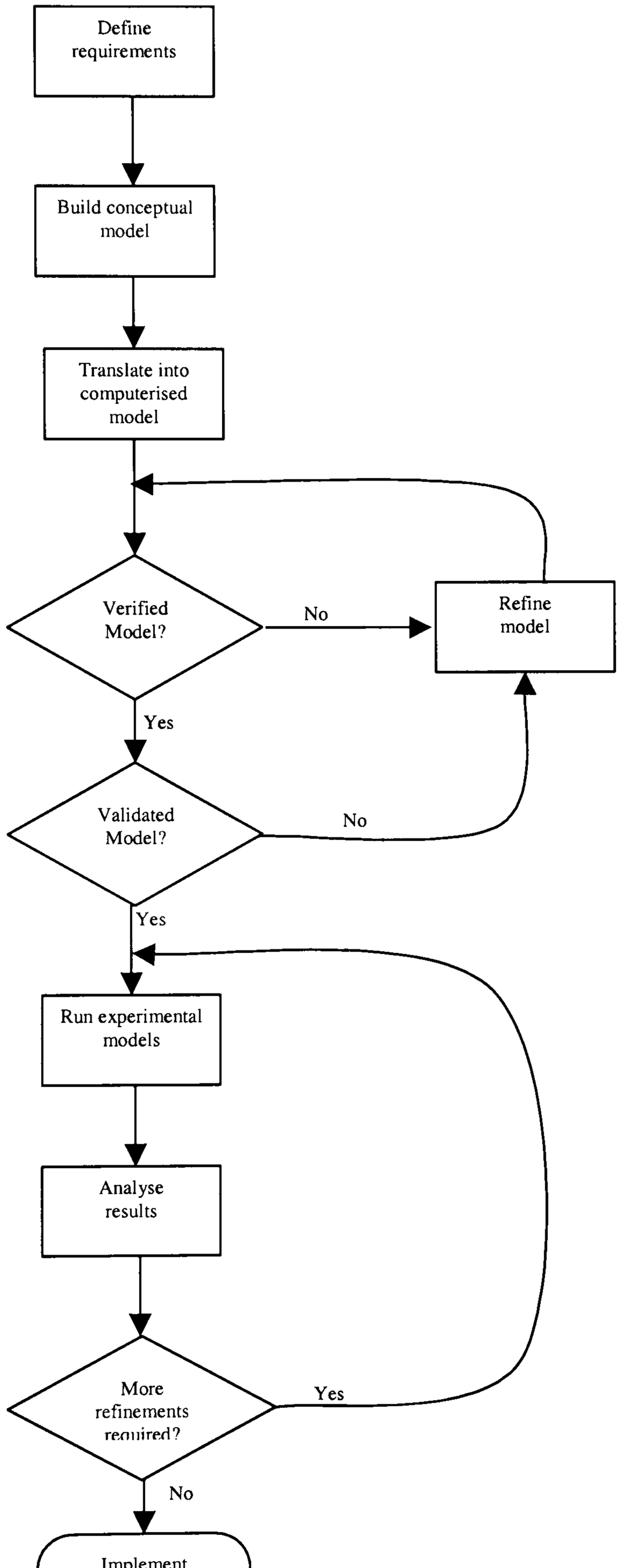

Figure 2. Steps in building a simulation model

Once the model has been verified and validated that it is indeed a good representation of the current system, the proposed changes can be modelled. In the

majority of cases there are a few competing scenarios that need to be compared, so a different model may need to be built for each of the scenarios though each will be based on the original. Comparing the scenarios involves running the models with a set of test data. To ensure a fair testing of the proposed systems a large set of test data that measures both standard and extreme conditions should be used, and the same set for each of the scenarios. The results obtained from the various scenarios can be analysed – and may suggest other scenarios that may be more beneficial than the proposed ones – and finally the most beneficial can be implemented.

The above stages in the model-building process are applicable for both business process modelling and computer network modelling; it is only the focus of the model that changes. However, in order to integrate the two modelling domains a much more thorough definition of the requirements is required to determine which activities will be performed by each model and how the models will interact with each other. When modelling business processes in the traditional way, activities last for specified periods of times and depending on the task being modelled these times may have some variability and are often modelled as a mathematical function. However when integrating the two modelling domains some of the task times will be dependent on times to be taken from another model it is imperative that the two activities match in terms of the starting and ending points of each task to ensure that the two models are referring to exactly the same process.

3.3 The Exploratory Case Study

In order to test the approaches to enable refinement a small case study was conducted. This case study formed part of a larger one, which is documented in various publications, but for the purposes of refining the propositions to form a hypothesis, only a section of the case study need be considered. The larger case study can be very briefly summarised as follows:

Company XYZ receive orders from their customers, check the order against their inventory, and despatch the goods to the customers. However, 30% of the orders received require some products that are currently out of stock. XYZ despatches the goods that are in stock and creates a backorder for the out of stock goods. This effectively increases the packing and delivery process by 30%. It is anticipated that a new computer system will improve the replenishment process, thereby reducing the

number of backorders, and hence workload required. The problem is to determine the percentage by which the backorders will be decreased. As this reduction in the number of backorders is crucial to the process as a whole, the need to accurately assess it is imperative. The problem is how can the change in performance be accurately assessed?

In order to analyse each stage of the proposition it is only necessary to look at a single process in the system. It was decided that the ordering process should be analysed, as this particular process would result in the most noticeable change as a result of the implementation of a new information system.

In the existing system the orders arrive by either phone or fax and are accepted, but there is no check made at the time of ordering to the inventory to determine whether the order can be fulfilled. If the order cannot be fulfilled then a backorder is created which effectively means two orders are produced, the goods currently in stock and the goods to follow. In the proposed system the inventory levels will be available to the person accepting the order, and therefore they will be able to inform the customer if there is a problem with fulfilling the order, which would offer improved customer service. It is anticipated that customers will still purchase the goods even if they are out-of-stock and therefore the profile of customer orders will not change as a result of the new system. However, having the inventory levels electronically linked to the sales will provide the company with improved stock control ability, allowing predictive ordering from their own suppliers and reducing the number of backorders required.

3.3.1 The Direct Approach

Discrete event models are designed to capture the effects of time delays and interleaving of activities competing for resources. COMNET III, a computer network simulation package, has the ability to generate software applications that model the traffic flow generated by a given information system. The information system, running on the order taker's workstation is not competing for resources and the processing time delays are aggregated into the delays in the computer network model.

The first proposition, $\mathbf{P_1}$ therefore, is **that the relationship between information technology and business processes can be modelled as a *direct* link between the computer network level and business process level**, where the information system is modelled implicitly between the two domains (Figure 3).

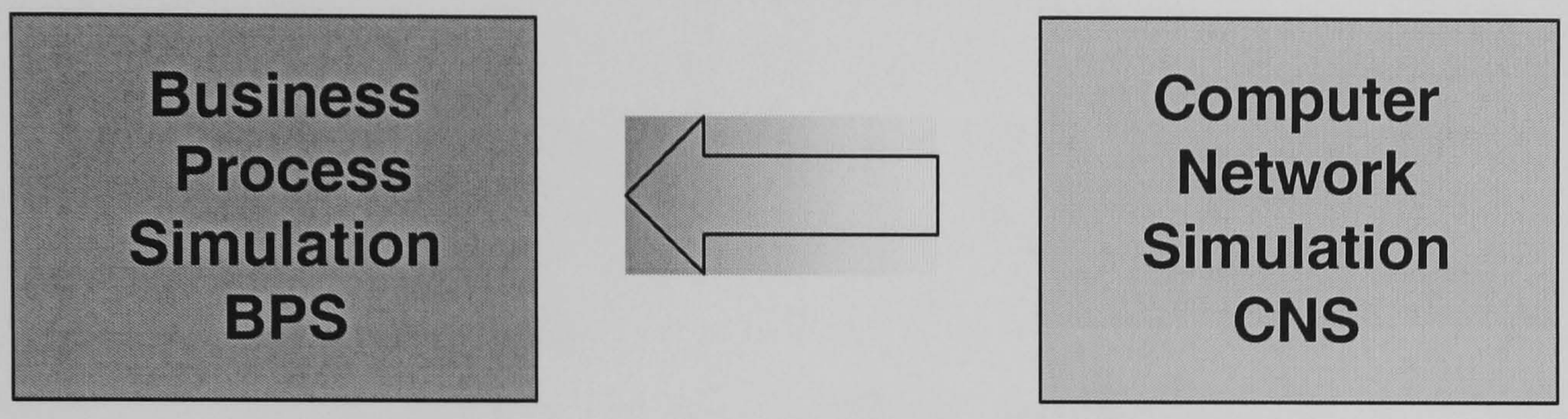

Figure 3. Direct integration approach

This suggests that if a computer network model of the proposed IT system is built, the outputs from this model, which will consist of the aggregated time delays for processing the data on the network, can be directly fed into the business process model at the point where that particular task is represented in the model. This process involves building two models, one from the computer network perspective and the other from the business process perspective.

In order to achieve this the traditional steps in creating a simulation model need to be modified. Each of the tasks in the business process model that use the proposed information system will require a breakdown of the activities that occur in the computer network to ensure that the tasks represented in each model correspond, the computer network model with the software application functions and the business process model with the task that initiates the function. This means that the define requirements stage is in much greater depth than when designing a single model.

Once the requirements have been determined the models can be built. This involves the same stages as previously mentioned, building a conceptual model, data collection, and building a computerised version of the model (in Figure 4 this has been amalgamated into the 'build XX simulation' stage for clarity of the diagram) but taking into account that any changes that may impact the other domain have to be mutually agreed to ensure that the two models remain compatible.

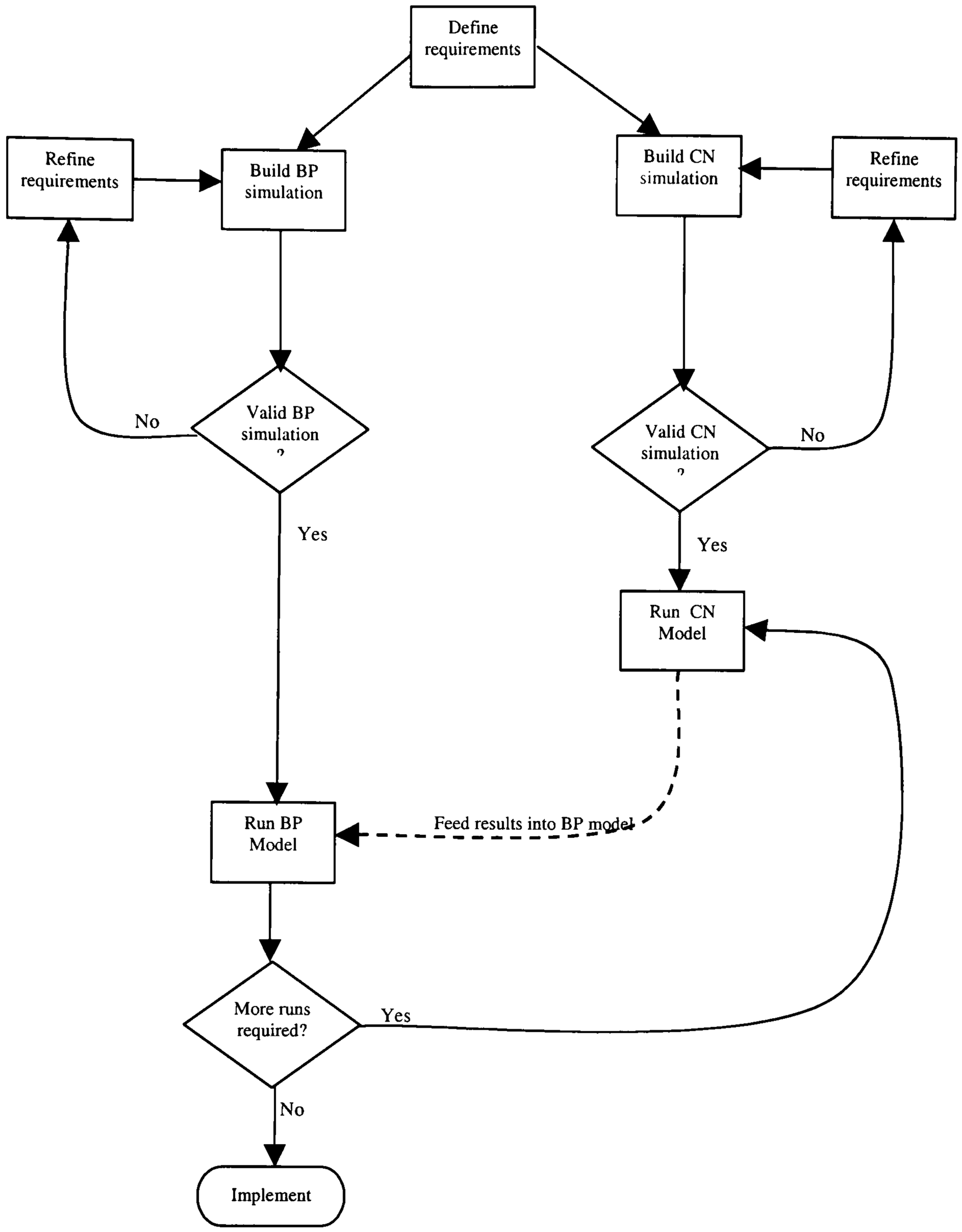

Figure 4. Simulation steps in direct integration approach

When the models have been built, they need to be verified and validated that they are a good representation of the system under scrutiny. The build/validate/ refine process is repeated until the model builder is satisfied that it is indeed a valid model. When both models have been validated the computer network model needs to be run first. The computer network model can be run under various conditions, such as network utilisation, obtaining a set of results for each of the conditions. The results from this run are then entered into the business process model as the time delays for the associated task, and the model is run under a similar set of conditions. As the computer network model results measure the application software running on the network under the specified conditions, when the results are fed into the business

process model the times obtained will reflect the effects that the computer network have on the business processes.

In order to test the proposition two models of the exploratory case study outlined in 3.3 were built, one that reflected the activities at the business process level, and the other that represented the new computer network that was to be installed. The business process model was built using the SIMPROCESS simulation package, and the computer network model was built using COMNET III. These two particular packages were chosen because the same company designed them both and it was felt that the integration would be simplified by the fact that both packages would follow the same protocols for the sequencing of the internal tasks.

Figure 5 shows the business process perspective of the receiving order process. This illustrates that from the business process perspective the receiving an order can be represented by the arrival of the order either by fax or phone. Both these activities have delay times and resources involved.

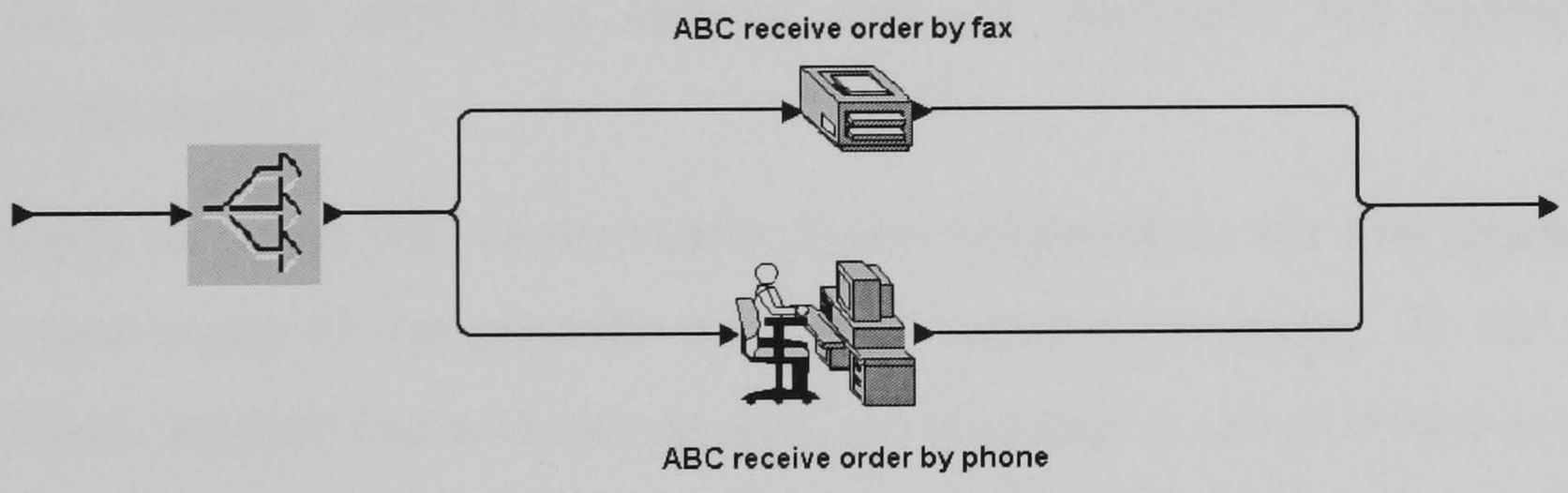

Figure 5. Receive order process (BP perspective)

Looking at the same process from the proposed computer network perspective then it can be seen that the process is far more complicated as one event in the business process domain corresponds to many events in the network domain (Figure 6). In this case the order arrives and the customer number and details are verified against their account, then for each item in the order the product database is accessed to assess whether this is a valid product code, then the product inventory is checked for product availability, and if the order can be accepted then it is recorded in the customers files and the product inventory is updated to reflect that the order has been issued. The process is modelled as a series of tasks that occurs in sequence initiated by the arrival of an order.

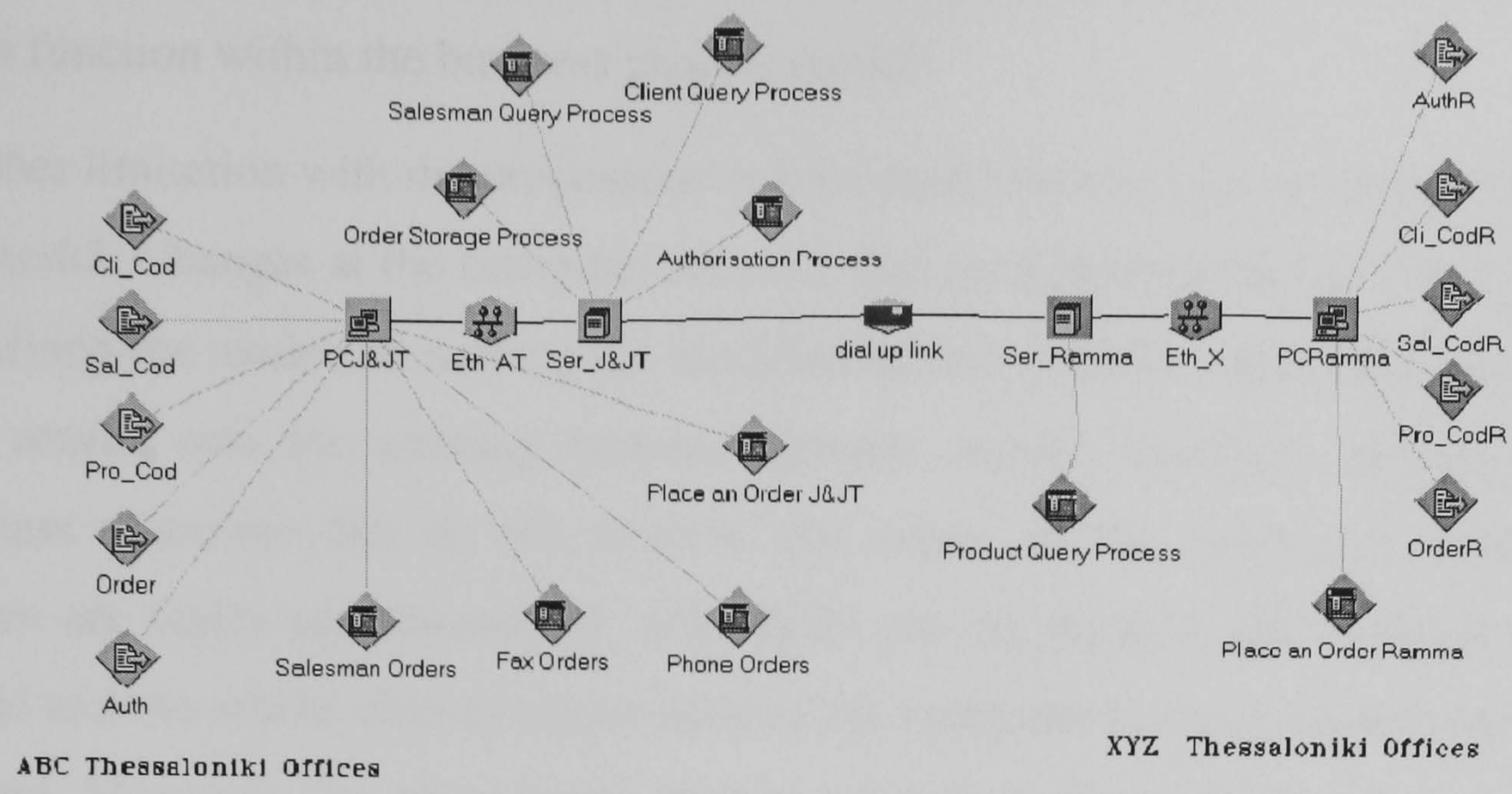

Figure 6. Receive order process (CN perspective)

From building the models it became obvious that the two models are working at a completely different level of abstraction. The business process model is dealing with orders, and does not consider the products that are ordered on an individual basis, whilst the computer network is dealing with the databases, and therefore with individual products.

For example, as stated 30% of the orders produce backorders, but this figure doesn't indicate how many of the products from each order are missing. At the business process level, the fact that an order produces a backorder or not is all that is relevant, whereas at the computer network level, how many of the products are out-of-stock is proportional to the traffic in the communication links. This increase in traffic will affect the speed with which an order can be input into the system, thereby affecting the whole process, even though the model does not deal explicitly with products.

Although the models were designed so that both models captured the same process – in this case the receive order process – the difference in the levels of abstraction meant that there were incompatibility problems in the times measured. For instance the times recorded for the communications to complete the placing of an order in the computer network model were measured in milliseconds, while the business process times for the same task are measured in either seconds or minutes. Given the stochastic nature of simulation models, the times allocated to a particular activity generally come from mathematical distributions, and the magnitudes of the times

recorded for the computer network model are insignificant within the variance of the given function within the business process model.

Another limitation with the proposition is how easily changes are accommodated into the model. Changes at the computer network that are hardware based involve simply modifying the model, re-running the modified model to obtain results and feeding the new results into the existing business process model. Similarly changes to the business processes that do not involve any aspect of the underlying information system are easily accommodated. Alterations can be made to the business process model and the results already obtained from the computer network model runs can be re-used. However, the main focus of this research is *IT-enabled business process change*, which implies that the changes that are of greater interest in terms of the research are those changes that involve the business processes that utilise the information systems that underlie them. Making changes to information systems related business processes are much more difficult to accommodate, as changes in either domain need to be fully reconciled with the other domain to ensure that both models are still compatible. This involves re-designing both domains for any change occurring within the information system domain, which may be viable if the change is fairly small or contained, but may become unviable if the changes are system wide - which in reality is more probable - limiting the usefulness of the approach.

Transferring the data between the two models was not automated and this task of transferring data from one model to another manually allows for errors to be introduced into the system, even though both models have been verified and validated independently. The transference of data between the models also posed another problem – should the data be averaged prior to the transference, reducing the chance of introducing an error, or should the data be entered as raw data, increasing the chance of introducing an error but improving the overall accuracy of the model.

The problems described here were uncovered from simply looking at the order taking process in the exploratory case study, a seemingly simple task. This clearly illustrated the need to refine the proposition to make more applicable to projects dealing with IT-enable business process change.

3.3.2 IS Model Linked Integration

To overcome the problems associated with the direct link integration the proposition was refined. Although the information system domain has no temporal element it defines the relationship between events in the business process and computer network levels. The proposition was refined to include an additional model that built in an explicit representation of the information system level to bridge the gap between the computer network and business process levels. The proposition **P_2 is that the relationship between information technology and business processes can be modelled through the inclusion of a third level, representing the information systems domain**. In this scenario the outputs from the computer network would be fed to the information systems level, and the output from the information systems level fed up into the business process level. Information could also be passed down from the business process level, through the information systems level to the computer network level (see Figure 7). This means that changes in any domain could be reflected in any of the other domains.

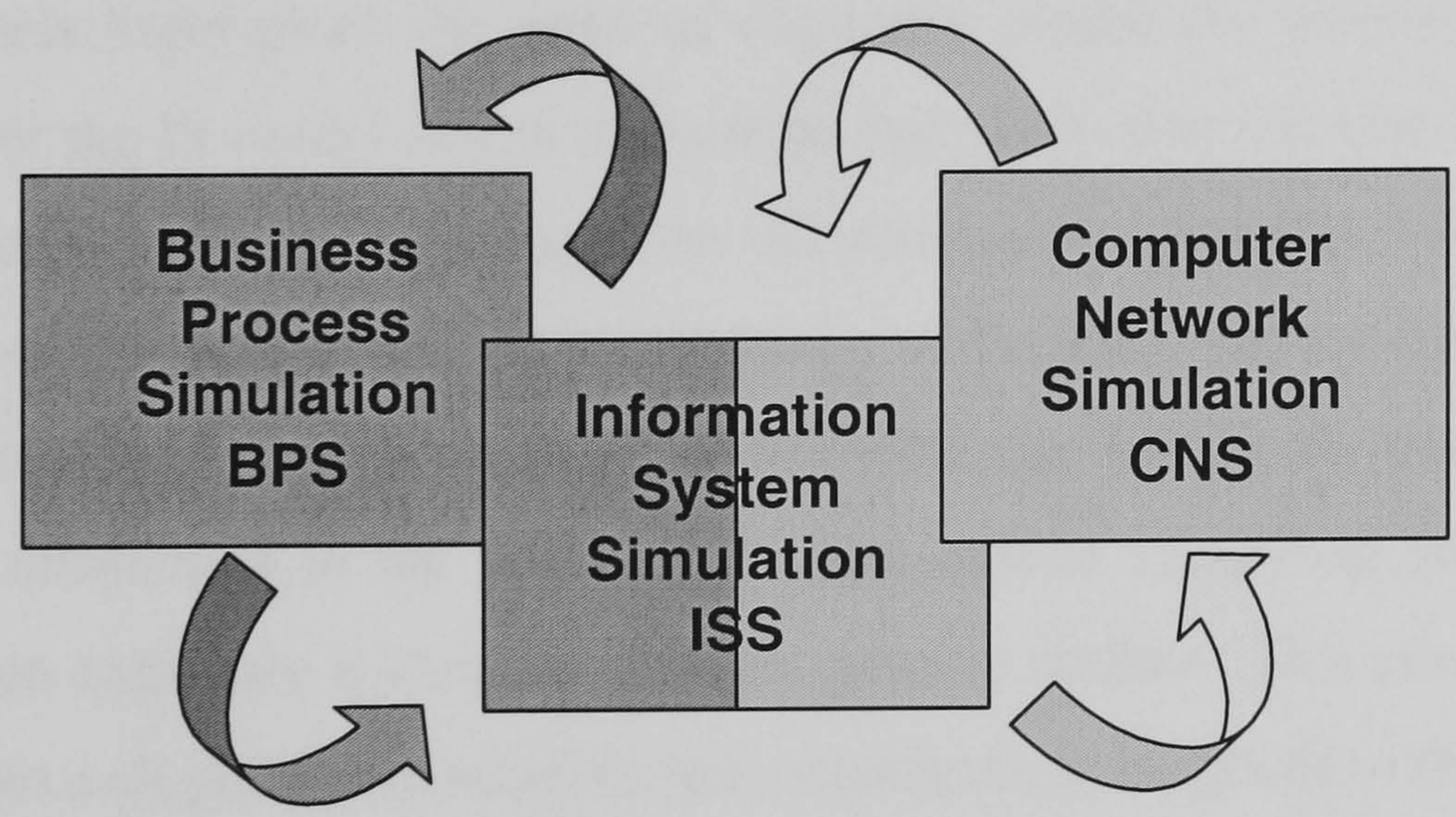

Figure 7. IS model linked integration approach

There were some obvious drawbacks in modelling the interactions between the levels in this way. The main disadvantage is that now three models are needed which would mean a more detailed analysis of the requirements to ensure that the three models were defining the tasks identically. Similarly, the amount of data to be transferred between models was now doubled and as no method of automatically transferring the data from one model to the other had yet been identified this was a major obstacle to designing the model in this way. Further building three models is a time-consuming

and costly exercise, and any errors within the models or introduced by the transference of data manually, can be 'rippled' through the models possibly exaggerating the error and skewing the overall results.

The problems foreseen in building the models this way were prohibitive even to try with the sample case study and would certainly be excessive in any real simulation problem. This lead on to thinking about how information systems could be effectively modelled explicitly using simulation techniques, but without building a separate model of the domain. Although information systems are in fact in the technology domain rather than the business process domain, their function lies firmly in the business process domain, and, as the aim of this research is to capture the impact of the functionality of the information system on the business process domain within the model, this brought the focus of the research into how information systems could be modelled explicitly within the business process domain.

3.3.3 BP/IS Linked Integration Approach

Using the direct approach to model the information systems layer implicitly between the two models highlighted the need to explicitly model the information systems layer, however the IS model linked integration approach demonstrated that including this as a separate layer would exaggerate the problems associated with maintaining the integrity of the model and the transference of the data. As the functions of the information system and the control of its utilisation lie within the business process domain any refinement to the approach should include modelling the information system domain explicitly within the business process domain. This combining of the two layers into a single model requires that consideration be given to the problems of the levels different levels of abstraction that caused problems with the direct approach. In that approach the two models were different levels of abstraction of the same entity (orders and products in the exploratory case study) and therefore caused problems when transferring the times from the computer network model to the business process model. If the information system layer is to be explicitly modelled within the business process layer then the level of abstraction of the resulting model will necessarily be the level of the information system. As this will also be the same as the computer network model level of abstraction the problems with the integration of the two models will no longer be an issue. This led to revising the proposition again to model the information systems level as a sub level within the business

process model (see Figure 8). The third proposition, **P_3 is** therefore, **that the relationship between information technology and business processes can be analysed by modelling the information systems domain as a sub-model of the business process domain.**

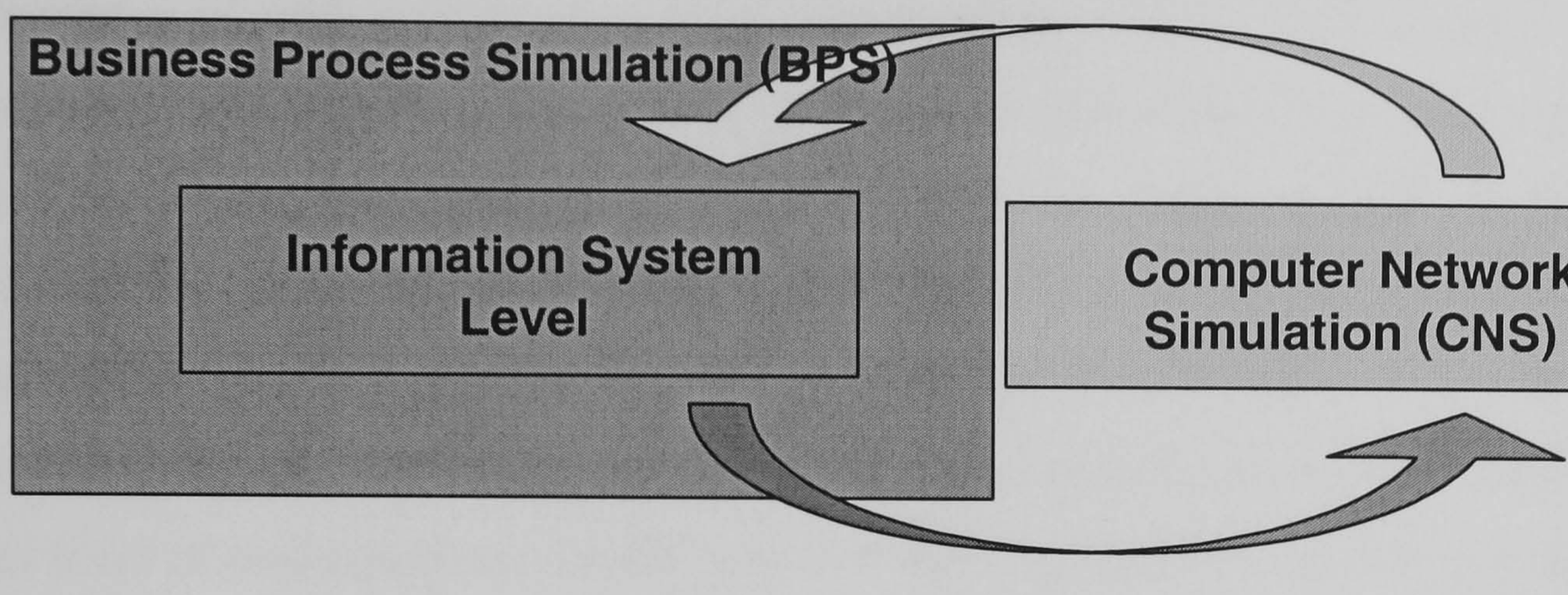

Figure 8. BP/IS linked integration approach

This method of incorporating the information systems level within the business process level had many advantages over the other methods. Firstly there are only two models that need to be built, though the business process/information system model is necessarily more complicated than previously envisaged. As the business process model now contains both the business process and information systems domains any changes in either domain are automatically reflected in the other without the need to transfer data between the two levels and without the need to re-run the models, thus reducing the chance of introducing errors in the transference procedure. There would still need to be data transference between the computer network level and the information systems level, but only on the scale that had initially been considered. Running large simulation models can be a time-consuming process, and although the more complicated model will take longer to run than the standard model this is offset by the fact that a separate information system model will no longer need to be run.

This new proposition was tested using the same sample case study, outlined previously, to investigate any limitations with it, and analyse how else this integrated modelling technique could be improved. Again just the ordering process was sufficient to test whether the proposition would withstand testing under a larger system.

Models of both the BP/IS and the computer network domains were designed. The impact of designing the model in this way made the BP/IS model much more detailed than it had been previously, and whereas in the previous model the activity

of receiving the order had been a single task, now it was required that it was broken up into a series of activities that represented the tasks that the information system required. Designing the model in this way also meant a more detailed analysis of how the information system was designed to work within the business processes. A breakdown of each task at every stage was required which implies a more detailed analysis of requirements. This meant for example analysing the possible ways that the order taking process could be conducted. Did the employee take all the details and then access the information to check all the details together, or were the details checked as they were entered, or was it a mixture of both where client details are checked first, and then when verified, all product details are entered and checked. This level of analysis is not usually required when modelling business processes. The BP/IS model of the receive order by phone section of the order taking process is shown in Figure 9.

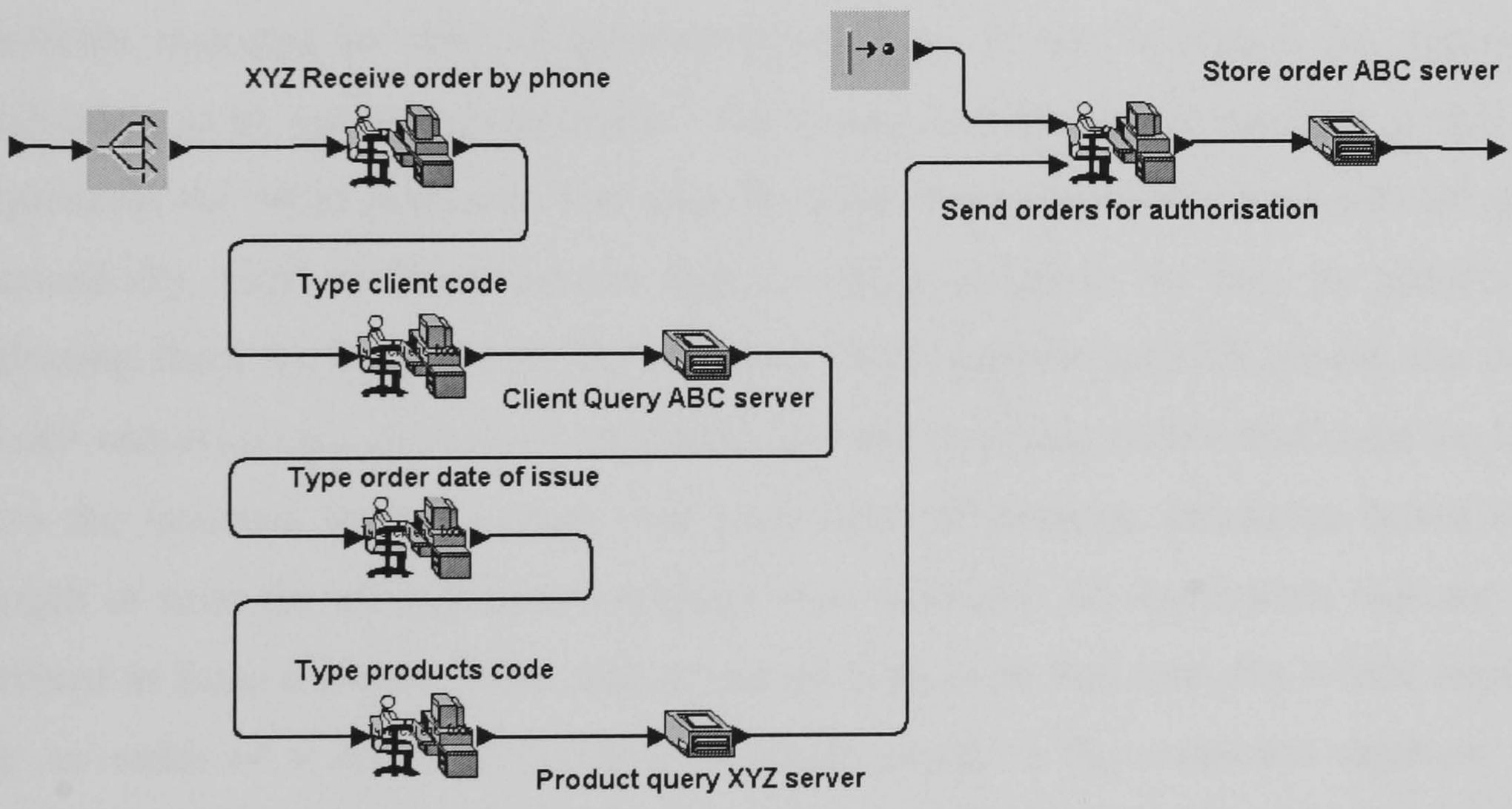

Figure 9. Receive order process (BP/IS level model)

In terms of complexity of the models the impact on the computer network model was however the opposite. The tasks could now be modelled as individual tasks rather than as a series of tasks, consequently reducing the complexity of the model. The computer network model at this level is shown in Figure 10.

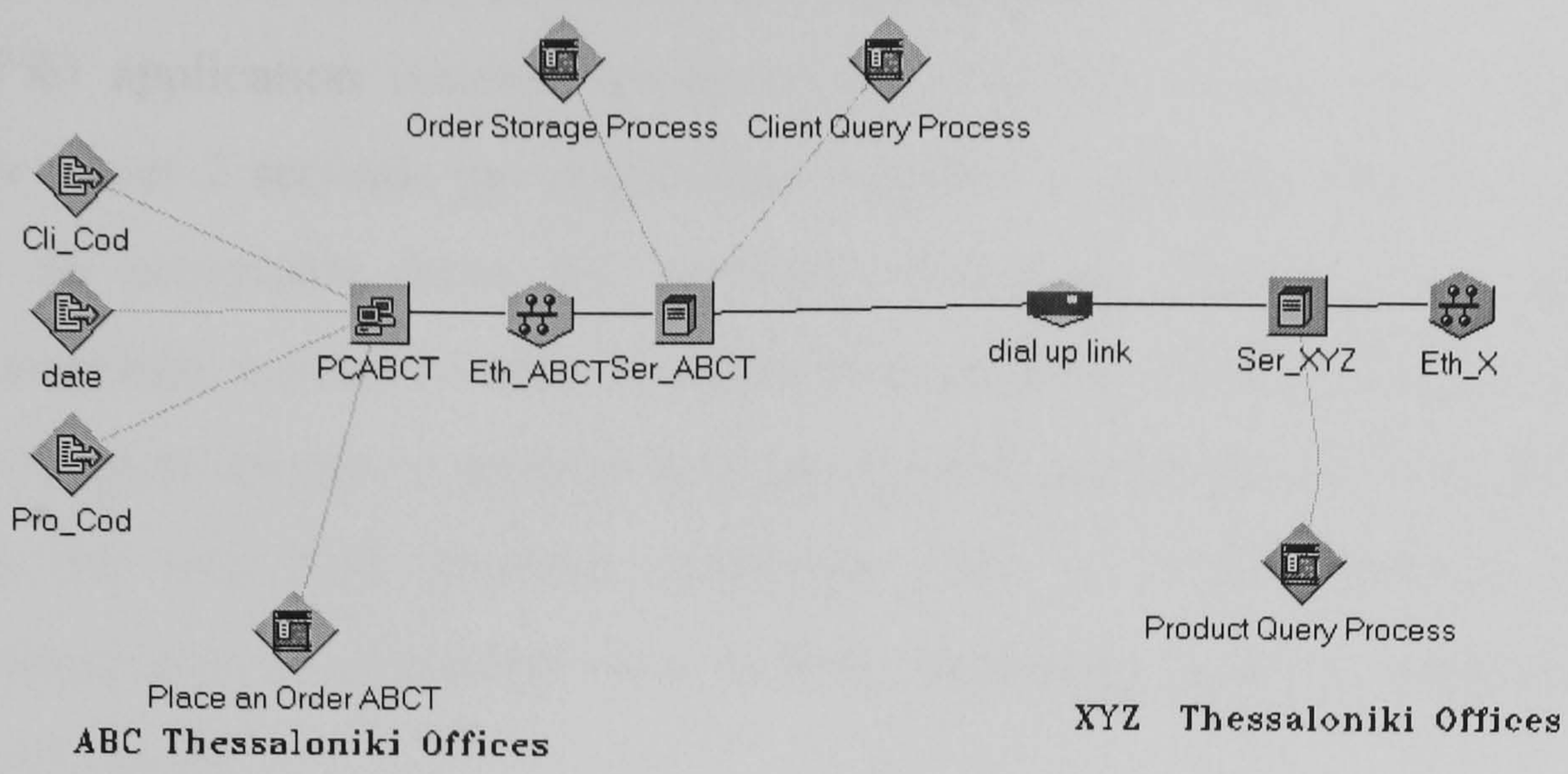

Figure 10. Receive order process (CN model)

3.4 Analysis of Results

Once the two models were built a series of test runs were completed. One of the facilities included in network simulation packages is that it allows the network utilisation to be set at various levels. The reason this facility is included is that it represents the other processes that may be operating on the same network that are beyond the scope of the processes that are under scrutiny, but may be indirectly affecting them by their use of the network. The computer network model was run under various levels of network utilisation in order to obtain results that could be fed into the business process model. For each level of network utilisation tested the length of time for an application instance was recorded. An application instance is defined as from the start of the task to completion, so in this case this would imply, for an order of n different products, a single check in the customer database to confirm details, and n checks in the inventory database to confirm product details. Running the model under the different network utilisation values allowed analysis of the effect that adding more processes using the same network would have. The results for times to complete an application instance were recorded under various levels of network utilisation and the results are shown in the graph in Figure 11. The results from the computer network were fed into the business process model that was then run with a set of test data designed to illustrate both standard and extreme conditions. As the results obtained from the computer network model incorporate the various network utilisation values are transferred into the business process model, the overall results will automatically reflect the effects of network usage.

From Figure 11 it can be seen that until network utilisation reaches a critical point (around 67%) application instance durations are relatively steady and utilise the network for about 2 seconds per application instance, a response time that can be considered as acceptable from the end-user viewpoint. However, as network utilisation increases, a sharp increase in application instance completion times can be witnessed, rising to almost 45 seconds for high network workloads (67% to 79%), to 60 seconds for very high network workloads (79% to 85%), followed by an extremely sharp rise as utilisation rises to 92% (indicating network congestion at such high utilisation).

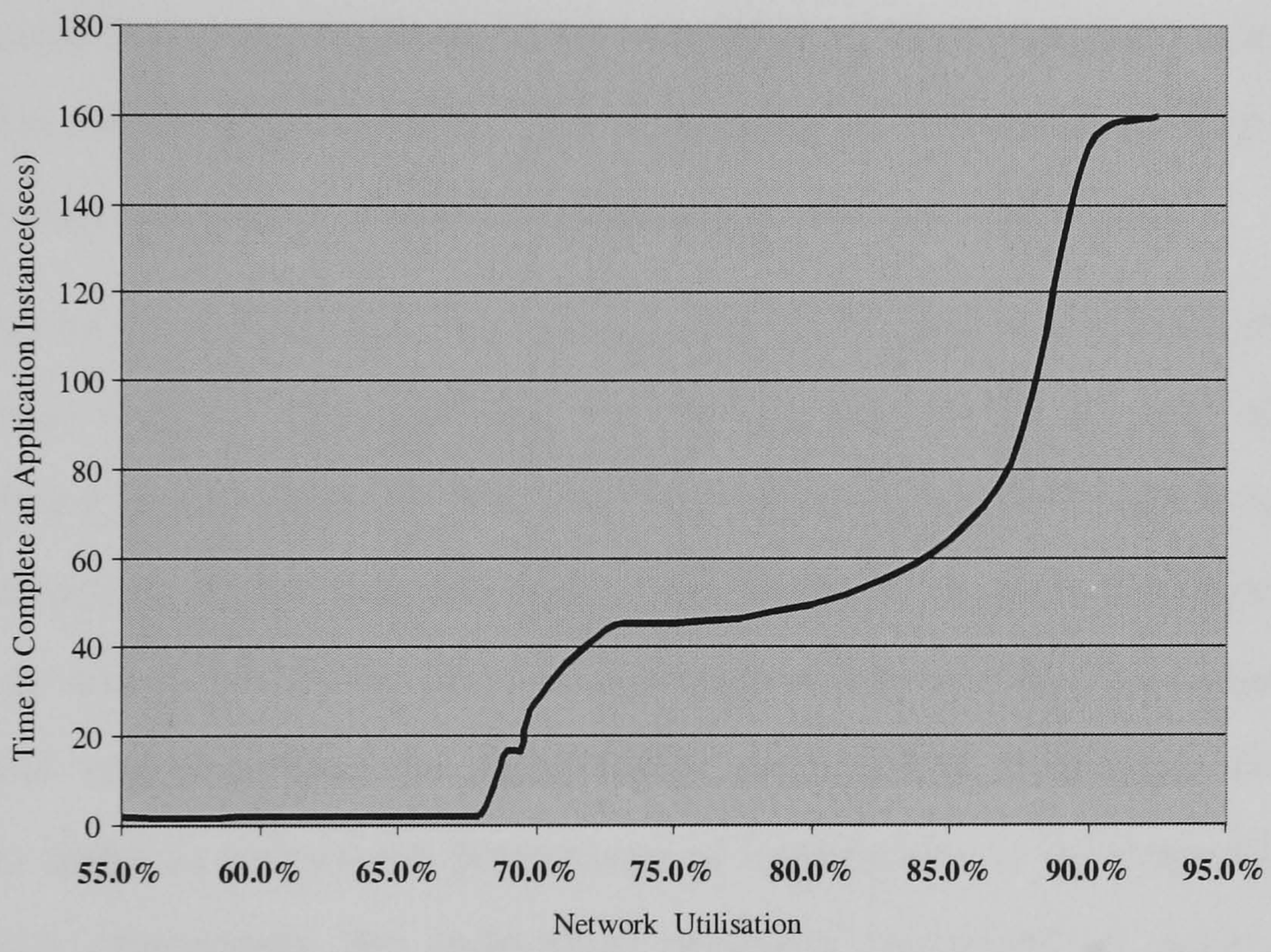

Figure 11. Graph to illustrate how network utilisation affects application instance completion times

Such response times are clearly unacceptable from the end-user standpoint, and give strength to the claims that IT capability can influence business performance. However computer networks have improved dramatically over recent years, and look set to continue to do so, with more powerful processors and faster communication links, so providing the infrastructure is updated in accordance with requirements of the information system then utilisation should not reach these critical levels. This example case illustrates a situation where the network utilisation is over-utilised without the underlying infrastructure being upgraded, so these high response times would be extremely unlikely to occur in practice.

The business process tasks within the system comprise of both manual and computer sub-tasks, and it is the manual tasks that are more time-consuming than the processing and communication times demanded of the computer network. For instance the more time consuming aspect of the receive order process is the time it takes for the employee to answer the phone then type the details in to the system, rather than the time it takes for the information system to access the database and return the relevant data. The impact of this is that the utilisation levels of computer networks are comparatively low and that they should never reach the levels that actually impact the business processes. Additionally, computer networks have improved dramatically over a short space of time, and more powerful processors, routers and communication links are always appearing on the market, improving the capacity of the underlying network. The remainder of this analysis therefore only considers the situation where network utilisation is low (i.e. under 67%).

By integrating the models in this way it was possible to address the main objective in the overall case study – the reduction in the number of backorders. One of the problems with the direct approach was that the business process model was operating at the level of orders, rather than the individual products requested within the order. Building the model at this lower level of abstraction allowed the individual products to be modelled and therefore the stock-levels analysed to determine the required stock levels in order to reduce the percentage of backorders to the required level. As the information concerning the individual products requested in each order was unavailable a set of test data was used to run the initial analysis. From the results obtained from running the models it became apparent that backorders were only generated on the days following those days where stock levels were allowed to fall to below 100 products. Increasing the replenishment threshold level by 100 reduced the backorder percentage by 5%. However as the demand for each of the products was set at varying levels, each individual product replenishment threshold level would need to be set individually to determine the overall optimum replenishment strategy.

Furthermore one of the other objectives of the overall case study was to reduce the overall delivery times, although this wasn't included within the scope of the order processing models that are described here. The delivery times are measured in hours, and the critical event that affects the delivery time is the time the lorry leaves the company. This time is dictated not so much by the processes of accepting and

processing the order, but by the fact that the lorry is fully loaded, which is in itself, dictated by the packing process, and the fact that the lorry leaves at approximately the same time each day. The impact therefore of a slight increase or reduction in time in the order taking process is irrelevant in terms of delivery times.

These results illustrate that although the system is not greatly affected by the time saved by the introduction of the new technology, the main objective of the reduction in backorders is greatly affected by the introduction of an information system, but in terms of the contents and the use of the system, rather than the time delays.

3.5 Integrated Modelling of Computer Networks, Information Systems and Business Processes

The results from the BP/IS linked integration approach demonstrated that although the information systems may have an impact on business processes, the computer network domain that they operate on have a limited impact on the business processes themselves unless there are very high levels of network utilisation. In fact the technology available on the market is improving the capacity of computer networks, combined with the fact that there is always a certain amount of redundancy built into any network, means that the business processes do not need to be overly concerned with the performance of the network if the response times are not time-critical and high levels of utilisation are not expected.

In addition to this computer networks are no longer built to support a single information system or business process, and therefore the resources that the information system utilises may be an insignificant part of the system when viewed in its entirety.

The increase in time taken to build the computer network model and the increase in complexity of defining the requirements that integrating the models demands means that the additional information supplied by integrating the computer network domain may not be cost-effective. This along with the knowledge that the computer networks should never reach such high levels of utilisation that it affects the business processes leads to the elimination of the computer network domain from this research, and replaces it with the assumption that the user will always have enough network capacity to perform the required tasks.

The results from the BP/IS linked model also showed that although the computer network did not impact on the business processes significantly, this does not mean that the information systems domain does not have a significant impact on the business processes, just that the effects of the impact are not being captured by the integrated IS/BP model presented above.

To determine the reason that the model fails to capture the impact of the information technology on the business processes it is necessary to look at how the two aspects of information technology, the computer network and the information system were modelled. In the previous models an attempt was made to capture the physical aspect of the information technology, but had omitted to capture the informational aspect. As the business processes depend on the information supplied from the information system, rather than on the physical connections of the computer network, and the times supplied by the computer network model proved to be negligible this calls into question the appropriateness of the capture and transference of times as a way of crossing the boundaries between the levels. Indeed, using the assumption that the user will always have the network capacity to perform the required tasks means that the information system layer will no longer affect the business processes in terms of the times recorded and the research should focus on the informational aspect as this plays a more significant role in terms of how the information is processed and used.

3.6 SUMMARY

This chapter presented the various approaches that were used to provide a basis for the framework presented in the next chapter. The review of different modelling techniques for both business process modelling and information systems modelling presented in chapter 2 indicated that simulation modelling was possibly one of the best techniques available to capture the evolution of the system over time. Integrating computer network simulation with business process simulation was intended to expand the simulation models ability from capturing three perspectives to capturing the four perspectives. Initially it was assumed that integrating the business process simulation and the computer network simulation models directly that would enable the interactions between the domains to be captured. However, though the models had been designed to represent the same activities, when the models were run it

became apparent that they were modelling at such different levels of abstraction that the models proved to be incompatible.

Analysis of the problems associated with the direct integration method suggested that the information system level needed to be modelled explicitly, rather than implicitly and therefore the method was altered to include a separate information systems layer. This however meant there were there were now three models to be integrated, and therefore the problems associated with data transference identified in the previous model were actually increased. Because of these problems the approach was considered unviable and therefore was altered again. As the functions of the information system lie firmly within the business processes, the approach taken was to embed the information system model within the business process model. This had the advantage that any alteration to either the business process aspect or the information systems aspect of the model would automatically be reflected in the other. This approach was tested using an exploratory case study of an order taking process. When the results were analysed it became apparent that the computer network model's impact on the business process model was negligible, although this does not imply that the effects of the information system does not affect the business processes, but that the model was simply not capturing the impact correctly. The reason that this occurred was the model was trying to capture the physical impact of the system in terms of time to complete a task, but the main impact of the information system on the business processes was not the impact of time, but the effects of how the information supplied by the information system was used by the business processes. This therefore changed the focus of how the information system domain was to be modelled in the remainder of this research.

Chapter 4: Development of an Integrated Model Framework

In the previous chapter we established that the effect of the underlying computer network on the business process domain was negligible in any processes that did not demand time-critical responses, due to the different time scales that the activities are measured in. However, it was established that the way that the information is used within the business processes may affect the business processes themselves. This chapter looks at the propositions outlined in chapter three and the limitations of them. From the analysis of the limitations a hypothesis is formed, and a framework developed.

4.1 Limitations of BP/IS Linked Integration Model

We have already established that the computer network domain has very little impact, so any further analysis of the proposition stated in chapter three is based solely on the BP/IS integrated model, and does not consider the disadvantages previously established with linking the two separate simulation models.

One of the main disadvantages of the proposition is the sheer complexity of the model. Incorporating the information systems level into the business process activities requires breaking down what is essentially a single task, e.g. receive order, to a series of smaller tasks, e.g. enter client details, enter product details etc. If the number of activities that rely on the information system is large then the task list associated with the activities may be huge, and consequently the complexity of the model may cause it to become unwieldy. The increase in complexity also increases the running time of the model. One of the advantages of simulation is that generally models can be run much quicker than real-time allowing analysis of longer term effects, and that this slowing down of the speed at which it can be run, loses some, though not all, of this advantage offered by simulation. A further consequence of the

increased complexity is that it introduces more scope for errors, again increasing the time required for validation and verification purposes.

This disadvantage can be balanced by the fact that the two models were combined, which meant that any changes in one domain were automatically reflected in the other. This means that there is no need to change two models when any alteration that may affect both domains is made – an obvious improvement from when the information systems model and the business process model were separate. Admittedly the changes required may be more complicated than previously due to the level of abstraction that each of the tasks are modelled at, but the verification and validation stages of the changes are also reduced as a result of the domains being modelled in a single model.

The main advantage of the linked model is that data is automatically transferred between the domains. This has the advantage that the times generated at each stage of the simulation reflect the stochastic nature of the simulation model. In the previous proposition where the domains were modelled as separate models, data about the length of time taken for each task would have to be transferred between the models. Depending on the complexity of the model, the number of computerised tasks and the run length, there may be a vast amount of data to transfer. This means either transferring a huge amount of data, or reducing the amount of data transferred by generating distributions that fit the data. This however has the drawback or reducing the accuracy of the model. By integrating the two domains into a single model the data is automatically transferred between domains without huge amounts of data needing to be transferred, or reducing the accuracy of the results.

The biggest limitation however, is a consequence of the way the model is designed. A closer analysis reveals there is an underlying assumption that the information system is actually supplying timely and appropriate information. It assumes that the points where the system is incorporated into the business processes have been well designed and validated, and the information that the IS returns is both correct and relevant to the needs of that particular activity. Furthermore, that the users of the system react in accordance with the information that they receive, rather than following a sequence of events assuming that the information is correct. However, we have already identified that part of the reason that there are so many reported disappointments with investments in information technology is that the investments

are not working as anticipated and that the assumption that the information system is supplying appropriate information may not be safe.

4.2 Refining the Hypothesis

The limitations expressed in the previous section, and the fact that the model fails to capture how the information provided is utilised implies that the way in which the information system level is modelled needs to be carefully considered. The layered approach covered in the previous chapter focussed on modelling how the times in one layer affected times in an adjacent layer. The results obtained from running the model illustrated that times in the lower layers have a negligible effect on the overall business process layer. Instead, the impact of the information system on the business processes is based on how the information supplied is used in the decision-making processes, rather than the speed at which it is supplied. This means that it is necessary to look at how the information is to be modelled within the system. Furthermore, the underlying assumption that the information that the IS supplies is appropriate that infiltrated the previous approaches should be tested, and the integrity of the underlying information system must be demonstrable.

Simulation is a useful tool to model interactions between individual activities in the same system. In business process simulation, although the sequence of tasks is specified, different activities may be competing for the same resources, affecting the order and time scales that activities are completed in. Simulation modelling therefore can be seen as capturing two distinct elements of the system, time and the selection of the next activity. In information systems, again there are sequential steps that are followed, as when a task is performed a piece of computer code will be executed. The difference is that there is no competing for resources, unless we consider processor time, but we have established that the effect of the computer network at the business process level is negligible, and so essentially other tasks that are being performed simultaneously do not actually affect the information system in terms of the *sequence* of tasks. However, they do affect the *information* returned and it is in this way that the information systems impact the business processes. Therefore if we want to measure the impact of an information system we must capture in the model the information changes that occur, and base the business process model on this information rather than a structured sequence of events.

The model of the information system layer should therefore capture the state behaviour rather than the behaviour over time. As simulation modelling is a time-based modelling technique this suggests that this may not be the best modelling technique for this level. Capturing the state behaviour of the information system level overcomes the problems associated with the uncertain assumption that the information supplied by the system is correct, as the state of the model at any time could be verified, providing confidence in the model. However, a verified model does not necessarily mean that the design of the system is valid. This leads to a closer inspection of the verification and validation procedures.

4.2.1 Verification and Validation

These two terms are often confused, but in fact have two quite distinct perspectives. Verification is concerned about the correct implementation of a specification i.e. are we building the *product right*? Verification does not check whether the specification is appropriate in any way, just that what has been built matches the specification, and therefore a verified system does not necessarily imply that the system built is appropriate for the needs of the company.

Validation, on the other hand, focuses on whether the original specification is correct i.e. are we building the *right product*? It is therefore the validation process that is used to check that the product will perform the tasks in an appropriate manner.

Robinson (1997) points out that in fact the verification and validation stages do not actually demonstrate that the model is correct, rather their purpose is to try to prove that the model is in fact incorrect. If the model is not proved to be incorrect, then the confidence in the models 'correctness' is increased. Eventually confidence in the model as a good representation of the system reaches a point where the results produced from experimentation are relied on for decision-making purposes.

In this research where a model of the information system is built there are two levels of verification and validation:-

- Verification and validation of the information system *design*
- Verification and validation of the *model* of the information system

In the previous propositions the verification and validation that occurred was that of the model, to ensure that it was functioning as expected and providing the expected

results. As identified in the previous section there is an underlying assumption that the system was providing appropriate and timely information, which implies that the verification and validation of the *design* had occurred prior to the model being built.

It has been established that many of the disappointments associated with information systems investments are that the system, although validated as a system, is not validated within the context of the business processes supported. The disappointments could be overcome if the design of the information systems is validated within the context of the business processes.

4.2.2 Refining Requirements of the Modelling Tool

The analysis of the previous BP/IS linked approach demonstrated the benefits of a deeper insight into the requirements of the modelling tools in order to capture the behaviour of the information system effectively within a model. The previous attempts were fundamentally flawed in that the attempts to model the information systems were time based rather than state based. This implies that simulation may not be the best technique to use to capture the information system level and another technique may be more appropriate. Simulation, however, still appears the most appropriate tool to model the business process layer and the evaluation of the previous approaches has provided insight as to the further requirements of the information system level.

The information system level model needs to be able to capture the state behaviour of the system. As the state changes are the result of some task within the business processes initiating a function of the system, the models will have to be very closely integrated. The previous approaches illustrated the difficulties with integrating the models in terms of data transference and integrity, and concluded that the approach of modelling the information system level as a sub-level of the business process layer was the most effective. In order to achieve this the information system model needs to be dynamic to reflect the state changes initiated by the business process model. By dynamically modelling the information system level as a sub-level of the business process layer it should be possible to validate the system within the context of the business processes.

4.2.3 Selection of Information Systems Modelling Technique

At the outset of this research it was assumed that the computer network had a larger impact on the information system, and hence on the business process that it supported, and that this impact was time-based. Consequently, it was thought that simulation modelling would be the most appropriate tool to initially capture the interaction between the computer network level and the business process, and later the information system layer itself. Subsequently, however, it was proven that the impact of time at the lower levels had a negligible effect at the business process level, and as such simulation was not the most appropriate tool to model the interactions of the information system with the business process level.

The refined requirements in the previous section indicate that there are three conditions that the information systems modelling technique must meet:

- It must be able to model systems dynamically
- It must be able to model the state behaviour of the system
- It must be able to be integrated with simulation modelling techniques

From the analysis of the various information systems design methodologies and techniques outlined in chapter 2, it was shown that there are a limited number of the techniques available that were able to model the system dynamically. JSD and Merise are both full information system design methodologies that take the process through all the stages from the feasibility study through to the implementation of the system. The aim of this research is not to design the information system, but rather to model the interactions between the information systems and the business processes dynamically and therefore a complete information systems design methodology is beyond the scope of the thesis. However the techniques employed by the ISDM's to model the information systems in a dynamic way are of interest. In Chapter 2 four techniques were identified as long-term dynamic modelling techniques, namely action diagrams, entity-life cycles, prototyping, and computer network simulation, thereby fulfilling the first of the criterion.

The second criterion, that the technique must be able to capture the change of state of the system variables was added as a result of the previous approaches in trying to model information systems through trying to combine business process simulation

and computer network simulation. Neither computer network simulation nor action diagrams are able to capture the state variable changes, and therefore both are unsuitable techniques for an integrated model.

The two techniques that fulfil the first two criteria are prototyping and entity life cycles. Both these techniques fit the first two criteria in that they are able to dynamically model the state behaviour of the system, which allows analysis of how one area of the system can impact another. Similarly, both techniques are used to verify and validate system design; and both require a thorough understanding of the system under analysis. Therefore it is the third criterion that determines which of the techniques is the most appropriate for modelling the information system level for this research.

Entity life cycles lack the ability to show concurrency between events, and can only show a single entity (or group of entities) perspective at one time. In terms of linking this to a discrete event simulation model this is unacceptable, as one of the most important aspects of linking the domains dynamically is to be able to capture the effects of interactions between the domains. This leaves prototyping as the only technique reviewed capable of capturing the dynamic interactions between the information system domain and the business process domain.

Prototyping has similar traits and therefore advantages to simulation modelling. The two techniques also both demonstrate the same limitations such as the fact that the model cannot represent the entire system, only the part under scrutiny. Information systems prototyping techniques offer advantages over simulation modelling techniques in that the prototype will consist of the data structures, or possibly a sub-set of the data structures, envisaged for the finished product, as well as the computer program code that performs the functions required for the purposes of the model. For instance, prototyping techniques allow the modelling of data structures such as relational databases that contain the information that is used by the business processes. Effectively the prototype will consist of a piece of code that demonstrates, by emulating on a smaller basis, how the data will be stored, retrieved and utilised in the complete system. Simulation techniques do not allow such insight into the informational aspects of the information system.

4.3 INTEGRATING SIMULATION WITH PROTOTYPING

The fact that both simulation and prototyping are both dynamic techniques that can be used to analyse systems using models prior to the implementation, though from different perspectives means that the integration of these two techniques actually complementary. By utilising the informational aspect of the prototyped model in the business process model we are able to analyse how well the proposed information system fits the requirements of the business and subsequently make alterations to the processes or the information system to ensure compatibility.

A prototyped information system can be designed in any language that offers similar structures as the final product is envisaged as being written in. As most simulation packages feature a facility to allow the user to program some aspects of the model, it is envisaged that the prototyped model will be an entirely self-contained model that can be accessed directly from the simulation package. This constraint obviously limits the choice of simulation package to one that allows all the user-code to be kept together though accessed from any activity, rather than having code attached to individual activities as is the case in most packages. However, some simulation packages allow access to external packages through the user coding facilities and therefore this constraint is not as limiting as one might immediately have thought.

Building a prototype of a system shows how aspects of the information system need to be constructed to achieve the results required. The prototype will not show the complete design, but rather a horizontal or vertical cross section of the functionality anticipated in the final product. Whether a limited function of all aspects of the design (horizontal) cross-section, or full functionality of a single aspect of the design (vertical) cross-section is built will depend on the needs of the business process and the purpose of the model. While building the prototype different designs can be tested within the model of the business process to evaluate the best design for the purpose, or the prototype design can be altered with the needs of the business process, which may not always be apparent at the initial requirements stage.

The prototype model needs to be designed in a way that it can provide the simulation model of the business process with information concerning the state behaviour of the data, and update the data when specific tasks within the business processes are performed. The simulation model needs to be able to receive this information and use

it in the decision-making processes that characterise simulation models. The level of abstraction therefore that this data has to be modelled at is based on whether a piece of information is known rather than the details of the information e.g. "order x has been received" rather than "order x is an order for product 1, product 6…." This is because it is the fact of whether an order has been received or not that affects the decision-making processes at the business process level and therefore the subsequent tasks that occur, rather than the contents of the order. The information system level may utilise the detail of the order to monitor inventory stocks, but at the business process level if an item is out-of-stock then it makes no difference which product it is, just how the order is then processed.

By integrating the two techniques into a single model the idea is that as the business processes occur and changes are to be made to the information system these will automatically be applied, updating the information system to reflect the current changes to status. This means that when a different process requests access to the information the updated version will be available.

In order to ascertain whether the information system is providing appropriate information, the people within the business process model have to be modelled so that they react in accordance with the information received, rather than simply following a pre-ordained sequence of tasks. If the people are modelled as naïve in this way then ascertaining whether the information system level is a valid design is simply a case of monitoring the actions of the people within the business process model.

This analysis of the limitations of the previous propositions and the subsequent refinement of the requirements of the modelling tool, and the selection of prototyping as an appropriate technique led to the refinement of the hypothesis. The resulting hypothesis, $\mathbf{H_1}$ is that by **integrating simulation modelling with information system prototyping into a single integrated dynamic model enables a full analysis of the impact of the two domains on each other, and facilitates the validation of the information systems design within the context of the business processes.**

4.4 BUILDING THE COMBINED MODEL

In order to build a combined prototype and simulation model the stages identified in section 3.2 need to be modified to incorporate the combined design. The simulation model must be written from the aspect of a naïve user, whose actions depend on the information supplied by the information system. This means that the information supplied by the prototype must exactly match the requirements of the user in order that they perform the correct task at the correct time. Similarly the actions that the users perform may alter the data within the information system, affecting the information that other users may receive. Therefore if any task affects the data then this must be recorded promptly to ensure other users do not receive incorrect information.

The requirements stages are recursive as more requirements are identified or refined during the process of building the model. Each of the models must be verified and validated to ensure that it is working correctly as an isolated model before being combined and verified and validated as a combined model. The stages within the building the combined model are shown in Figure 12. Each of the stages will be discussed in more detail.

4.4.1 Stages in Building a Combined Prototyped IS and BP Model

The initial stages of defining requirements still entails identifying the problem to be addressed and the objectives that the model is designed to achieve. As with specifying any requirements for any project, the better the requirements are understood and the clearer that they are specified, the easier it is to develop a system. This is true regardless of the nature of the project. However, the process of defining the requirements is further complicated by the necessity of identifying which information will form part of the information system and which will be modelled in the business process. It is vital that the scope of each domain is clearly mapped, and that both domains address the processes in a way that is compatible.

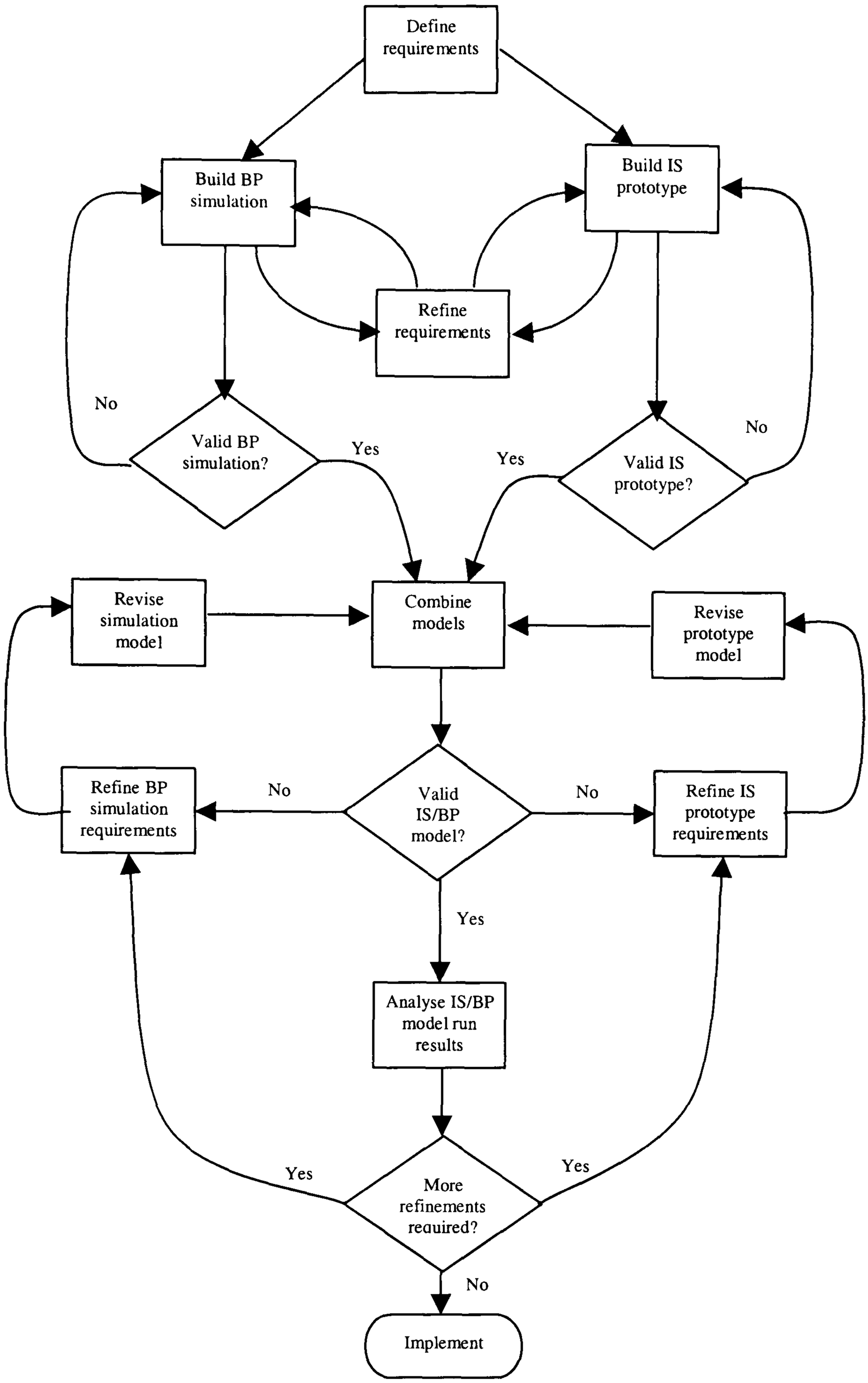

Figure 12. Framework of simulation steps in integrated model

It is important to stress that the prototyped information system will not offer the entire range of functions that the completed product would, but a vertical or horizontal cross-section of the full functionality, so careful consideration must be given to the specific objectives of the information system to decide which functions will be included within the prototyped model and which would be better incorporated into the business process model. This research does not attempt to identify how to

decide which aspects should be modelled using which technique, as this will emerge from the scope and objectives from the reasoning behind building the model. However the functions that are to be validated will have to be included within the prototyped model, while those that are more supportive in nature may be able to be included within the business process simulation, or possibly omitted entirely if their effects have no impact on the business processes. An example of this could be the security that may need to be built into the system. Although this would necessarily be included within the final product of the information system, it actually has little impact on the business process perspective, and may therefore be omitted from the prototyped model. Similarly, those aspects of the system that incorporate a time-element or are exclusively concerned with the how the process is conducted should be modelled in the simulation model, while those aspects of the system that reflect changes in status to the data should be modelled in the prototype model. However, it is likely that many of the aspects to be modelled may fall into both categories and therefore may require inclusion in both models.

At this stage ("define requirements" in Figure 12) it is necessary to identify how the simulation model will request information from the prototype and identify in what form the information will be supplied, though this is likely to be restricted by the programming interface available within the simulation package. As stated previously this may dictate which package will be used, and in which programming language the information system prototype will need to be developed. Another aspect that may affect the choice of simulation package is the system codes that can be used within the coding interface, as certain attributes about the entities of the model itself may need to be available to the information system and the ease with which this information can be passed from the simulation model to the prototype will be an important factor, especially if this information will be required each time a request is made. An example of this may be user access rights, where different users have rights depending on their status. If the security aspect of the information system is not being modelled, it does not mean that this aspect of the security can be omitted. Therefore whenever a user requests information from the system, information concerning the user status must be passed to the system, and would be required each time the user made a request.

Similarly the points at which the process interacts with the information system must be identified, and whether the process will be requesting information from the information system, or whether it will be updating information in the system. At this stage it is the communication between the model builders that is the most important aspect. This will determine the design of the models and the compatibility, which will in turn determine the accuracy of the combined model and the speed at which the results can be obtained. The better the requirements are identified, the lesser number of iterations that will be required in the refinement stages later in the process. However, as understanding of a system improves as the system is modelled, it is unlikely in the extreme that no refinements of requirements will be required later on, regardless of how detailed the initial requirements were identified.

After the requirements for each of the domains have been identified initial models can be built. Although the overall aim is to create a combined model, the two modelling techniques used mean that the two separate domains of the model can be built individually. Building the two models independently allows the modellers to utilise techniques appropriate to their particular domain, so for instance the simulation model builder may use activity cycle diagrams to build a conceptual model prior to building the computerised model, while the information system modeller may use entity-relationship modelling and data flow diagrams to design the information system, before building the limited functionality version for the model. In this way the model builders are able to use the most appropriate techniques for their particular needs. During the building of the models it is anticipated that the requirements will need to be refined as the model builders uncover ambiguities within the original requirements. Close communication between the builders of the two domains is again essential to ensure that the models remain compatible. The importance of this close communication between the model builders cannot be over-emphasised as true compatibility of the models requires that both modellers have a thorough understanding of the how both aspects of the model operate and how the integrated model will control the flow of information between the models.

When the models have been built they need to be verified and validated to ensure they work in isolation, prior to the combining stage. As the business process model relies on the outputs from the information system, it is necessary to test the model under strict conditions to verify that the model works in accordance with the

specification. Similarly for the information system, which relies on updates from the business process model to make changes to the system. This means that test scenarios need to be developed that can be used at this stage to test both domains separately. It is anticipated that during the verification and validation stages there will be more requirements that are identified, or existing ones that need more refinement, causing the models to be adapted. This build/refine/validate stage is iterative and needs repeating until the modellers are satisfied that the models are a good representation of the system.

Once the models have been built to the modeller's satisfaction then the two models need to be combined. The ease with which this can be done depends on the simulation model package code interface, and hence the importance of the choice of package and programming languages chosen for both the business process domain and the information systems domain. The prototype model is anticipated as a piece of code that can be accessed by the simulation directly from the package, so this combining stage is technically simple with the code just being placed where the simulation package can access it using the agreed request codes.

Once the two models have been combined, it is necessary to validate the model. Again, there will be changes that will be required to one or both domains, some of which may be incremental, others that will be larger. The difference between this stage and the independent model stage is that the refine requirements stage is depicted as two separate activities for the two domains. The fact that the refine requirements activities are separated does not imply that the changes in one domain will not affect the other, but encourages the design of the two domains independently to ensure that the advantages of the integrated model are not lost by focussing on a single perspective once the model is combined. It is anticipated that the majority of the time spent in building the combined model will be spent looping around the build, refine requirements and validate activities of the BP simulation, the IS prototype and the combined models.

Eventually the combined model will satisfy the model builder that it is a satisfactory representation of the system under study and the model can be run under different scenarios to test the effects of changes to the system. This may produce a need to further refine the requirements, but this stage of requirements is expected to be either very minor, or in relation to capturing data output for later analysis. The combined

model can be tested under a variety of scenarios to determine if any changes to the system to explore the limitations of the system, or how it will perform under extreme conditions.

4.5 ADVANTAGES OF THE PROPOSED FRAMEWORK

This section looks at the advantages of combining prototyping techniques with simulation modelling techniques over modelling both domains by simulation, and addresses specifically the problems highlighted in section 4.1

The main disadvantage associated with the previous integrated model was the fact that there was an inherent assumption that the information system was operating correctly. This arose from the fact that the model failed to capture the informational aspects of the information system, and instead had concentrated on the communication aspects so that it could be integrated with the computer network domain. The advantages of the new method over the previous integrated method is that by modelling the information system using prototyping techniques we are now able to capture the informational aspects which were overlooked in the previous method. By incorporating this aspect into the model we are able to model how the information is both used and updated by the business processes, and therefore how well the information system performs the task required by the business processes.

One consequence of modelling the informational aspects is that the design of the simulation model can now be made dependent on the output from the information system. This means that by monitoring the effects within the simulation model we can evaluate how well the system is functioning within the business processes, and therefore validate the design of the underlying information system. The fact that the information system design can be tested within the business process allows the problem owners to evaluate how well the design fits the requirements and modification of either the business processes or the information system design to optimise the investment, reducing the disappointments that are so often reported.

Another advantage that this integrated method has over the BP/IS linked integration approach is that the two models are modelled independently initially. This means that the design of the simulation model is at the 'normal' level of abstraction, rather than having to break individual activities down to a series of tasks that further complicates the model and which introduces scope for errors, as well as slowing down the overall

run speed. Different people employing different skills can then build the models, thereby improving the overall design and creating a more complete model quicker than a single person trying to model both the aspects in a single model. Linking the models would no longer require explicit data transference, which had caused many difficulties in the previous approaches. Instead, the models are now designed to be integrated into a single model, so any data transference between the two aspects of the model would be internal. The actual technical ease with which this can be performed will be dependent on the language interface within the simulation package chosen, but will be quicker and less prone to error than any external data transference method.

The fact that the models are created separately and then combined into a single model ensures that any changes within the either domain will automatically be reflected in the other domain, but in this case there will be no need to run more than one model, and no additional data transference. This will not only improve the overall run times, a consideration when running large-scale models, but will also reduce the introduction of errors at this stage.

4.6 SUMMARY

This chapter began by analysing the problems experienced in the linked integration model presented in chapter 3. The model failed to capture how the information supplied was used by the business processes, and had instead concentrated on the physical aspects of the information system. However, the main problem with the approach taken was that there was an underlying assumption that the information system was a valid system for the processes that it supported. This assumption, when tested, could not be considered as safe, and therefore a different approach that could capture the information aspects of the system was required.

Refining the hypothesis involved analysing the reasons that the assumption had been introduced. This revealed that there were two levels of verification and validation required in an integrated system; one of the *design* of the information system, and the other of the *model* of the information system. The linked integration approach had only considered the validation of the model rather than the design. In order to validate the design of the information system the model had to be able to capture the informational changes that occurred in the system. Therefore the requirements of the

information system modelling technique had to be altered to reflect this. A review of the information systems modelling techniques revealed that prototyping was a dynamic technique that could capture state changes within the system and could be integrated with simulation modelling techniques.

The approach was therefore altered to integrate simulation modelling with prototyping, and to this end a framework was developed. Integrating simulation modelling with prototyping offers many advantages over the two techniques separately. By integrating the two techniques the integrated model can capture all the four perspectives of the system, and so provide a more complete picture of the system under study, which would be impossible by either of the techniques independently. More importantly interactions between the two systems can be modelled and the effects of changes in one domain can be reflected in the other. By modelling the entities in the simulation as naïve and only reacting to the information they receive from the information system it is possible to validate the design of the information system within the context of the business processes, and thereby reduce the number of disappointment experienced when information systems are implemented and then found not to be aligned with the business processes.

Chapter 5: Applying the Integrated Model Framework: The E-Arbitration-T Case Study

This chapter describes the process and findings of a case study that was used to test the hypothesis. A case study was considered to be the most suitable method of testing the framework as both simulation and prototyping naturally lend themselves to this type of study, and it is an ideal way to test the theory in this thesis, that the framework described in the previous chapter can help understand the impact of IS systems in an organisational dimension. Simulation case studies have the advantage of testing the theory in the manner that it will be applied in future projects. It allows a practical assessment of how the theory is applied to a project and enables an analysis of the implications of each of the stages identified in the procedure. Simulation projects are very much practice-based and therefore the assessment procedure needs also to be practice-based if it is to be relevant to the future use of the theory.

5.1 Case Study Description

The case study presented here was part of the European Union funded project under their Information Society Technologies (IST) Programme[1]. The project title was Electronic Arbitration Tribunal: an Alternative Dispute Resolution for SME's and the objective was to *"develop and validate the regulatory structure and the dynamic and intelligent infrastructure needed to allow simple and efficient distributed process in electronic out-of court dispute settlement systems"*. The part of the project that this dissertation relates to is the design and validation of an electronic arbitration system

[1] IST-2000-25464 E-Arbitration-T was a project lead by Commercio Electronico Global (Zaeagosa, Spain) and TIGA Technologies (Paris, France) and funded by the EU IST programme from January 2000 to February 2003. The case study reported here is the work package undertaken at Brunel University as part of the International Consortium.

that could be used in international disputes. At present all international arbitration is conducted 'in person' and documents are filed through the submission of hard copies, so there is no underlying IT infrastructure that exists to be built on. The project fits the requirements of the research in that the business processes of arbitration are established and accessible, and that although there are expectations of the impact of introducing information technology, a thorough review of the full consequences of information technology on arbitration proceedings is desirable.

5.1.1 Dispute Resolution Systems

When a business transaction goes wrong causing some dispute between the participating parties, normal communication channels often fail. Full-blown court proceedings are expensive and lengthy. Small businesses often cannot afford to have their cash tied up in lengthy legal proceedings awaiting the outcome of the award, and sadly many have folded due to cash flow problems, though they may have ultimately won the case. In these instances there are other dispute resolution mechanisms that are available that are both cheaper and quicker than a full-blown court case. The most popular of these alternatives are negotiation, mediation and arbitration.

Mediation and negotiation attempt to help the parties come to a voluntary settlement with or without the help of a third party. It is becoming increasingly popular as a dispute resolution method as parties are encouraged to devise the terms of the settlement themselves and good relationships between the parties can be fostered, allowing for continued trade following the settlement. These are cheap alternatives to other dispute resolution methods, but there are some considerations that need to be taken into account before any mediation or negotiation can proceed. The parties are not bound by definite rules, and the process is a very ad hoc basis. Critically there is no compulsion to continue the process, to reach an agreement, or to fulfil the settlement terms and a reluctant party can always frustrate the process. The parties must both be in a negotiable position for this method to have any value. If either party believes itself to be obviously in the right, then they may feel that they are compromising their position to reach a compromise settlement. If both parties are convinced of the soundness of their position then this could lead to long protracted talks, possibly without any resolution at the end.

Arbitration on the other hand gives a guaranteed settlement (called an award), which is enforceable in the national courts of all major trading nations. It still relies on a private agreement but in this case the agreement is to let a third party, the arbitrator or tribunal, decide the terms of the settlement. Good business practice is to include the agreement to arbitrate as part of the original business contract before any dispute has arisen. Arbitration has stricter rules than mediation, which govern when and how the parties put forward their arguments. This is a more expensive procedure than mediation but unlike court proceedings legal representation is less frequently necessary and both parties and arbitrators can adopt working practices to keep the costs down. Arbitration also allows parties to come to a mutual early agreement that the tribunal can write into the award.

5.1.2 The Arbitration Process: An Overview

International commercial arbitration is strictly governed by the 1958 New York Convention[2], which defines the procedural requirements for it to be recognised in a national court. The UN also publishes recommended procedural rules to comply with the convention, but there are many arbitral institutions that also have their own rules and national statutes, such as the UK Arbitration Act of 1996, which define default rules for proceedings. These rules are well publicised, and vary quite considerably. Arbitration is still a time-consuming process, and typically a case will take between ten months and a year from the initiation of the arbitral proceedings. In principle the New York treaty requires that each party have an equal opportunity to present their case to a neutral party who is not involved and has no prior involvement with the dispute. Each party must know all of the case presented by the other parties and be able to comment upon the cases they present. Whatever the procedure adopted in a particular dispute it must ensure this due process and it must not be possible for one party to undermine the proceedings by non-compliance or deliberate attempts to frustrate proceedings. Every organisation that manages arbitral proceeding has clearly published rules governing the appointment of arbitrators and communication – written and verbal – between the parties and the arbitrators. As part of the E-Arbitration-T project a glossary of agreed terminology for describing arbitral

[2] United Nations Convention on the Recognition and Enforcement of Foreign Arbitral Awards (New York Convention of 1958)

proceedings in different jurisdictions was devised and the subset of that terminology used in this thesis is presented in Appendix B.

When two businesses enter into a contractual agreement the contract may or may not have an arbitration clause. If the contract contains an arbitration clause, it may be as simple as "in the event of a dispute we agree to go to arbitration", or it may stipulate the published "standard" rules under which the arbitration will be conducted, or perhaps it will specify details of the arbitral process going as far as naming the tribunal. Many arbitral institutions publish template clauses that can be incorporated into a contract.

In the event of a dispute the parties will inevitably have had some form of communication between themselves, even if it is just the aggrieved party informing the other of their complaint. The parties will probably spend some months in communication before one or both decide to take the dispute to arbitration. For the purposes of this study the party initiating the arbitration process will be known as the claimant, and the other party(ies) will be known as the respondent(s). Following this terminology there is only ever one claimant[3]; all other parties to the dispute are respondents. The claimant then submits a request to arbitrate through an arbitral institute, who review the request to confirm that it is a valid dispute, and then forward it to the respondent(s). The fact that some communication will have taken place prior to the start of the arbitration proceedings means that the respondent should never be taken by surprise by receiving a request to arbitrate.

Depending whether the terms in the contract contained an arbitration clause or not, the respondent may be allowed to accept or refuse arbitration. If the respondent refuses to arbitrate then the process finishes at this point, and the parties are free to choose alternative methods of dispute resolution. If the party accepts to go to arbitration then the arbitration process starts.

At this stage the various rule sets define the timings of events, and submissions of documents. However, whichever rule set is applied, although the official names of the documents may alter, the substantial part of the content is still roughly the same.

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[3] This is an information systems perspective that is at variance with legal practice. Where several legally independent entities agree to act jointly as claimants in a dispute the legal discussion uses the plural form claimants. However, in terms of information flows and actions they appear to be no different from a single large organisation and this thesis, as in E-Arbitration-T, uses a singular claimant.

Figure 13 and the following description give a generic view of the arbitration process, and not specific to any particular rule set.

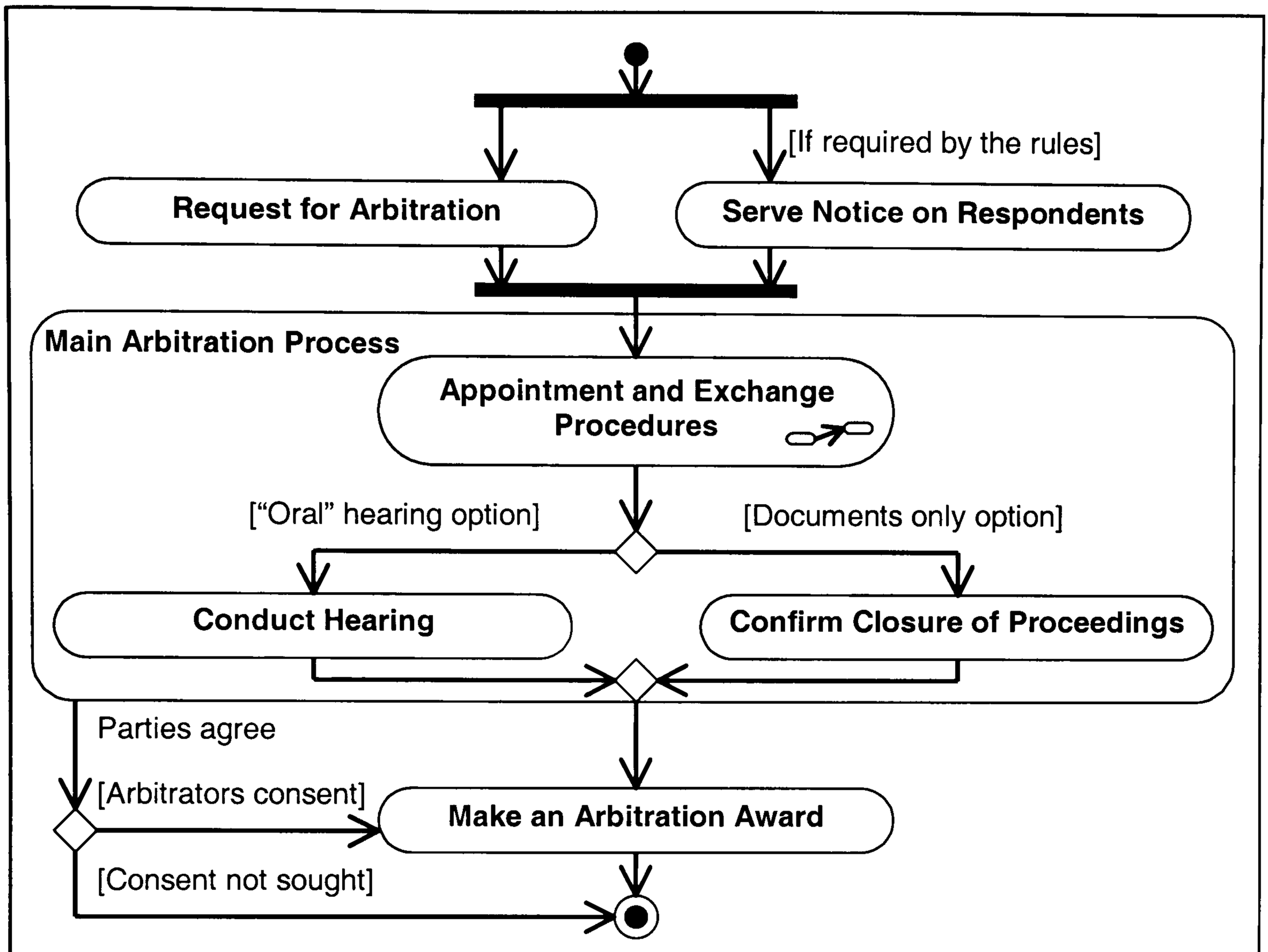


Figure 13. Overview of Arbitration Process

The process of arbitration starts when the claimant submits a Request for Arbitration to the institution. Under some rules the claimant is specifically required to simultaneously serve notice on the respondent, otherwise the institute inform the respondent of the claimant's request. The respondent then has a fixed time period to submit a formal notice to agree to arbitrate and be bound by the decision. If the respondent elects not to agree to arbitration the process is halted and the parties are free to find another method to resolve the dispute.

The main arbitration process then starts when the claimant submits a document that contains details of their claim. This claim is then forwarded to the respondent who again has a fixed time period in which to submit their defence to the claim. The respondent may also at this point submit a counterclaim. This is passed back to the claimant, who has the opportunity to make a reply to the defence and, if a counterclaim was submitted, a defence to the counterclaim. Finally if a defence to counterclaim was submitted then the respondent has an opportunity to submit a reply

to the defence to counterclaim. In cases where a prior arbitration agreement exists or the fast-track rules are being used the Request to Arbitrate may be submitted with the Statement of Claim as both parties have already signed to say that any dispute arising from the contract will be resolved through arbitration.

While this exchange of summary statements is proceeding, the tribunal will be formed. This is a complicated process and is dependent heavily on the rules and the terms stated in the original arbitration agreement. This process is discussed more fully in 5.3.3. The tribunal members each have to submit a statement of independence to the institution and parties before the institute confirms their appointment with a notice of formation distributed to all the parties and arbitrators. In general the exchange of summary statements is more lengthy than the appointment process and therefore substantive details are not exchanged until after the tribunal has been formed. In the case of fast-track rules any initial documents containing the claim and subsequent responses that the institution has already received are forwarded to the individual arbitrators.

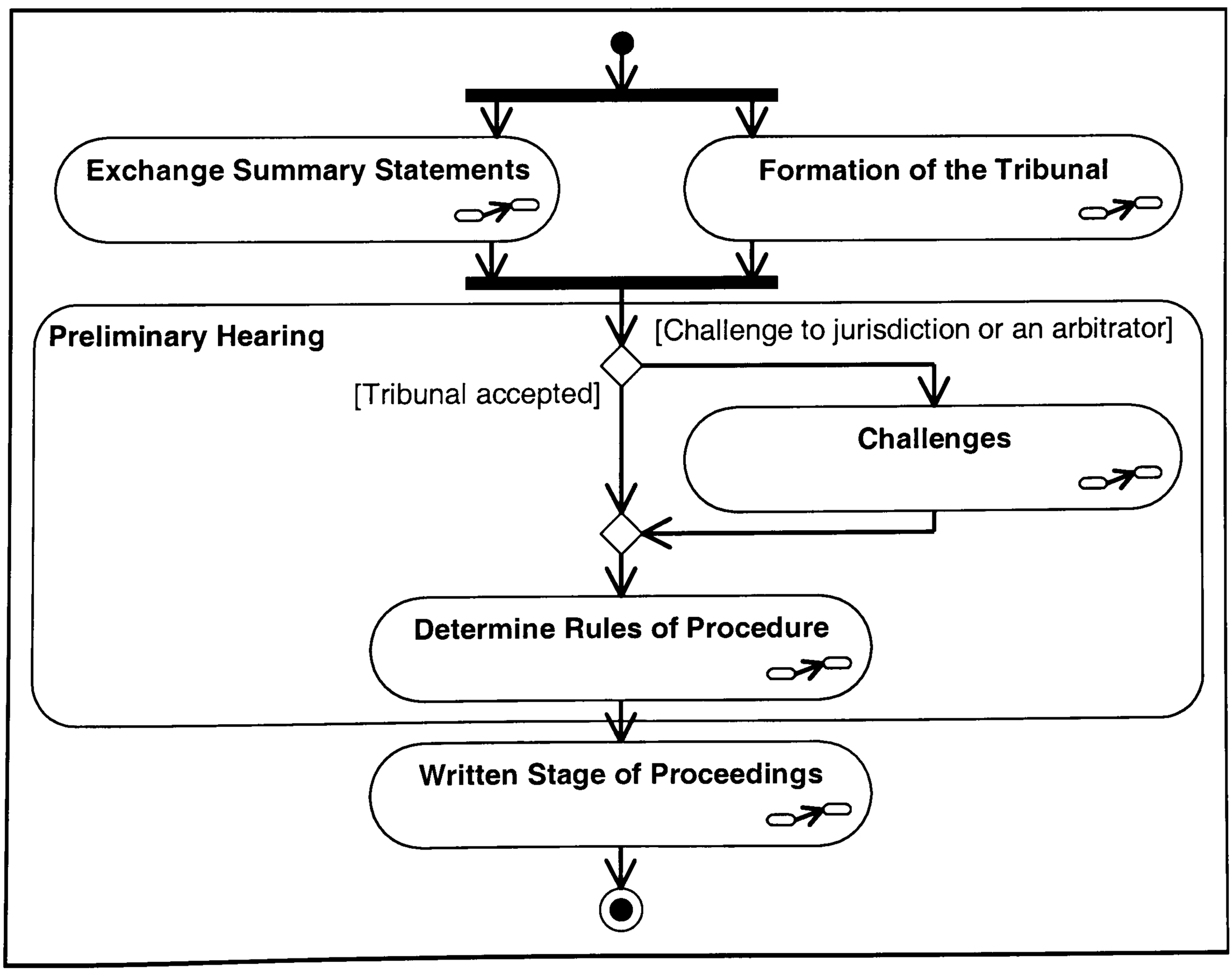


Figure 14. Appointment and Exchange Processes

When the tribunal has been formed, a preliminary hearing may be conducted. The purpose of the preliminary hearing is to set out a timetable of how the arbitral process will proceed (the initial document exchange is likely to still be proceeding). At this point the tribunal may suggest that additional specialist advisors may need to be brought in to give a report on a certain aspect, or that a site visit may be necessary, or any similar request. A provisional date for the full hearing may also be set at this point.

Once the initial document exchange process is completed, there may be another stage where additional documents are exchanged. This is seen as a separate exchange process because of the nature of the way the documents are exchanged. In the initial exchange documents are exchanged in turn, one party, then the other. In this additional document exchange the parties both submit documents to the same deadline, the institute holds the documents until both are received, then forwards them to the other party, so this process follows more of a swapping procedure. These documents will include submissions such as the party's comments on the specialist advisors report.

When all possible documents have been exchanged a hearing may take place where the parties are allowed to present their case to the arbitrators in person, after which the tribunal will discuss, between themselves, the details of the award. The arbitrators write the award, which is signed by all, and sent to the parties via the institution.

This is a basic view of the arbitration process. Much of the process described here varies with each rule set. A summary of the differences of the various rule sets and references to the particular sections can be found in Appendix A

5.2 Scope and Objectives of Study

This case study involved the design and validation of an on-line arbitration system. The system is intended to be used by arbitral institutions and SME's in both national and international disputes. It had to be a cost effective option, as well as adhering to standard rules in arbitration. There were also major security issues that had to be addressed by other parties in the consortium.

The overall aim of Brunel University's part of the project was to design an electronic arbitration system that could operate under any set of rules, provide a document management system, and give guidance to the parties on their responsibilities.

In addition to its contribution to the development of a live online arbitration service another aim of the research was to test the hypothesis that combining discrete event simulation model of the process, with a prototype of the information system, would successfully allow us to analyse the effects of the information system within the business process.

The framework was applied to the case study and two models were built, the business process simulation of the business process of arbitration, and the arbitration information system prototype. These two models were then combined to produce an integrated model. The information systems prototype part of the integrated model applies the rules to each individual case and therefore provides a document management system whereas the simulation model uses the information supplied by the information system prototype to control the actions of the people involved in the process of arbitration.

The prototype has the task of converting the rules into procedural timetables for each case and then applying them intelligently at each stage of the process. This involves determining which document is due next in the sequence, who it must be written by and when it must be submitted by. This information is requested by all the people in the simulation model throughout the arbitration process and therefore must be correct for each individual that makes the request. All the people within the process will be modelled as naïve and will only do the tasks requested of them. This means that if the person performs the correct task at the correct time, they must have been supplied with the appropriate information by the prototype system. By monitoring the actions of the humans in the system we can verify whether the information supplied by the information system is not simply correct, but timely.

This case study fits the requirements of the research very well as the expectation of introducing information technology to a paper based process is that it will accelerate the process of arbitration. By conducting the model building process in this way we are better able to align the information systems with the business processes, and may be able to suggest other ways in which the introduction of information technology

may improve the process further. Combining the simulation and prototype models it is possible to envisage how the information system will work in conjunction with the process allowing the design of the information system to be improved and validated. This is a direct consequence of the design not being simply validated, but validated *within the context* of the business processes that it will underpin.

5.3 Describing the Problem

Although arbitration rules are well established and thorough, throughout any rule set you will find qualifiers such as "unless the parties agree otherwise", which means that although the arbitration may be carried out notionally under a particular rule set, all the rules that the parties agree to adhere to may actually differ from the official rules. The reason that parties may agree to be bound by a particular set of rules and then alter individual rules is that if there is some point in the rules that was unforeseen by both parties and therefore they had no agreement on, then they are otherwise bound to abide by the official rules for that particular point. This means that any system has to be able to encompass, not only all the variations between official sets of rules, but also the individual rule changes that the parties or arbitrators choose to enforce. The system therefore must be extremely flexible, but also robust.

Within the rules used for any particular dispute, one rule cannot contradict another. This is a very demanding standard for an information system to achieve and the combinatorial complexity creates problems with the verification of the design.

Further to this the system envisaged will be able to cope with any rule set. This is of particular importance in international arbitration, because each country will have a number of standard arbitration rule sets that are frequently used. If the system could only cope with a few specified rule sets then its usefulness would be limited to those organisations that had agreed to be bound by those particular rules, cutting down its potential customer base.

Controlling the actions of the people in the process by the responses of the information system prototype does not preclude the possibility of allowing people to know what other people in the system are doing and utilising the knowledge. However in this case study the parties are necessarily unaware of the other parties and arbitrators actions. This is an accurate reflection of reality as a party will not know if the other party intends to make a submission or not until the document is

submitted, or the deadline has been reached with no submission made. Because of this, each party has an independent view of the system.

Before describing how the model was built it is necessary to look at each of the parts of the process in detail and identify the areas within each section of the process that affect the design of both the simulation model and the information system prototype, but more importantly those areas that affect the integration of the two models. Specific modelling problems for the framework are identified in descriptions of each of the processes (sections 5.3.1 to 5.3.8). These problems were discussed in detail between the model builders to identify which domain(s) the solution would be based in, and exactly how they were to be addressed, to ensure that both modellers designed compatible models. The way in which the identified problems are addressed and included into the integrated model are detailed in section 5.4.

5.3.1 The Request

This stage is started with the initial submission of the claimant. The contents and name of this document vary depending on the rule set chosen. It shall be referred to it throughout this dissertation as the "request". Some of the basic requirements included in this document will be present regardless of the rule set being used, for instance a request for arbitration, the contact details of both the claimant and the respondent, details of the arbitration agreement (if any), contractual documentation, and the nature of the dispute. Some rule sets insist that the statement of claim is stated within the request for arbitration (e.g. American Arbitration Association – AAA), while other rule sets, such as UN Commission on International Trade Law (UNCITRAL), allow the statement of claim to be made either with the request or subsequently.

Additional information supplied may be affected by the rule set chosen or the terms in the arbitration agreement. For instance under the LCIA (London Court of International Arbitration) rules if the arbitration agreement stipulates that the parties must nominate an arbitrator then the claimant's nominee is submitted with the request. The UNCITRAL rules leave the nomination as optional at this stage, while the Chartered Institute of Arbitrators (henceforth abbreviated to CIArb) rules stipulate that the claimant has an additional 14 days within which he can submit his nomination. Other possible information that may be a required or optional part of the

request may include the language that the arbitration should be conducted in, the seat of arbitration, the number of arbitrators and their qualifications. In some instances the fee for the arbitral institution must accompany the request.

Much of this additional information has no bearing on the arbitral *process* that is to be modelled, though information on whether a nomination is contained within the request will affect the initiation of the tribunal formation process and therefore needs to be known.

This document is submitted to the arbitral institute, who verify that this is a genuine request to arbitrate before forwarding the request on to the respondent party.

When the respondent receives a copy of the claimant's request to arbitrate he then has a set number of days in which to reply to the request, which again is dependent on the rule set. The response may, like the request, contain a number of pieces of information. The most fundamental part of the response will be the confirmation or denial of the claim, but it will usually include some comments on the arbitration arrangements suggested by the claimant, and the nomination of an arbitrator if this is required. This is returned to the claimant by one of the submission procedures outlined in the following section.

In terms of building the simulation model and the information system prototype several points need to be specifically addressed. The process is deemed to have started on arrival of the request at the arbitral institute. However the contents of the request document affect the list of documents that the parties are able to subsequently submit, and hence the process of arbitration. If the request contains evidence of an existing arbitration agreement between the two parties, then the respondent cannot refuse the request and the details of the agreement affect the sequence of the subsequent events. If no arbitration agreement exists the respondent may refuse the request and the process ends. Assuming that an arbitration agreement exists, it may contain information on the rule set that the dispute will be conducted under, the number of arbitrators, and even the identity of the arbitrators. Each of these impacts the process of the arbitration. This aspect of the process means that the simulation model has to prompt the information system prototype that a new case has arrived. The information system prototype then has to generate the possible case structure based on the contents of the request.

This initial submission has the effect of detailing the documents that are eligible for submission throughout the process of the case. Each possible submission document contains details of who is responsible for the submission, what conditions must be satisfied before this document can be submitted, what are the consequences of submitting this document, and the time allowed from the conditions becoming true to the submission deadline. All of this information will be unique to this particular case. The integrated model therefore has to create a unique case structure for each case based on the rule set stipulated by the parties.

The selection of a particular set of rules controls which documents are required and when they need to be submitted. The information on the tribunal affects the tribunal formation process (see section 5.3.3), but if the request contains an arbitration agreement where the members are named then the tribunal formation stage may begin immediately, otherwise this stage must be delayed until the respondent's reply to the request is received. The interactions between the simulation model and prototyped model must therefore ensure that the process is either started or delayed for the appropriate length of time depending on the details contained within the request.

The request may also contain full details of the claim. This is turn means that the respondent, instead of having to just return a response to the request has also got to submit his defence statement and, if applicable his counterclaim. This again impacts on how the integrated model controls the process of arbitration. If the request contains a full claim then the respondent has, say, 30 days in which to submit their response and possible counter-claim. If however the request does not contain full details of the claim then the respondent has to reply to the request within 15 days stating their intentions. As there are time-limits in place it is imperative that the system takes appropriate action if the limits are reached, and hence the details contained with the request in terms of both time limits and the documentation that the respondent is expected to produce.

5.3.2 Submission Procedures

The arbitration process breaks down into four basic activities: receiving written information and preparing a written response; copying and distributing documents; attending meetings (hearings) before the tribunal; and site visits or inspection of

goods by arbitrators or "experts". This section describes the submission procedures used in the copying and distribution of documents and provides a deeper analysis of them.

There are two submission processes that occur in arbitration. The first, which is the most common procedure, involves the submissions being sent directly to the parties with copies being sent simultaneously to the institute secretariat, who oversee the administration of the case. This scenario is illustrated in Figure 15. This method of distribution is used by, among others, the LCIA, UNCITRAL and CIArb.

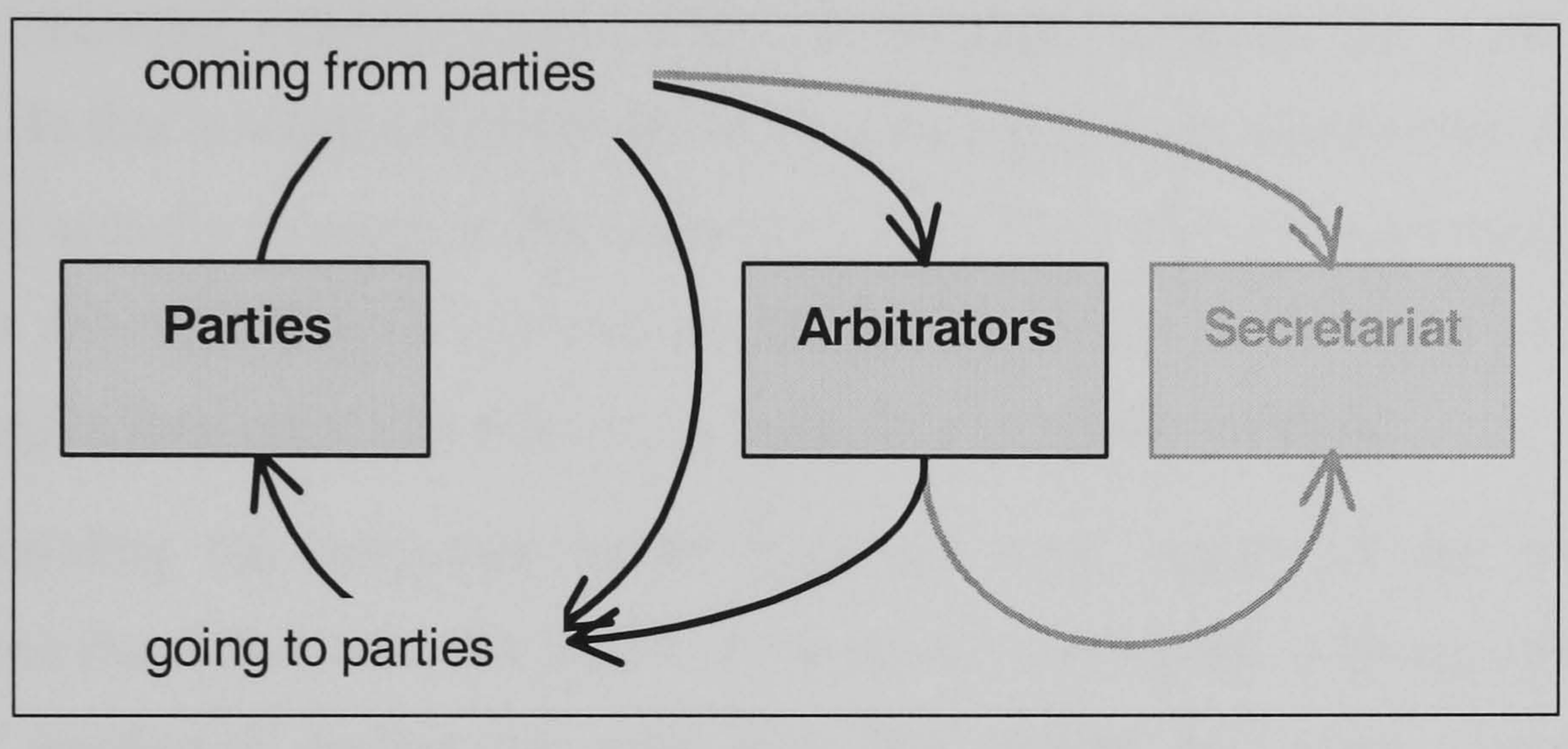


Figure 15. Direct distribution (Elliman et al., 2003)

The second option for the distribution process is illustrated in Figure 16. In this case the parties send their submissions to the institutional secretariat, generally in multiple copies, and the institution then forward the documents to the other parties at the appropriate time. This method of distribution is used by the ICC.

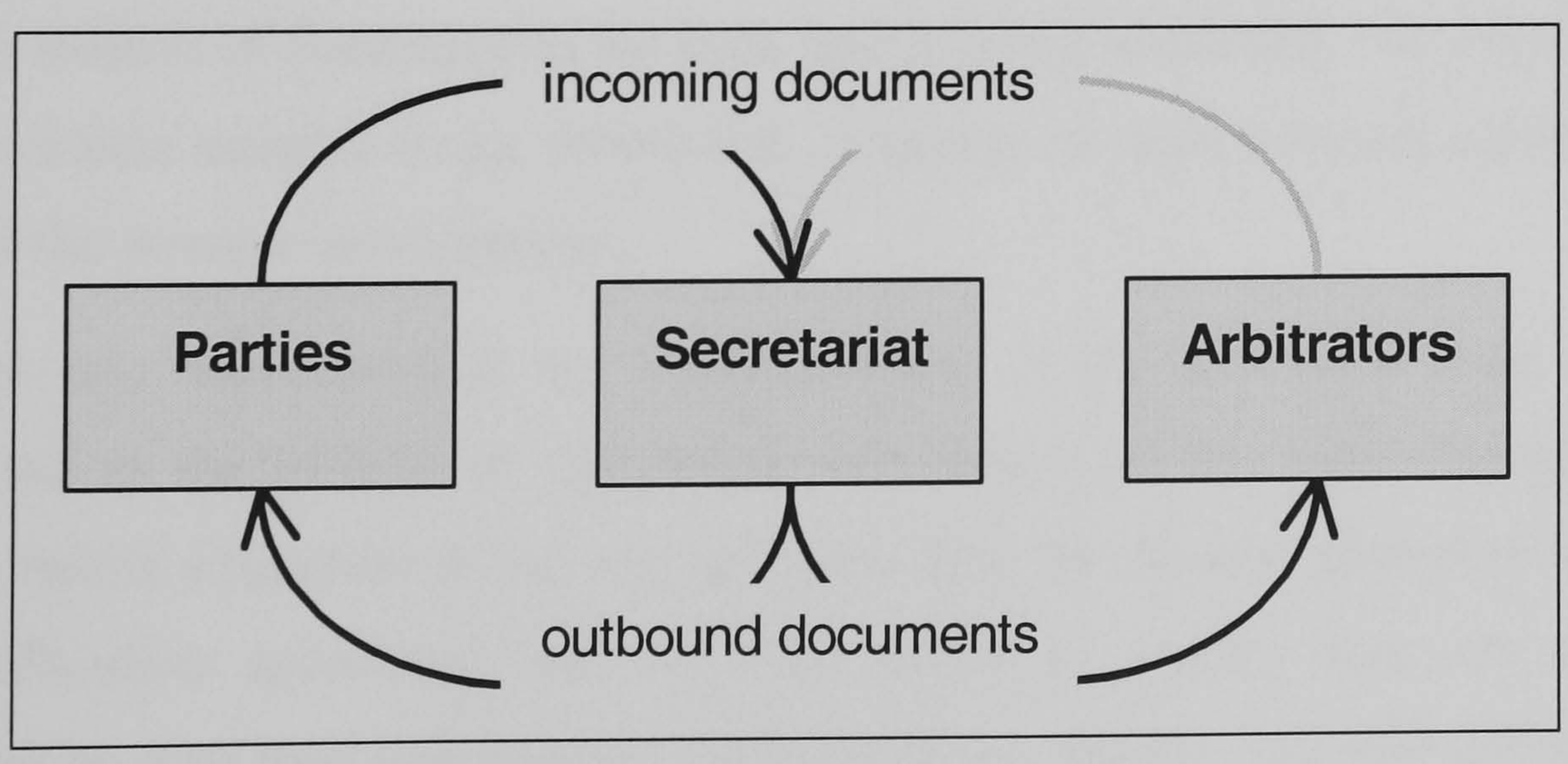


Figure 16. Managed distribution (Elliman et al., 2003)

The important difference about these methods of distribution to note is that the managed distribution adds not only additional carriage time, but also additional clerical time as the secretariat ensure that the correct documents are enclosed, in the

correct number of copies, and that they are sent on to the appropriate parties. This additional time is balanced by the fact that the institute plays a more controlling role than in the direct distribution model, where they are only able to monitor the process as it proceeds.

One other important point about submission procedures is the recording of the delivery time as this determines the moment that time limits are counted from and to. Any document submitted within the proceedings must be sent by a method that allows recording of delivery time. When a package is delivered by courier or post then the recorded delivery occurs when the package is signed for at the delivery address. So this is when it is delivered to the office post room, rather than when it the addressee actually receives it. The time limit under most rule sets is counted from the day after delivery. ICANN however counts the time limit from the day of delivery, though again they insist that delivery is made by a verifiable method.

When building the integrated model there are some aspects of the submission procedures that affect how this aspect of the model is designed. Although the dispute may be conducted on-line the rules may still require that some documents be submitted by post. For instance the award document must be distributed in hard copy to the parties and the institute, regardless of the method of transmission. Other instances may arise if a party wishes to submit a document, but support it with a physical item. This is still regarded as a single submission, even though it will arrive at the institute's office at separate times. Therefore it is imperative that we know not only the method of transmission for each article being submitted, but whether more than one article makes a single submission, implying the need for more parameters to cover all the possible permutations.

Different rule sets determine the commencement of the time limit from different points, but as the method of calculation will always be the same throughout the dispute, this is a function of the rule set rather than the dispute. However, there are other difficulties associated with the time limits. If a party does not submit a document on time then they lose their right to do so, but the case will still continue. This needs to be reflected, and the consequences of a non-submission must be executed. This requires that the list of possible documents is updated to reflect this non-submission, and therefore the simulation model must be able to prompt the information system prototype at such times. The information system prototype must

be able to distinguish between a submission and non-submission, and return appropriate information to control the subsequent actions of the users.

5.3.3 Tribunal Formation

Once the parties have agreed to resolve their dispute using arbitration, the process of electing the arbitrators to preside over the dispute starts. This part of the process may start as soon as the request is received, providing that an arbitration agreement exists between the parties, and the claimant has submitted his nomination with the request, or the arbitrators are named within the arbitration agreement. If either of these is not the case then this must wait until the respondent has submitted his agreement to arbitrate.

The tribunal formation stage is the most difficult single stage of the entire process, mainly because there are numerous points that the intended system of electing arbitrators can go awry, and other rules are then implemented to continue the process. The tribunal can consist of either a sole arbitrator or a tribunal of three arbitrators. If the tribunal consists of three members then one of the three is designated the chairman. It is his responsibility to decide any issue where there is no majority decision. He is also responsible for delivering the award to the institution.

If the tribunal consists of three arbitrators, then generally each party nominates a person to the tribunal. Then, depending on the particular rule set (e.g. UNCITRAL, CIArb), or the terms in the arbitral agreement, the two elected members of the tribunal elect a third member to act as chairman. Other rule sets (e.g. LCIA, ICC) stipulate that the institution will elect the chairman. Once a chairman is elected the institution relinquishes control of the case to him.

If the tribunal is to consist of a sole arbitrator then again, depending on the rule sets and the arbitral agreement this may be decided by the parties (UNCITRAL, ICC, CIArb) or by the institution (LCIA). If the parties have to elect a sole arbitrator then this may involve a number of lists passing to and fro between the parties until a nomination is made that both parties are content with. This process of exchange has a time limit imposed to prevent the situation where parties disagree overly long on the appointment. If they fail to agree by this time limit then the institution will appoint an arbitrator to oversee the case. Again, once a sole arbitrator is elected then the institution relinquishes control of the case to him.

Any elected arbitrators have to then issue a statement of independence confirming that they will be impartial adjudicators in the case, and disclose connections that may give rise to justifiable doubts on their ability to judge the particular case. The parties have a right to challenge the appointment, but this challenge must be made as soon as possible after appointment (usually within 15 days).

The sequencing of events in this stage is heavily dependent on the contents of the request to arbitrate. This means that the integrated model needs to be able to recall the details of the case and correctly implement the process of tribunal formation.

If the request contained an arbitration clause that identified the tribunal members then the institute can immediately contact the nominees and request that they arbitrate the dispute.

If the arbitration clause stipulates that three arbitrators are required and that each party will nominate a single arbitrator, and the request document contains the claimant's nomination then the institute can immediately contact the nominee to request that he arbitrate the dispute. However, this stage then pauses until the respondent's choice of arbitrator is indicated in his statement of defence.

If the arbitration clause stipulates that there will be a sole arbitrator to oversee the proceedings then the appointment process must be delayed until the claimant and respondent have agreed on a suitable candidate, or the time limit dictated by the rules has expired.

It must also be remembered that a nominated arbitrator may refuse to act on a case, or that the parties challenge the jurisdiction of the appointed arbitrators. At this point special rules, detailed in the respective institutional rules, are enforced to continue the appointment process.

5.3.4 Preliminary Hearing

The preliminary hearing, if it occurs, may take place at a number of points within the proceedings. When it occurs is generally dependent on both the rule sets and the arbitrators' preferences. The content of the preliminary hearing will therefore vary depending at what stage in the process it occurs. Whatever stage the hearing occurs, most rule sets stipulate that the parties must have at least two weeks notice between formal notification and the hearing.

If the preliminary hearing occurs before all the initial documents have been exchanged the purpose of the meeting will generally be to propose a terms of reference that will be in effect for the remainder of the process. This will include a provisional timetable of the process stating such facts as when documents should be submitted and approximately when a full hearing may occur, and the subsequent award issued. The preliminary hearing may well be conducted as a telephone conference call if there are not many issues to be agreed and the parties and arbitrators are geographically distant.

If the preliminary hearing occurs after the initial exchange of documents this offers the arbitrators an opportunity to look at the facts of the case, and determine if they require more information from either or both the parties, and issue deadlines by which they must be produced. It also allows the arbitrators to decide if a site visit by a neutral expert is required and arrange a suitable time for this to occur. Holding the preliminary hearing earlier does not prevent either of these happening, but the arbitrators may feel in a better position to make decisions having read all the initial facts of the case.

Whenever the preliminary hearing occurs, a record of the hearing, containing a timetable or the terms of reference will be produced by the tribunal and sent to the parties.

The problems in the design of the integrated model for both the preliminary and main hearing part of the process are virtually identical. These will be explained more fully in section 5.3.7.

5.3.5 Initial Document Exchange

The initial document exchange begins when the claimant submits the full statement of claim. This may be included with the initial request, or it may follow the issuing of the terms of reference that are produced as a consequence of the preliminary hearing. This initiates a document exchange process where alternate parties write documents as shown in Figure 17.

When the respondent receives the statement of claim, he then has the opportunity to write a full defence to the claim. This must be submitted with the time limit to be considered. Under most rule sets if the respondent wishes to issue a counter-claim against the claimant it must also be included within his defence, though at the

arbitrators' discretion they may be submitted later. Usually, if a respondent does not submit a defence, or state that his intention is to do so, at this point then he loses his right to submit any counter-claim.

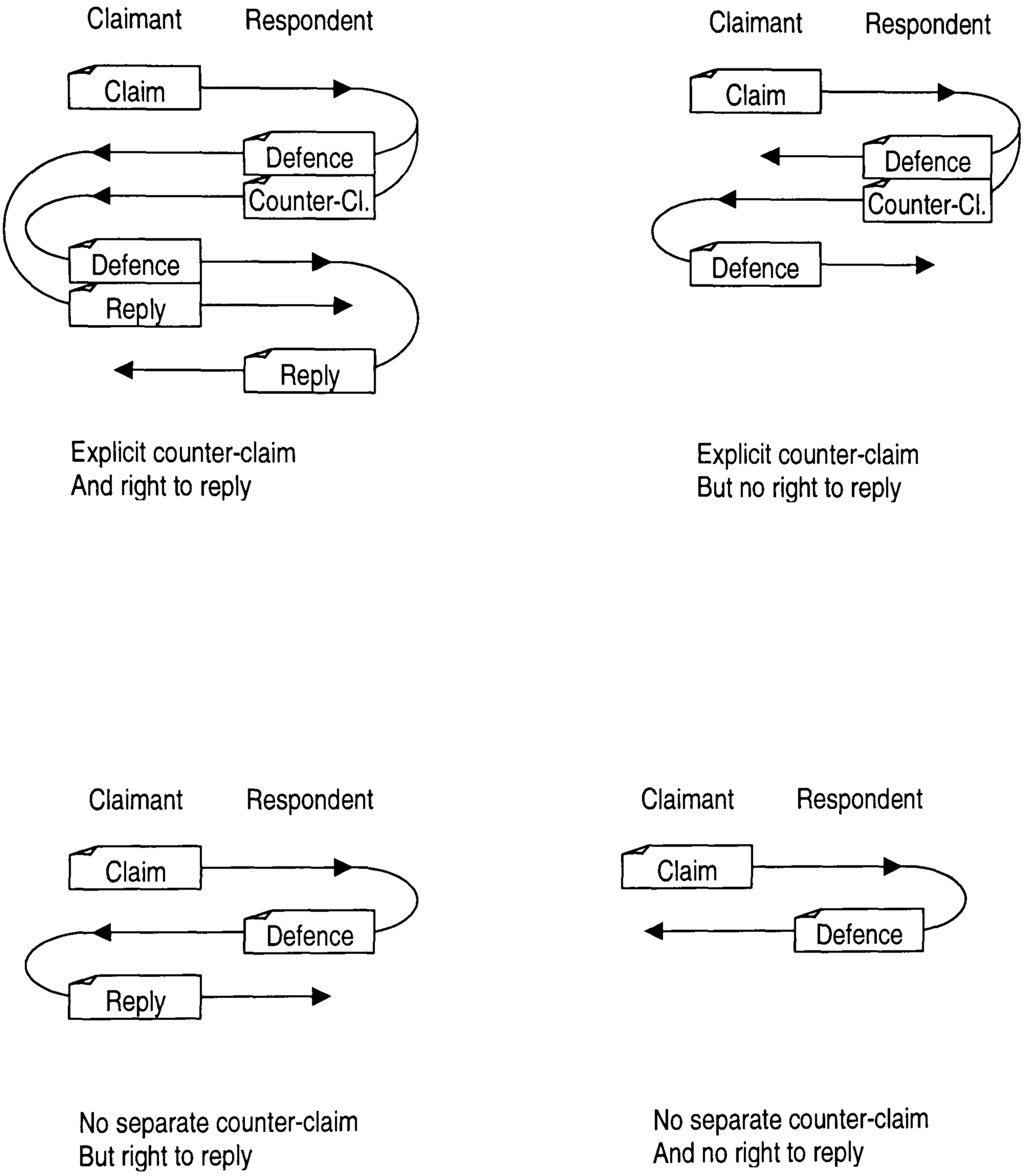


Figure 17. Initial document exchange (Elliman et al., 2003)

If the rule sets allow, then the claimant may then submit a reply to the defence to claim, and if a counter-claim has been made against him then he may submit a defence to the counter-claim. Finally the respondent gets the opportunity to submit a reply to the defence to counter-claim if appropriate. Again all documents must be submitted within the stipulated time limits to be considered.

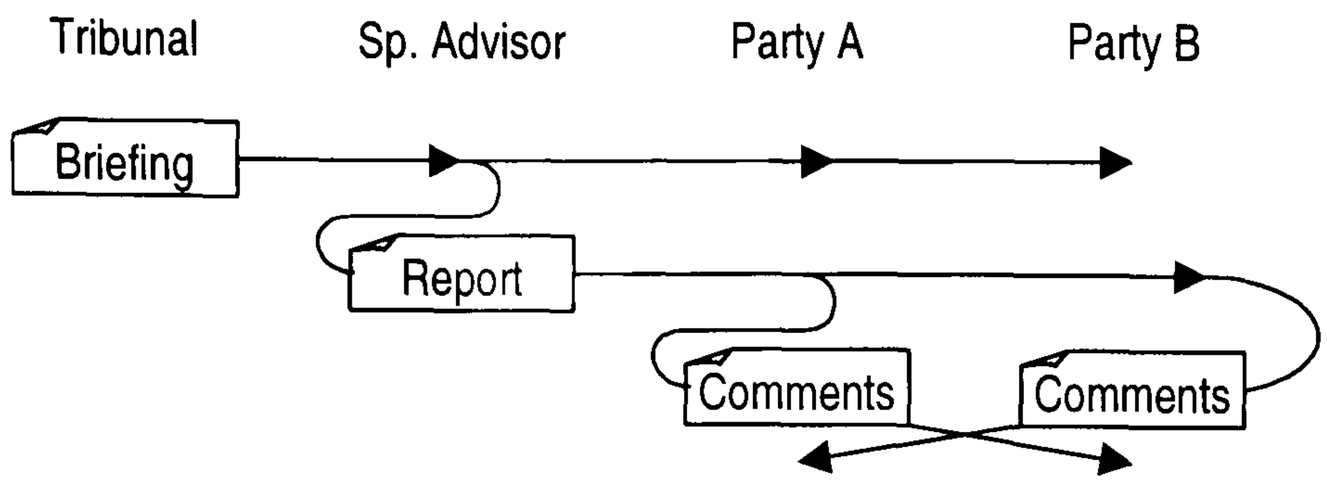
In terms of designing the integrated model, the main problem occurring with the document exchange concerns the grouping of documents for submission purposes.

Different rule sets require that different documents must or may be submitted together. This means that varying numbers of documents may be submitted at one time, some of which will also have to be distributed together. So the documents required to be submitted and distributed together remain together through processing, but those documents that are submitted together, but may have different dispatch criteria are dealt with independently. Adding to this problem is the problem that non-submissions also affect the number of documents that are expected at the institutional secretariat. This means that the information system prototype has to correctly identify the bundles in which documents need to be submitted and distributed, while the simulation model has to control the grouping of the documents into the appropriate bundle.

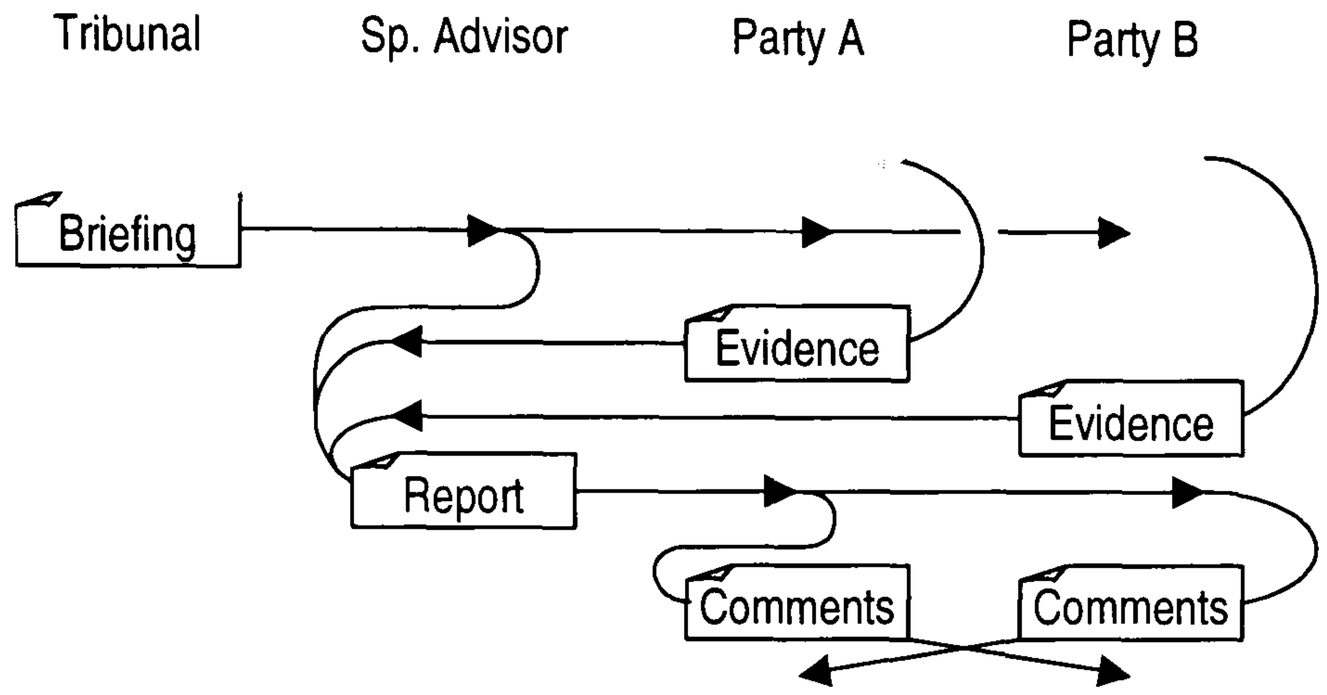
5.3.6 Additional Document Exchange

This part of the process may or may not appear in the procedure. The documents that it refers to are any documents that are requested by the arbitrator. They include documents such as the reports from neutral experts on site visits, or specialist advisors reports on, say, a technical matter. The difference between the additional document exchange and the initial document exchange is in the way the parties write and exchange documents. Whereas in the initial document exchange process the parties took it in turns to write documents, in this additional documents exchange process the parties write their documents simultaneously, then when both documents have been received they are passed to the other party. This is illustrated in Figure 18

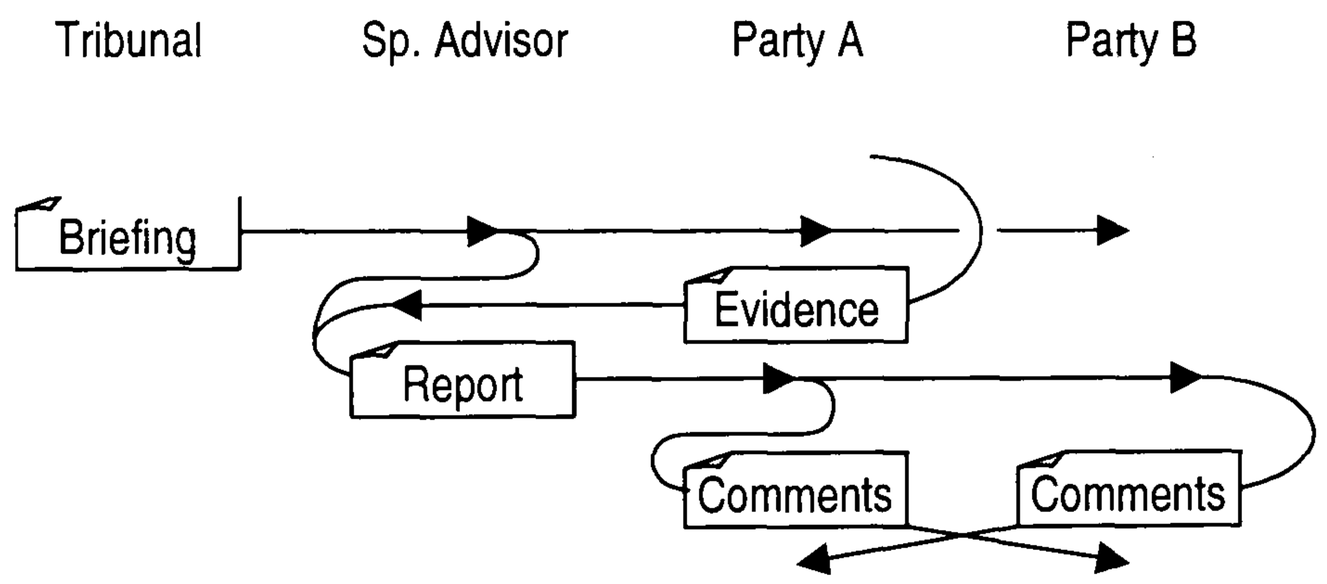
For instance, the parties should receive the specialist advisors reports at roughly the same time – this will obviously depend on carriage times – and both will be allowed the full time limit to submit their comments on the report. When the comments on the report are completed they are submitted to the institution, who then wait until both copies are received before distribution. The reason for this is that if one party returned their comments before the deadline and it was immediately forwarded to the other party, the second party would gain an advantage by knowing the contents of the document before he had made his own submission. This is obviously not an acceptable situation.



Specialist advisor to consider documents already submitted



Specialist advisor to consider evidence from all parties



Specialist advisor to consider evidence from just one party

Figure 18 Additional document exchange (Elliman et al., 2003)

The main problem with the design of the integrated model associated with this stage of the proceedings is in the identification of which documents belong to which stage of the dispute and therefore altering the document exchange rules to ensure that documents are distributed in the correct way. The identification of the end of a stage is linked to the production of a particular document. However, documents are not always delivered in the same order that they are produced, so more complex rules surrounding the completion of the various stages are required for the model.

Non-submission of documents affects the overall number of documents that are expected at the secretariat, and therefore when designing the model, the simulation model needs to be able to identify the fact that an expected document has not been submitted, prompt the information system prototype to update the case details to reflect the non-submission, and then re-calculate the number of items expected in the affected submission and distribution bundles.

5.3.7 Main Hearing

There are some rules that are expedited by being documents only processes (e.g. CIArb Short Form rules – CIArb SF) and do not have hearings. Generally though, after all the documents have been exchanged a main hearing takes place. This is the only opportunity that the parties have to present their case directly to the arbitrators. Again most rule sets stipulate that the parties must be give reasonable notice of when and where the hearing will take place, however generally the arbitrators will consult the parties to arrange a mutually agreeable time if possible. A report on the hearing is then submitted by the arbitrators to the parties.

The problems identified within the hearings of the dispute were concerned with setting the dates. Firstly the date chosen has to be when all participants to the dispute could attend, and in a suitable time frame. The date for the main hearing would usually be determined around the time of the preliminary hearing, so a prediction of how long the document exchange process would take was required. This was, as in reality, only an estimation, but was used as the starting point for identifying a suitable date. The various participant's diaries were then examined to find the first available date that would suit all participants taking into account travelling times to and from the hearing if necessary. The rules stipulate that the parties must have two weeks notice of the hearing before it occurs, so if the estimated date of the close of the document stage was too optimistic the proposed date may be inappropriate and would have to be re-arranged. Once a hearing date was determined, then the participants have to ensure that they leave on the appropriate day to allow travel to the hearing, suspending all other tasks until their return.

5.3.8 Award

After the main hearing has occurred, the arbitrators write the final award. In the case where there are three arbitrators then all members co-operate in writing the award.

When it is completed all three arbitrators must sign it. This is a legally enforceable document that the parties have agreed to be bound by, by accepting the terms of arbitration.

The problems associated with the award really refer to any documents written by a tribunal of three arbitrators. In reality, all the arbitrators would have input into any tribunal document, although a single arbitrator may actually be responsible for the actual writing of the document. Whoever composes the document will show it to the other arbitrators for approval, before the chairman submits it. This means that although the three arbitrators work on the same document in the same time frame, they are not all working on it simultaneously.

5.4 Building the Simulation Model

The above case study was modelled using the framework described in chapter 4. Each stage of the framework is described in terms of how it was applied to this particular case.

5.4.1 Defining Requirements Stage

The purpose of the model was to illustrate the way in which electronic arbitration would impact the business processes and through this analyse the benefits of bringing the arbitration process to the electronic age. As arbitration can be conducted under a variety of rules the analysis stage would also be required to take into account the differences within the rule sets. In order to do this it was agreed that there were too many rule sets – potentially an infinite number – to create separate models for each case and therefore a generic model should be built that could read in different rules and then operate using that particular rule set. This would also allow the rules to be altered in individual cases as demanded by all the major arbitration councils and rules.

The information system was to provide a document management system that provided users with guidance on their individual responsibilities. In order to check that the functionality of the information system was correct the model would have to be designed so that the users of the system would only react to the specific information received from the information system, rather than from any other source.

The problems identified in the previous sections (5.3.1 to 5.3.8) were also discussed, between the model builders, in detail, to establish how the specific problems would be tackled and to identify which domain the solution would be based in, the information system prototype or the business process simulation, or indeed as many of the problems required, in both domains. Some of the problems such as the process of tribunal formation fall entirely within the simulation model. Although the rules to be used for the formation process are contained within the case structure held in the information system, the application of the rules to control the process of formation is within the domain of the simulation model. The simulation model therefore controls how the process is executed, and will vary on a case-by-case basis depending on the rules applied, but once applied the same process will be followed regardless of any subsequent changes to the status of the case caused by other on-going activities. Other aspects of the case, such as the contents of the request document are dealt with entirely by the prototype model. In this instance the contents of the request contains information that determines the way in which the rest of the rules will be applied to this case, indirectly affecting the process. However, the process itself is not affected at the time of submitting the request, and therefore the contents of the request fall entirely within the information systems domain. The third type of problems comprise of the integration of the two models, such as the control of submission and delivery of documents. In this instance the information system provides the simulation model with regular information concerning the status of the case, changing the process flow based on the information received. The majority of the problems identified fall into this category.

These problems where the solution lies in the combination of the domains needed to be discussed more fully to establish specifically how the integration would operate at these points. For example the control of the submission of documents; the number of documents to be submitted at any particular point is information contained within the information system, as it is based on both the rules, the particular pattern of document submissions and the particular documents themselves. The simulation model has to ensure that the correct number of documents is received before passing them on to the next stage of the process. Careful consideration had to be given as to how this part of the process would be handled for each possible submission scenario, for instance if a document is not submitted on time, or if a single submission consists

of both an electronic and postal component. Both the IS prototype modeller and the simulation modeller had to be clear on what information would be returned from the information system and how the information could be utilised to ensure correct procedure in every case.

Table 4 shows each of the problems identified in the previous sections and indicates which domain will be used to address the problem. From the table it can be seen that many of the solutions to the problems require the interactions of both the business process domain and the information systems domain and this very identification of the problem areas reinforces the belief that information systems and business processes are so intertwined that they should be viewed together, and therefore modelled together.

		IS	BP
Request	Contents of request	✓	
	Contents of arbitration agreement	✓	✓
	Rule sets	✓	
	Details of documents	✓	
Submission	Method of submission	✓	
	Submission process		✓
	Time counted from	✓	✓
Tribunal formation	Contents of Tribunal formation agreement	✓	
	Process associated with formation		✓
	Non- acceptance of position		✓
Document exchanges	Control of submission and delivery of documents	✓	✓
	Status changes of documents	✓	✓
	Contents of documents	✓	
	Deadline dates	✓	✓
Hearings	Setting hearing dates	✓	
	Ensuring attendance		✓
Award	Collaborative work	✓	✓

Table 4. Problems identified with their respective domain of solution

For the simulation to be used to compare both on-line and traditional methods of arbitration it is necessary to determine whether the case is being conducted electronically. This would not be necessary in the 'real' system, as only cases being conducted electronically would be using the system. However, this needs to be specified in the model as it affects the date that the submission has to be despatched in order to arrive at its destination by the submission date, thus affecting the timings within the business processes.

Simulation Model: The simulation model was designed from the users perspective. To achieve this different entity types had to be defined. The entities that flow through the process are documents and these control the various sub-processes within the system. However, the users are also modelled as entities, rather than resources. This allows better control and ensures that particular users are uniquely identified and select specific tasks rather than using a pool of similar resources. This means that a particular entity is associated with a particular case, and only that entity may collect or write that specific document. This meant that five distinct entity types needed to be identified; Claimant, Respondent, Arbitrator, Expert, and Document. The institutional secretariat was modelled as a resource, as any member of the team could deal with any incoming case and therefore did not need to be uniquely identified. The document entities flow through the process from one user to another as the simulation model runs. Each time a user receives a document or notice, or completes a task they enquire from the information system what their responsibilities are now. The response dictates their subsequent actions, which may be to write a document, attend a meeting, or do nothing. Each time a user completes a task such as submitting a document another signal needs to be sent to the information system to update the status of the case.

Information System Prototype: The information system prototype had to be able to interpret different rule sets logically. For instance certain documents can only be submitted if other documents have already been submitted, e.g. a defence to counter-claim cannot be submitted if a counter-claim has not already been submitted, so patterns of possible documents submissions are applied to different rule sets. However, as parties are able to alter rules in any way, providing that all parties to the dispute agree, the information system must intelligently apply the parties chosen set of rules. The prototype was to be designed such that it would read in a set of rules, and set standard variables accordingly, thus allowing the flexibility required.

Variables that would be set in this way included

- Identification of the moment of time that time-limits would be counted from
- Standard number of days for document submission
- Time restrictions in appointment process and appointment strategies
- Possible document patterns

- Default number of arbitrators
- Default meeting arrangements and timings
- Time restrictions for challenges
- Names of documents

Integration Requirements: For the purposes of integration a large set of user codes were created which would be called from the simulation model to indicate that an action had occurred, or a piece of data was requested. The user codes defined had a limited set of integer values that would be returned to the simulation model and could be interpreted into the action that the users would then be required to take.

Each time the simulation model submits a request to the information system certain information would be required by the information system to identify the user requesting the information to ensure that they receive the correct details. In reality this stage would be completed when the user 'logged in' to the system by entering their username and password. In the case of arbitrators who may be involved in more than one case at a time they would also be required to select the case that they were making an enquiry about. For the purposes of the simulation this information is stored as attribute values in the entity and is automatically passed to the information system when a request is made. Similarly, as many of the responses are affected by time, the current simulation time is also passed to the information system.

The interaction between the two models is shown in Figure 19. Each time a document arrives at either the secretariat, or the parties, arbitrators, or experts either finish reading or writing a document, a signal is sent from the simulation model to the IS prototype. This signal allows the IS prototype to identify who has received the document, and through the access role data structure, identify the dispute to which they belong, and the their personal perspective of the case. The IS prototype then updates the case structure to reflect the event that triggered the signal, and returns information to the user informing them of whether they are due to start writing a document, to attend a meeting or do nothing at the current time. This information is then used to control the person's actions within the simulation model.

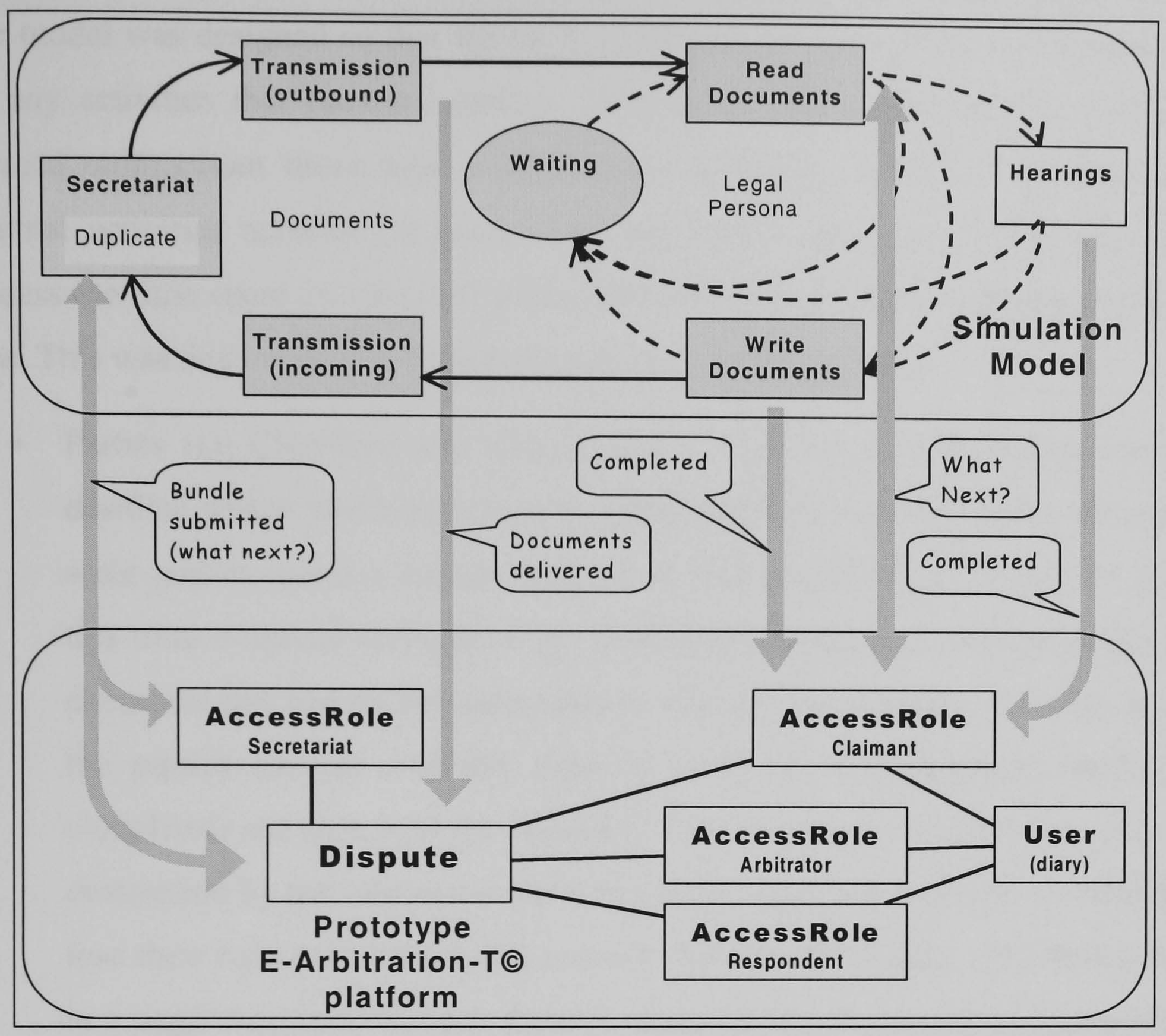


Figure 19. Interaction between Simulation Model and IS prototype (Elliman and Eatock, 2002)

Similarly, documents can also trigger signals to be sent to the IS prototype. This is used for recording when documents arrive at the parties' addresses, or the institution. These are necessary as time limits are calculated from the time that the document is delivered, rather than when the party reads the document. In this case the signal directly accesses the dispute data structure, and updates the state of the case to indicate that a recorded delivery has arrived. This is not used to directly control the simulation model. However, any user that then accesses the system after this event therefore receives an updated status of the case, and their actions are controlled by the response.

5.4.2 Building the Models

Simulation Model: The model was built using the simulation package Arena. This particular package was chosen because it has an interface that accepts code written in Visual Basic, and allowed access to various simulation-controlled attributes that could be used to assist the integration process.

The model was designed so that the users performed their tasks in a cyclic manner. As any activities that occurred outside the scope of the arbitration process were deemed unimportant these were not modelled explicitly. However because these external activities account for users time that cannot be spent in the arbitration process the time spent on other activities had to be reduced from the users available time. This was dealt with in different ways depending on the user.

- Parties (i.e Claimants and Respondents) – in this case the parties have a deadline within which they have to submit their documents. Within this time-scale parties spend a certain amount of time preparing the document. How this time is spread throughout the time-span is irrelevant, providing that the document has had its full allocation of time by the deadline. To achieve this the parties use all available time to work on the document until it is completed, and then hold the document until it needs to be posted to reach its destination by the submission date. If parties miss their submission dates they lose their right to submit that document. Parties will usually only be involved in a single case and therefore there is no real issues of priority of documents.

- Neutrals (Arbitrators and Experts) on the other hand have no deadlines and therefore this approach will not be effective for them. In this case the neutrals spend a certain amount of time working on a document and submit it as soon as it's ready. To account for the fact that most neutrals also have full-time employment outside the scope of the model the available hours that the neutral is able to work each day is significantly reduced. To ensure that documents are completed in terms of priority, each document has an 'expected submission' date, and this is used to determine the urgency of the document. If neutrals miss the expected submission date then the case is simply prolonged by this time period.

All users were modelled in a similar cyclic manner; every day they check to see if there is any new mail, then read their mail and check to see if they have any new tasks to complete as a result of receiving this mail, if there are new tasks to complete their task list is updated. Next the users select the highest priority task on their list and begin working on it. They continue working on it until either they complete the task, they have worked the maximum number of hours allocated for that day, or they are scheduled to leave for a meeting. If they complete the task then they re-check

their task list to see if any more tasks are waiting to be completed, and pick up the next highest priority task to begin working on. If they leave for a meeting then the task returns to queue of documents waiting to be completed, and the user travels to the meeting if it is in person, or logs on if the meeting is to be held electronically. If the user has reached the end of the allocated working hours for that day then the task returns to the queue of documents to be completed and the users waits until the following day to repeat the cycle.

As neutrals may be working on more than a single case at a time, and more importantly in a different capacity in each case, it was necessary to identify both the individual neutral and the role that they were performing in this case, while still ensuring that work on the highest priority task, regardless of role. This was achieved by creating a file entity for each neutral role within a case, and relating the file entity to particular neutral entities on a many-to-one basis.

Prototype Model: The prototype was built using Visual Basic, as this was the language that was readily imported into the simulation model. As the idea was simply to confirm the design was valid rather than build a portion of the finished product, the choice of language was not overly significant.

The prototype was designed in such a way that any information supplied would be based on the role that the individual would play within the case. This was done because the same user could be involved in a number of disputes, in a different role. Whenever a signal is sent to the information system, information concerning the user and the case and are simultaneously passed to the information system.

The basic classes within the dispute record system consist of data about the dispute itself, the participants, the document catalogue, and the rules. These are used to support the basic document management and hearing functions. There are four basic document management functions that need to be supported; Set up a new case, modify rules, submit a document(s), and deliver a document(s), and two hearing functions; schedule a hearing and record a hearing.

The *new case* function occurs whenever the institute receives the request from the claimant. At this point a default set of rules is applied and a case structure generated that includes all possible submissions for the case. Each user in the case is then allocated a task list based on the case structure and their role. All other information

supplied by or to the information system uses this case structure and the user task list and therefore these form the core of the information system. It is important that the case structure and task list are kept up-to-date if the information system is to provide timely and accurate information and therefore are frequently updated throughout the arbitration process to reflect the current status of the case

The *Modify rules* function may be invoked by the tribunal if they wish to modify any of the rules. This may result in the case structure being altered, and consequently the individual users task lists being updated.

The *submit* and *deliver a document* functions are the most often used and record that a document has been submitted to the secretariat, or delivered to a party or arbitrator. Both functions involve the case structure being updated to reflect the contents of the documents and therefore the possible documents that may be generated as a consequence of this submission, and the deletion of those that become invalid, for instance if a defence to claim did not also have a counter-claim, then the system would update the case structure with this information, preventing the inclusion of any document that is a direct consequence of the counter-claim, such as defence to counter-claim. The user task lists are also updated to reflect the users current task profile.

The *schedule a hearing* function uses the case structure to determine the approximate time scale of a future hearing, and then sets a date that all parties are free after the approximate date. The *record hearing* is invoked at the end of a hearing and used to update the case structure and the user task lists, keeping the document management system up-to-date with the current status of the case.

Using these data structures and functions meant that the information system could easily respond to the requests of the simulation model when the individual users would ask "What next?" and the answer supplied would be either write a document (along with the information about the document that was to be written), attend a meeting (along with information about when and where the meeting would be held), or simply that there was no current task for this user.

5.4.3 Refine Requirements/Validate Models

As the models were being built further refinement of the requirements were performed. Some alterations would affect a single domain, whereas other alterations

would affect the integration of both the domains. During this time many more user functions were added. This process of building the model and refining it greatly improves the model builders understanding of the system and how all the activities within the process interact with each other. One example of the refinements that were made at this stage concerned the distribution of documents between the parties and arbitrators. All the rules state that all documents must be sent to all parties in the case, and this was therefore anticipated as being simple to model. However as the model was built it became apparent that the number of copies to be dispatched was not simply one less than the number of participants in the case (the sender doesn't need a copy). One instance where the number of copies will differ is when the parties are negotiating who the sole arbitrator will be, copies will be sent to the other party, but the when arbitrator is appointed he will not receive copies of the negotiations that preceded his appointment. Simply incrementing the number of participants in the case as arbitrators are appointed fails to overcome this problem as any documents submitted prior to the appointment that form a part of the proceedings e.g. the request need to be copied and sent to the arbitrator. This therefore led to a refinement in the calculation of how many copies were made and to whom they were sent. The refinement meant changes to both the information system prototype and the simulation model as the information about whom the documents were sent to was included in the information on the case structure while the simulation model controlled the distribution aspect.

Although this problem could easily have been overcome with changes made simply to the simulation model, it is important to note that changes had to be made to both aspects of the model. The information about how many copies were made and to whom they were sent, is information that is required by the planned information system, and therefore needs to be included in the prototyped model to ensure that the prototype (and the subsequent system) always supplies the correct number of copies to the correct people. If this aspect had been corrected simply within the simulation model, this requirement would not have been able to be validated within the system.

Each of the models was validated to ensure that they performed as expected. In order to validate the individual models test data was developed that could test the workings of the models under specific conditions. As the simulation model was designed to receive data from the information system, this data had to be included in the test data

to determine what action would be taken given a specific response. In this way the simulation model could be validated that it would perform a particular action given a particular response. Cases were generated where the responses from the information system were input into the model and the output of the model analysed to determine whether the correct document flow and timings had occurred. To validate the information system a case generator module was created that allowed the generation of cases to a specific profile. These were fed into the information system and the resulting case structure, task lists and timings were examined to determine their accuracy.

The refine requirements, build simulation/prototype, and validate model stages were repeated many times. The stages become so closely entwined that in reality they are not seen as three separate stages, but are to all intents and purposes a single stage, in which two validated models are produced.

As the models are to be combined, and it is anticipated that more alterations will be required it is not necessary at this point to produce a perfect model of either system. It is necessary to be sure though that the models are returning valid results, so that any discrepancy between the expected results and the actual results following the combining of the models is due to interactions between the models and not the individual models themselves.

5.4.4 Combine Models and Validate IS/BP Model

When the two models were working sufficiently well, they had to be combined. This task was technically simple because the prototype model had been designed using visual basic that the simulation package could interpret. The technical aspect of the integration was therefore just to place the code where it could be accessed by the simulation package. Comparing this stage with the previous propositions illustrates the technical simplicity of the integration. In the previous examples one model was run and the results collated and then manually transferred from one model to the other, then the second model was run using these results. The new integration framework allows the two models to be fully combined into a single model and each use the information supplied by the other during the running of the integrated model.

Once the models had been combined the combined model was run. Running the combined model simply involved running the simulation model. Whenever the

simulation model had to make an enquiry to the information system, it would call the particular user function, which would run the appropriate function within the visual basic code and return a value that could be interpreted by the simulation model into an action.

To verify and validate the model we needed to produce cases with particular attributes so that different aspects of the model could be tested. To generate cases with specified profiles a case generator module (see Figure 20) was developed. This allowed attributes to be set to specified values or allowed percentage values to be entered to produce the variety of cases that would be required for the testing of the model.

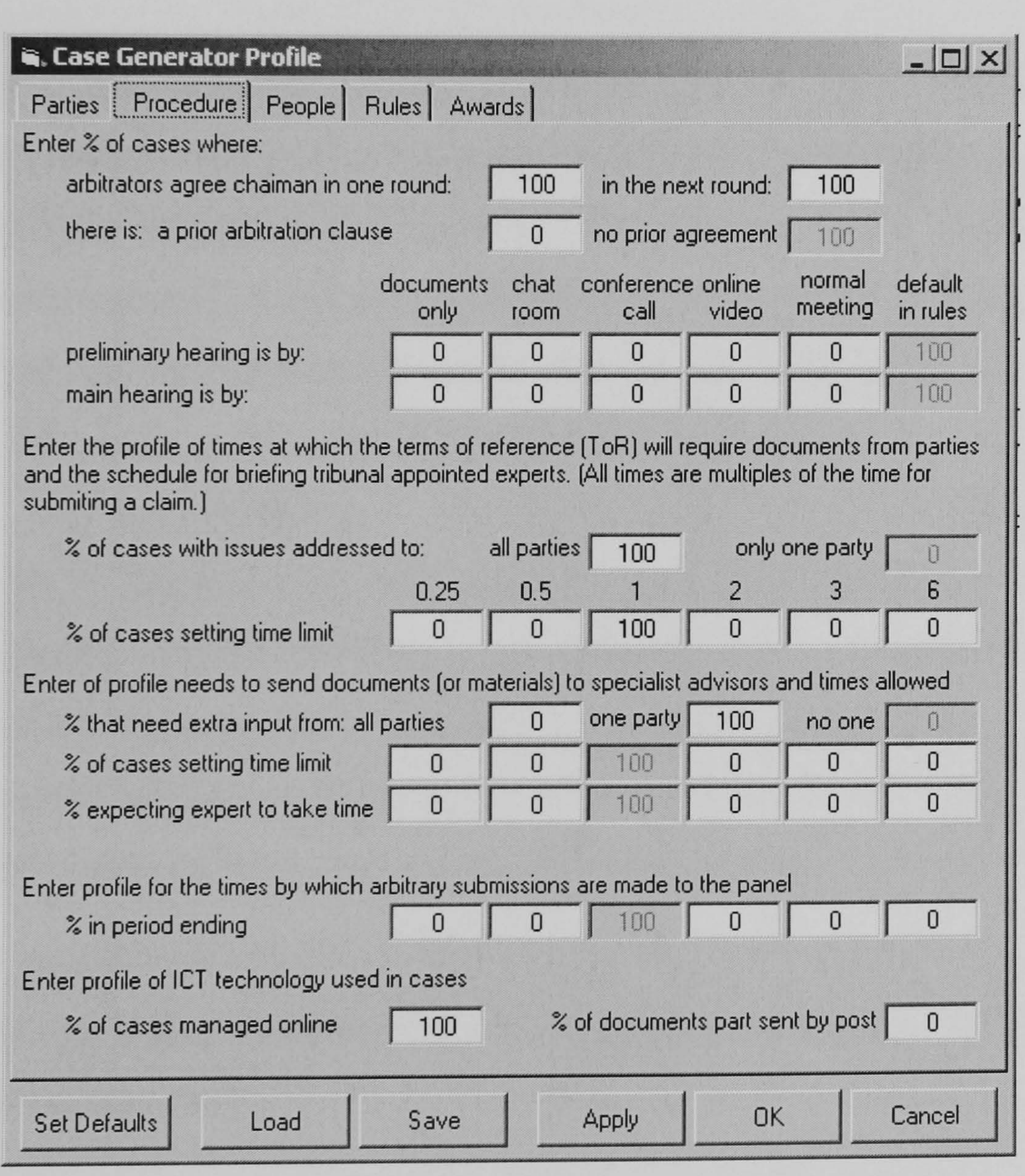


Figure 20 Case generator editor

Using the editor and the case generator it was possible to generate a set of files that would test the different aspects of the model. The set of cases were used to validate that the model operated correctly under the given attributes of the case. For each case that was processed through the model a case diary was produced. The case diary recorded when anybody started writing a document, completed a document or when

a document was delivered to anybody. Recording the progress of a document through the system allowed verification of the actions of the people, and therefore the responses of the information system.

5.4.5 Further Refinement of Requirements/ Revise Model

The further refinement of requirements, the revise model and the validation of the model stages were completed iteratively, so again they effectively merge into a single stage with an output of a validated combined model. This part of the process was the most time-consuming as it became apparent that some requirements had not been anticipated.

A prime example of this is the different states that the document can be in. Initially it was envisaged that documents could be in either of three states, not started, being written or submitted. However, as the model verification and validation progressed it became apparent that this was insufficient to capture all the possibilities. For example, when a tribunal consisted of three arbitrators, who had to write a document together, if one of the arbitrators is extremely busy and is delayed in completing the document, then even if the other arbitrators have spent their allotted time on the documents, it is not registering as submitted, because the third arbitrator has not spent time on it. Therefore the other arbitrators are not available to perform other duties because they are still deemed to be working on the collaborative document. This highlighted the need for more possible states that the document could be in. Other situations highlighted other scenarios where additional states were required. In all it was perceived that there were six possible states that the document could be in;

- Not started – this means that the document is not able to be started at this point in time, because all the preceding documents have not been submitted/delivered
- Ready to be started – this means that all the preceding documents have been submitted/received
- Started
- Completed – this is used if a party has more than one document to write at a time, to signal that the current document is completed but not yet submitted, allowing the party to start writing the next document.

- Submitted – this means that the document has arrived at the secretariat/server within the time allowed
- Delivered – this means that the document has been delivered to the arbitrators or party and if a time limit is in force, it is calculated from this point.

However, this also implied changes to the information system, because it was now necessary for each document to have attached a condition that must be met before it could be started. This condition would consist of a reference to ensure that all previous documents had been delivered.

A similar problem was identified in the batching of documents. Depending on whether the documents form part of the initial document exchange or the additional documents stage, the batching rules differ. The simulation model needs to know how many entities must be placed in any batch, and the information system can calculate the maximum number in the batch given the rule set and the particular document being submitted. However, the information system cannot predict if any party will fail to produce any of the documents. This caused a problem within the simulation model, as the model would halt until a specified batch size had been collected. When the simulated time reached the deadline for submission of these documents it needed to be prompted into continuing with the process regardless of the fact that the batch size was smaller than anticipated. The protocols used within the simulation package do not allow this to occur, and therefore defaulting parties submitted 'ghost documents' on the deadline date. These documents did not have any transmission times and costs associated, and served no purpose other than to prompt the process to continue. In reality this could be achieved by the information system checking the internal date and if the deadline for a case is reached then continuing with processing.

Initially the date for the meeting is predicted based on the profile of the case. An approximate time scale for the meeting date is calculated based on which documents are expected to be produced and the times allowed to produce the documents. Then, a date at least a few weeks after the calculated date, when all arbitrators are available, a meeting date is provisionally set. However, as the case progresses, some delay may be incurred, or additional time allowed, which means that the allocated date is no longer viable. In this case the date has to be re-scheduled. This means that there is

three states that the meeting date can be in; provisional, actual, or completed. The implications of this for the model meant that the prediction logic of the hearing date had to be re-designed. This re-design involved adding a calendar to the IS prototype, which then calculated provisional dates for each document to be submitted. If documents were consequently submitted substantially after this date then the provisional date for the hearing would be adjusted to allow for this. One consequence of this is that the system is able to provide provisional timetables for the case, which are automatically updated whenever the case is delayed for any reason.

One of the other major refinements that was required at this stage if the system was to free clerical time in the institutional offices, was the additional 'rules' required to fully automate the document handling procedures. The rules needed to include the institution's, possibly undocumented, office procedures. This included tasks such as checking that all expected documentation had arrived, and the issuing of notices. As a consequence for the integrated model, a greater number of document types, triggers for their production, and detail on their contents and distribution had to be defined. This stage of the process involved many iterations, with the details in the case complexity going through three major versions to incorporate the detail that was used in the final model, while the integrated model progressed through approximately twenty versions over the months of investigation.

These were just a few of the refinements required at this stage. Many of the changes could not have been predicted at the requirements stage of the process, it was the combining of the model that enabled them to be seen. These complexities may have been completely overlooked in the original requirements stage and therefore omitted from the final design if simulation techniques had not been used to highlight the problems.

The necessary alterations to the original requirements meant that both the models had to be altered appropriately. This meant, in the case of the states that a document could take, extending not only the list of conditions in order to identify the particular state, but refining the simulation model to ensure that the correct action was taken depending on the state of the document. The close communication that had occurred between the model builders during the original design and building stages meant that the alterations could be easily included into each model, though the effects of the changes on the model were quite marked.

The integrated model was extensively tested using the cases generated from the profiles supplied to the case generator to ensure that the model was indeed valid. Different combinations of rule sets and case attributes were used and resulting diaries were carefully examined by legal advisors involved in international arbitration cases, to determine whether the model was working correctly. This produced several other small oversights that had to be rectified. When the legal advisors finally confirmed that given the case description the model was processing it both correctly and in appropriate time scale the model was finally ready for running experiments.

5.4.6 Model Runs

After the models were validated with cases with specific attributes a set of test cases were generated to compare on-line and off-line arbitration under various rule sets. The aim was to develop a generic model and therefore a 'template' was produced and individual rule sets were encoded into the template. By creating the rule sets in this way, any standard set of rules could be altered on an individual case-by-case basis as demanded by the arbitration agreement. In this way any rule set could be encoded into the template and validated using the model.

Rule sets: Four standard rule sets were encoded, LCIA, CIArb, UNCITRAL, and ICC. Each of these was also encoded with on-line document submission rules (i.e. LCIA with EAT, CIArb with EAT, UNCITRAL with EAT, ICC with EAT). Two documents only sets of rules CIArb SF and E-Arbitration-T (EAT) rules were also encoded. This made ten different rule sets that the test data was to be tested on. Each case generated would be run under all ten rule sets so that genuine comparisons could be made.

Case Complexity: There were three different levels of case complexity that the model was tested under. The first level were structurally simple in terms of the fact that they consisted of a single arbitrator, no experts and no additional documents or counter-claims. The second level was the other extreme where all cases were structurally complex, in that they had three arbitrators, experts, additional documentation requested, and counter-claims. The third level of complexity was a more realistic view of the mixture of cases that an arbitration centre would receive. Some of the cases had single arbitrators while others had three arbitrators, they had

varying numbers of experts, some contained counter-claims, some had some documents not submitted in time etc.

Numbers of cases: For each level of case complexity there were 400 cases generated, so 1,200 different cases in total. Each of these was run through the ten rule sets, giving a total of 12,000 cases tested on the system in total. Each of the sets of cases therefore were identical, with the exception of the rule set under which the cases were conducted, providing true repetition which could never be achieved in reality, and therefore allowing a true comparison of the effects of the different rule sets. The results that are analysed in the next chapter are based on these cases. A sample case structure summary for a complicated case is shown below using the UNCITRAL rules.

```
This is a case with 2 respondents and a claimant selecting a tribunal of three
        arbitrators and UNCITRAL rules.
There is no prior arbitration clause but they agree to arbitrate.
The claimant appoints an arbitrator.
The respondents agree to appoint an arbitrator.
The arbitral institution appoints a chairman after consultation with the other
        arbitrators.

The tribunal will hold a preliminary hearing using a telephone conference.

The terms of reference request documents on issue 1 after 30 days.
There will be a specialist advisor appointed to assist the tribunal.
They will receive extra evidence from respondent 2 within 30 days and will be
        expected to report in about 30 days.
The tribunal will hold the main hearing using a face-to-face meeting.
```

Figure 21. Sample case structure summary (UNCITRAL rules)

The models were run until all 400 cases had been completed, and therefore the run lengths of the various models varied according to the model complexity and the stochastic nature of the model. As the purpose of the model is to analyse how information systems affect the business processes and the validity of the information system design rather than analyse resource usage, a warm-up period and comparable run lengths were unnecessary. An analysis of the results from both the project and research perspectives are presented in the next chapter.

5.5 Summary

This chapter provided an in-depth analysis of the case study used to test the framework. Each of the different stages of the process of arbitration was examined in detail and the particular problems that the model would have to address were highlighted. The framework was applied to the case study and the problems identified were explicitly categorised into which domain they would be addressed in. Some of the problems identified needed to be handled by both domains, which

reinforced belief that information systems and business processes are so intertwined that they should be designed together and therefore modelled together. A detailed description of how each of the stages in the framework was applied to the case study explains how the integrated model was developed, and how the modellers understanding of the system improved through the process of modelling. When the model was finally validated a set of test cases were developed that would be used to test the system. The test cases were developed such that they tested both the extreme cases and the more realistic scenarios, but more importantly that they a true comparison of the effects of the different rule sets on any particular case. An analysis of the test runs is presented in the next chapter.

Chapter 6: Evaluation of the Integrated Model Framework

This chapter looks at the results obtained from running the model and analyses the results from two perspectives. The first perspective is the project perspective where the results obtained from the model are discussed, while the second perspective is the research perspective where the method itself is analysed to see whether the research objectives identified at the start of this dissertation have been achieved.

6.1 Project Outcomes

The project objectives were identified as:

- Analyse the effects of an electronic Arbitration system in terms of costs and time saved
- Explore other benefits of on-line arbitration.

The first of these two objectives is possible through the use of simulation techniques, while the second objective is derived from a better understanding of the system, which although not directly attributable to the simulation runs is a consequence of designing and building the model.

6.1.1 Simulation Run Results: A Project Perspective

For each case that was run through the simulation model a case diary and a document list was generated. The document list contains details of the contents of the documents and the conditions that need to be met before they could be started. The document list is updated as each different document is submitted, and when it is delivered to the various parties in the case, so by the end of the case there is a complete record of exactly what documents have been received by whom and on what dates. An excerpt of a typical document list is displayed below and a full document list (from the end case perspective) is detailed in Appendix C. In this case

there are 3 arbitrators (Arb-1, Arb-2, and Arb-3), the claimant (C-1) and two respondents (R-1, and R-2). The method of distribution in this case is direct, i.e. the parties send the documents directly to the other parties and arbitrators in the case, so the submitted date is the date that the document was received by the institute secretariat.

Other information concerning each document is also available, for instance R-1's statement of defence (D-15) and counter-claim (D-17) both need to be submitted together, and this is identified by the fact that the "submit in" variable is set as B-16 (defence bundle). Similarly R-2's statement of defence (D-18) and counter-claim (D-20) are submitted together in defence bundle (B-19). This ensures that the party's individual documents are submitted together, but it is not necessary for all respondent parties to submit their documents together. However, all the defences and counter-claims must be distributed together so for all four documents the "distribute in" variable is set as B-14 (all defences and counter-claims bundle).

```
.....
.....

 D-13: Statement of Claim, from C-1
      document, type 20, time allowed 30 days, status: 1
      starts sequence Written stage - pleadings; followed by D-15, D-17, D-18, D-
     20, N-41
      ContentsID=20011, type 20, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      projected filing: 08/08/2002

 D-15: Statement of Defence (R-1), from R-1
      document, type 21, time allowed 30 days, status: 1
      submit in B-16, distribute in B-14
      Written stage - pleadings; after D-13; followed by N-41
      Part of ContentsID=20012, type 21, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      projected filing: 08/09/2002

 D-17: Counter-Claim (R-1), from R-1
      document, type 22, time allowed 30 days, status: 1
      submit in B-16, distribute in B-14
      Written stage - pleadings; after D-13; followed by D-21, N-41
      Part of ContentsID=20012, type 21, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      projected filing: 08/09/2002

 D-18: Statement of Defence (R-2), from R-2
      document, type 21, time allowed 30 days, status: 1
      submit in B-19, distribute in B-14
      Written stage - pleadings; after D-13; followed by N-41
      Part of ContentsID=20013, type 21, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      projected filing: 08/09/2002

 D-20: Counter-Claim (R-2), from R-2
      document, type 22, time allowed 30 days, status: 1
      submit in B-19, distribute in B-14
      Written stage - pleadings; after D-13; followed by D-21, N-41
      Part of ContentsID=20013, type 21, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      projected filing: 08/09/2002
.....
.....
```

Figure 22. Sample document list

The case diary gives details of when any documents are delivered, started or completed. An excerpt of a diary is shown in Figure 23 and similarly a full case diary is displayed in Appendix D. The information contained within both the diary and the document listing was used in the verification and validation stages to ensure that the model was an accurate representation of a real case. The diaries and document lists were discussed with solicitors that conduct arbitration proceedings to ensure that nothing had been overlooked.

```
01                    Diary file for case 1
01                    ========================
01
01
03          25 Mar 2002  -----  Agreement pending  -----
04                       Notice of Arbitration filed by the claimant
05          26 Mar 2002  Notice of Arbitration delivered to arbitrator 3
05                       Notice of Arbitration delivered to arbitrator 2
05                       Notice of Arbitration delivered to the chairman
05                       Notice of Arbitration delivered to respondent 1
05                       Notice of Arbitration delivered to respondent 2
07 005002                respondent 1 starts Response to Notice (R-1)
07 005003                respondent 2 starts Response to Notice (R-2)
08 005003 30 Mar 2002    respondent 2 completes Response to Notice (R-2)
08 005002 31 Mar 2002    respondent 1 completes Response to Notice (R-1)
04          07 Apr 2002  Response to Notice (R-1) filed by respondent 1
06                       appoint claimant nominee, appoint respondent nominee on
                          submission from respondent 1
04                       Response to Notice (R-2) filed by respondent 2
03                       -----  Tribunal formation  -----
05          08 Apr 2002  Response to Notice (R-1) delivered to the claimant
05                       Response to Notice (R-1) delivered to arbitrator 3
05                       Response to Notice (R-1) delivered to arbitrator 2
05                       Response to Notice (R-1) delivered to the chairman
05                       Response to Notice (R-1) delivered to respondent 2
05                       Response to Notice (R-2) delivered to arbitrator 3
05                       Response to Notice (R-2) delivered to arbitrator 2
05                       Response to Notice (R-2) delivered to the chairman
05                       Response to Notice (R-2) delivered to the claimant
05                       Response to Notice (R-2) delivered to respondent 1
07 002002                arbitrator 2 starts Agreement to serve and disclosure 2
07 002003                arbitrator 3 starts Agreement to serve and disclosure 3
08 002003 12 Apr 2002    arbitrator 3 completes Agreement to serve and disclosure 3
08 002002                arbitrator 2 completes Agreement to serve and disclosure 2
04          13 Apr 2002  Agreement to serve and disclosure 3 filed by arbitrator 3
04                       Agreement to serve and disclosure 2 filed by arbitrator 2
07                       the secretariat starts List of names
08                       the secretariat completes List of names
04                       List of names issued by the secretariat
05          14 Apr 2002  Agreement to serve and disclosure 3 delivered to arbitrator 2
05                       Agreement to serve and disclosure 3 delivered to the chairman
05                       Agreement to serve and disclosure 2 delivered to arbitrator 3
05                       Agreement to serve and disclosure 2 delivered to the chairman
05                       List of names delivered to arbitrator 3
05                       List of names delivered to arbitrator 2
05                       Agreement to serve and disclosure 3 delivered to the claimant
07 002002                arbitrator 2 starts List of preferences (Arb-2)
07 002003                arbitrator 3 starts List of preferences (Arb-3)
05                       Agreement to serve and disclosure 3 delivered to respondent 1
05                       Agreement to serve and disclosure 3 delivered to respondent 2
05                       Agreement to serve and disclosure 2 delivered to the claimant
05                       Agreement to serve and disclosure 2 delivered to respondent 1
05                       Agreement to serve and disclosure 2 delivered to respondent 2
08 002002 25 Apr 2002    arbitrator 2 completes List of preferences (Arb-2)
08 002003                arbitrator 3 completes List of preferences (Arb-3)
04          26 Apr 2002  List of preferences (Arb-2) filed by arbitrator 2
06                       appoint institute nominee on submission from arbitrator 2
04                       List of preferences (Arb-3) filed by arbitrator 3
05          27 Apr 2002  List of preferences (Arb-2) delivered to the chairman
07 002001                the chairman starts Agreement to serve and disclosure 1
08 002001 01 May 2002    the chairman completes Agreement to serve and disclosure 1
04          02 May 2002  Agreement to serve and disclosure 1 filed by the chairman
07                       the secretariat starts Notice of Formation
08                       the secretariat completes Notice of Formation
04                       Notice of Formation issued by the secretariat
.....
```

Figure 23. Sample case diary

For each of the cases in the simulation runs, both diaries and a list of documents were collected. For each case a record of when specific events had occurred were recorded. These events were either when the case changed from one state into another, or when a specific event such as a hearing had occurred. Four of the stages were recorded, the formation of the tribunal, the standard document exchange, the additional document exchange, and the award stage. Similarly, the preliminary hearing, the issuing of the terms of reference, and the main hearing were recorded for all cases.

The simulation run results were collated and the results for the mixed case scenario are shown in Figure 24. The graphs for the simple and complicated cases are included in Appendix E.

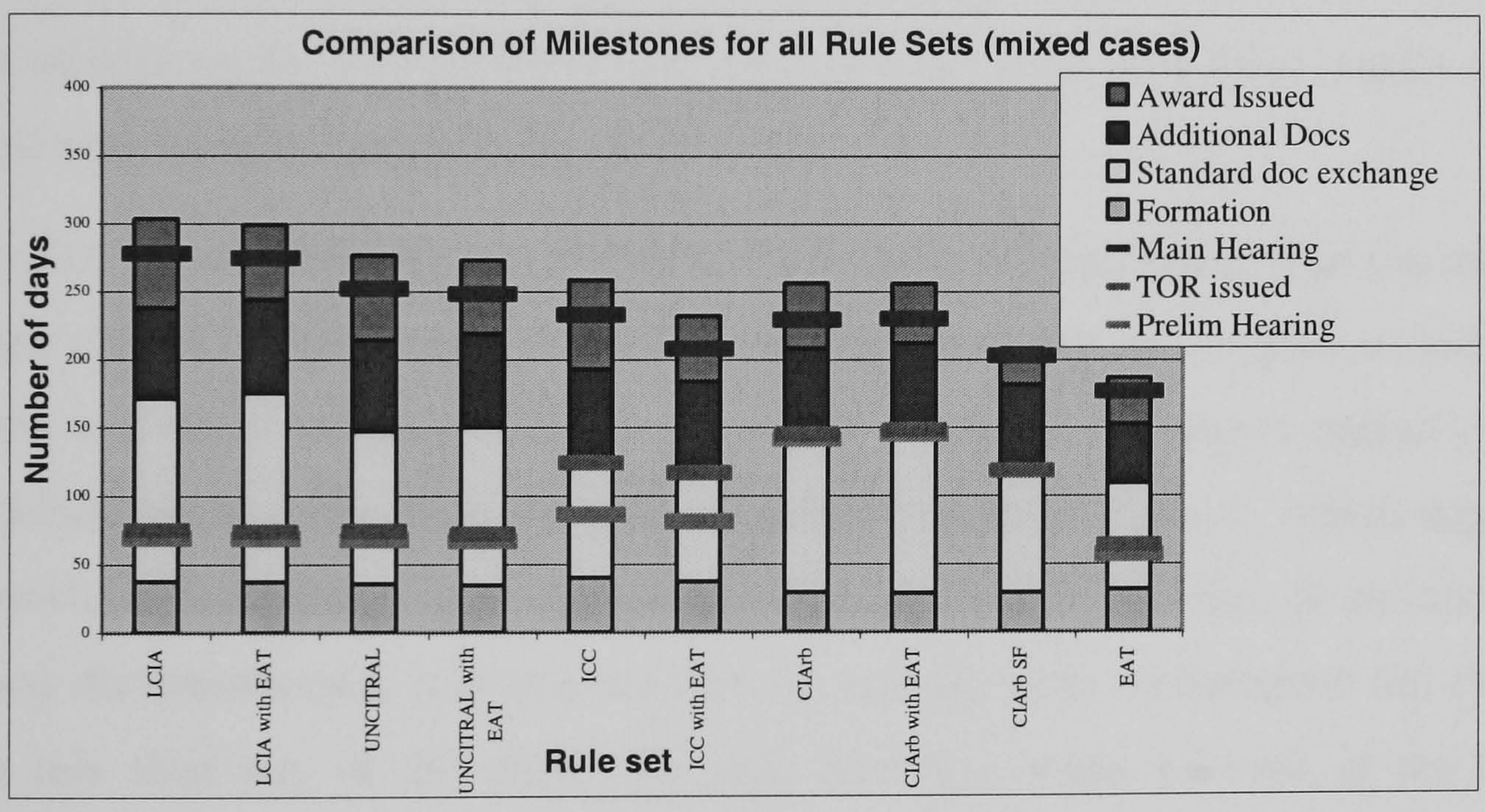


Figure 24. Graph to illustrate the variation of cases under different rule sets (mixed cases)

From the graph it can be seen that the result of adding electronic facilities makes little difference to the time taken to complete the case. The main exception is in the case of the ICC rules. The reason that there is a bigger difference between the traditional and on-line methods following the ICC rules is that the ICC practice the managed distribution method discussed in section 5.3.2, where the parties and arbitrators send their documents to the institutional secretariat who then forward them on to the relevant people. Therefore submitting the documents on-line and the server then informing the relevant people of a submission halves the postage delays compared with those that do not follow the managed distribution procedure.

The fact that overall completion times are not significantly reduced seems a surprising result, and had the system been introduced without this analysis then perhaps the disappointments so frequently quoted as being associated with information systems would have manifested themselves. Looking further into why this phenomenon may occur suggests that this is due to the time at which people make their submissions. It was generally agreed by all the lawyers that were consulted that people will submit their documents at the last possible moment, taking all available time and ensuring that the other party(ies) do not gain any advantage by their early submission. One consequence of this is that even when using on-line transmission facilities, rather than submitting their documents say four days before the deadline, they now can submit them on the deadline day, effectively giving themselves four extra days in which to complete the document. This has the overall effect of making the electronic submission procedure have very little impact on the overall time taken to complete the case.

It can also be seen from the graph that it is the choice of rules rather than the method of transmission of the document that has the largest impact on completion times. In fact the individual aspect of the rule set which produces the largest impact on the completion times is the time allowed for submitting the document, which supports the previous explanation over the postal vs electronic transmission. If we consider the two documents-only rule sets we can see that the time to complete the case is much less than any of the other rule sets. However when we look at the times allowed to submit the documents we find that the CIArb SF and E-Arbitration-T rules allow just 20 days to submit a document. With the electronic transmission allowed in the E-Arbitration-T rules this means that documents can be submitted on day 20, while using say LCIA rules which although allowing 30 days, has an effective deadline of 26 days when allowing for postal delays.

This implies that adding electronic transmission facilities on their own do little to accelerate the process of arbitration while using traditional rules, but if attention is made to the rules used in the arbitration process then electronic arbitration can speed up the whole process.

So if adding electronic transmission facilities to traditional arbitration rules has little impact on the time taken, what is the impact on cost? Regardless of the rule set followed in traditional arbitration copies of documents must be made and distributed

to the other parties and arbitrators. The documents that are likely to be submitted are large and there are costs associated with this. There are the costs associated with photocopying the documents, in terms of both consumable resources and clerical time to complete this task. Then there is the cost associated with the despatch of these documents and the transmission either by post or courier depending on the speed required and the size of the packages. Wherever the package is received there is the clerical cost again associated with the filing of the document, and the cost of physical storage of the document. With electronic arbitration these costs could be virtually eradicated, as copying of documents will no longer be required as they will be in electronic form, and storage will be electronic reducing the need for large spaces to store large volumes of paper. Figure 25 shows the number of submissions per case under each of the rule sets for the mixed case scenario. This graph illustrates the order of magnitude in savings on document submissions that could be made by introducing electronic submission procedures.

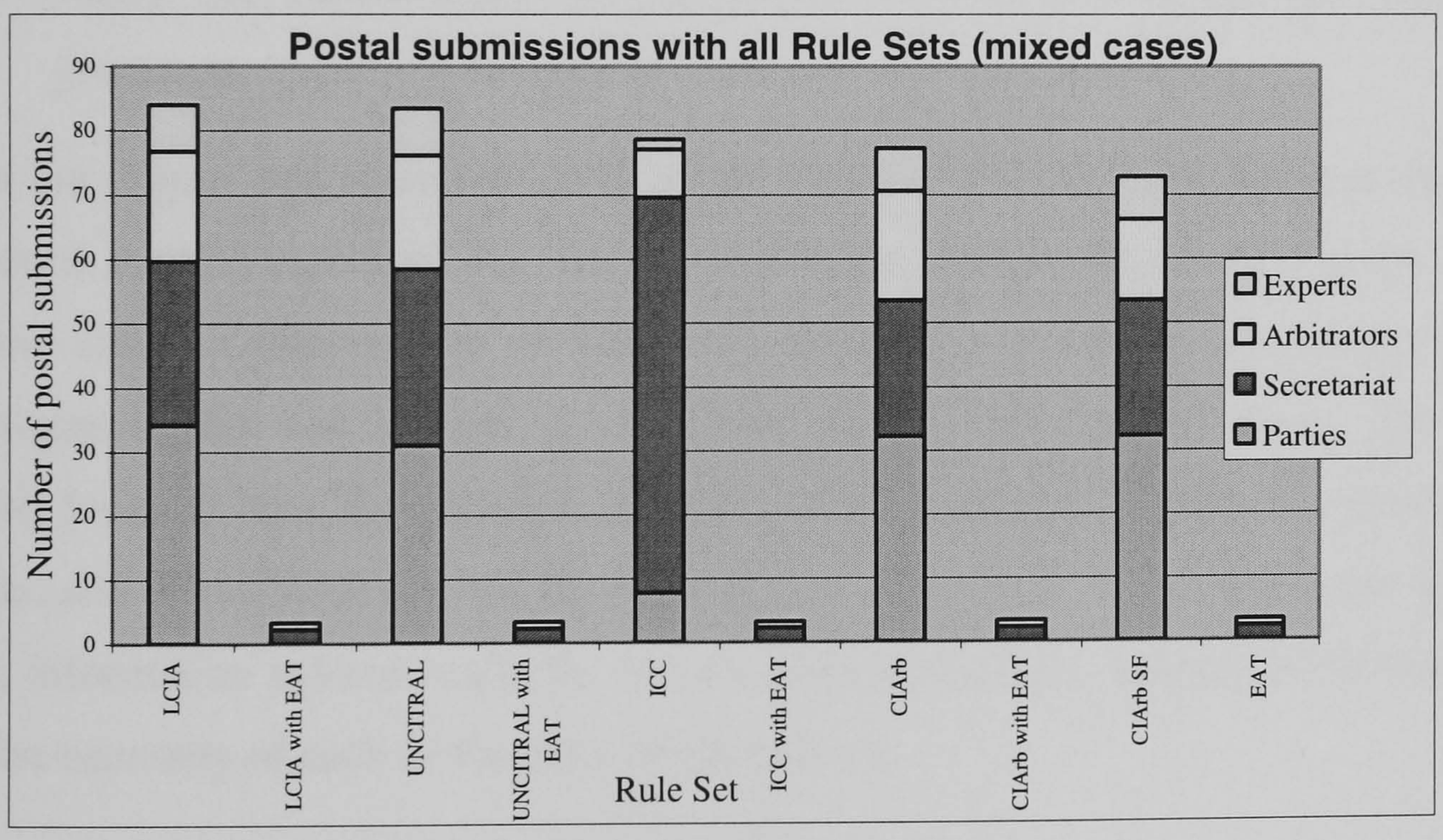


Figure 25. Graph to illustrate the order of magnitude of the reduction in postal submissions by adding electronic submission procedures to standard rule sets

The most significant benefit of the E-Arbitration-T is not shown in the time and cost savings demonstrated by the simulation run results, but is instead the on-line management functions that guide the user through the process. This is tailored to the individual given the status of the case that they are involved in. At any time during the proceedings the individual may enquire of the server what tasks they are currently able to complete. This will automatically be updated whenever a new document is submitted. Also whenever any new document is submitted in their case

all parties concerned will receive an e-mail informing them that a document has been submitted, and what tasks they now have to complete, and the time-scales that it must be completed in. This positive case management function provides the parties with up-to-the-minute information concerning their case and actively informs each person involved in the case each time a change to the status of their case has occurred. Information on submissions now due and approaching deadlines can also be obtained, reducing the chance of a non-submission through not realising if, or when, a document is required.

6.2 RESEARCH OUTCOMES

The research objectives that the case study tried to address were to:

- validate the design of the information system through the use of simulation modelling techniques,
- verify the functionality of the information system within the business processes.

From the project outcomes identified in the previous section it can be seen that the proposed method produced the desired results for this particular case study. This section aims to analyse the benefits of integrating simulation and prototyping techniques in this way in light of the results gained from the case study. The first section looks at how the research objectives were achieved through the simulation results, and offers evidence that the method is a viable tool for validating the design of an information system while the second section offers an analysis of the method and the necessity of each of the parts of the process.

6.2.1 Simulation Run Results: A Research Perspective

In this section the aim is to illustrate that the design of the information system is correct. The model was designed such that users could only react to the information that they received from the responses from the information system. Therefore in order to validate the information system we can analyse the output from the simulation model, in terms of the actions of the users of the system.

To illustrate this point two examples that are taken from the requirements of the system are exhibited. The first is the document writing and submission procedure,

while the second concerns the appointment of the tribunal process. These two examples were chosen because they illustrate how the information system and the business process model act in unison to provide the required results.

As already stated in section 5.4.2 the parties work on a document and submit it a matter of days before the deadline date. The number of days before the deadline that the document needs submitting varies to emulate the different postal times from various places. From the excerpt of the diary below we can see that the claimant receives the terms of reference on the 12th June 2002, and is then able to begin writing the claim. The fact that the claimant is able to start writing the claim means that all documents that are required to have been delivered prior to this task starting must have been received. This can be easily verified by reviewing the diary and checking which documents the claimant has received. Under the LCIA rules, that this particular case is being conducted under, the time allowed for submission is 28 days, so submission would have to be received by 10th July. The claimant completes the claim on 24th June – this is solely so that he can start on another document if another is due – but holds on to the claim until nearly the submission date (for the reasons explained in section 5.4.2). The date recorded as the filing date is the date that the institute secretariat receive the claim, rather than when it is posted.

```
.....
.....
05          12 Jun 2002   Terms of Reference delivered to the claimant
05                        Terms of Reference delivered to respondent 1
05                        Terms of Reference delivered to respondent 2
07 005001                 the claimant starts Statement of Claim
08 002001   15 Jun 2002   the chairman completes Specialist briefing
10 002003   16 Jun 2002   arbitrator 3 ends assistance with Specialist briefing
10 002002                 arbitrator 2 ends assistance with Specialist briefing
04                        Specialist briefing filed by the chairman
05          17 Jun 2002   Specialist briefing delivered to specialist advisor 1
05                        Specialist briefing delivered to the claimant
05                        Specialist briefing delivered to respondent 1
05                        Specialist briefing delivered to respondent 2
08 005001   24 Jun 2002   the claimant completes Statement of Claim
04          08 Jul 2002   Statement of Claim filed by the claimant
.....
.....
```

Figure 26. Sample diary output to illustrate that the date and contents of document submissions is correct

This example illustrates that the information concerning the contents and dates for the document to be submitted was correct. If the information on either of these topics had been incorrect the claimant would either write a different document, or submit it at a different time. In this way we are able to demonstrate that the actions of the users, which reflects the information supplied by the information system can actually give confidence in the design of the information system itself, and that the processes that control the parties writing documents is also satisfactory.

The second illustration is the appointment of a three-person tribunal. In this example both the parties nominate a person that they would like to be on the tribunal panel. By default, the claimant nominates the one labelled Arb-2 and the respondents, between them nominate the one labelled Arb-3. When both these nominated arbitrators have viewed the details of the case and satisfied themselves that they are eligible to accept the appointment then they write a document to formally accept the position. When the agreement to serve and disclosure documents from both nominated arbitrators have been received by the institutional secretariat (14th April 2002) then a list of possible names of candidates to act as chairman is provided by the secretariat.

```
.....
.....
05          08 Apr 2002  Response to Notice (R-1) delivered to the claimant
05                       Response to Notice (R-1) delivered to arbitrator 3
05                       Response to Notice (R-1) delivered to arbitrator 2
05                       Response to Notice (R-1) delivered to respondent 2
05                       Response to Notice (R-2) delivered to arbitrator 3
05                       Response to Notice (R-2) delivered to arbitrator 2
05                       Response to Notice (R-2) delivered to the claimant
05                       Response to Notice (R-2) delivered to respondent 1
07 002002                arbitrator 2 starts Agreement to serve and disclosure 2
07 002003                arbitrator 3 starts Agreement to serve and disclosure 3
08 002003 12 Apr 2002    arbitrator 3 completes Agreement to serve and disclosure 3
08 002002                arbitrator 2 completes Agreement to serve and disclosure 2
04          13 Apr 2002  Agreement to serve and disclosure 3 filed by arbitrator 3
04          14 Apr 2002  Agreement to serve and disclosure 2 filed by arbitrator 2
07                       the secretariat starts List of names
08                       the secretariat completes List of names
04                       List of names issued by the secretariat
05          15 Apr 2002  Agreement to serve and disclosure 3 delivered to arbitrator 2
05                       Agreement to serve and disclosure 2 delivered to arbitrator 3
05                       List of names delivered to arbitrator 3
05                       List of names delivered to arbitrator 2
05                       Agreement to serve and disclosure 3 delivered to the claimant
07 002002                arbitrator 2 starts List of preferences (Arb-2)
07 002003                arbitrator 3 starts List of preferences (Arb-3)
05                       Agreement to serve and disclosure 3 delivered to respondent 1
05                       Agreement to serve and disclosure 3 delivered to respondent 2
05                       Agreement to serve and disclosure 2 delivered to the claimant
05                       Agreement to serve and disclosure 2 delivered to respondent 1
05                       Agreement to serve and disclosure 2 delivered to respondent 2
08 002002 25 Apr 2002    arbitrator 2 completes List of preferences (Arb-2)
08 002003                arbitrator 3 completes List of preferences (Arb-3)
04          26 Apr 2002  List of preferences (Arb-2) filed by arbitrator 2
04                       List of preferences (Arb-3) filed by arbitrator 3
06                       appoint institute nominee on submission from arbitrator 3
05          27 Apr 2002  Response to Notice (R-1) delivered to the chairman
05                       Response to Notice (R-2) delivered to the chairman
05                       Agreement to serve and disclosure 3 delivered to the chairman
05                       Agreement to serve and disclosure 2 delivered to the chairman
07 002001                the chairman starts Agreement to serve and disclosure 1
08 002001 01 May 2002    the chairman completes Agreement to serve and disclosure 1
04          02 May 2002  Agreement to serve and disclosure 1 filed by the chairman
07                       the secretariat starts Notice of Formation
08                       the secretariat completes Notice of Formation
04                       Notice of Formation issued by the secretariat
.....
.....
```

Figure 27. Sample diary output to illustrate the selection of an arbitral tribunal panel

The task of compiling the list of possible chairmen is not eligible to be started until both elected arbitrators documents have been received, and it can be seen from the diary that the secretariat indeed does not begin the task until receipt of Arb-2's

acceptance and disclosure documents have been received. Similarly the secretariat cannot start the appointment of the chairman until both lists of preferences have been delivered, but in this case they actually arrive on the same day (26th April 2002). On identifying the proposed chairman all the documents submitted by this point in time are forwarded to the proposed chairman to determine whether he is eligible to accept the position in the case. Finally on receipt of the chairman's (Arb-1) agreement to serve and disclosure document, the secretariat issue a notice to inform all participants in the case that the tribunal has now been formed.

Again this example illustrates that the information system and the business process aspects are working in unison. The information system controls the fact that the secretariat's task of creating the list of names for the nominated arbitrators to select the chairman from, cannot start until both nominated arbitrators have signalled their acceptance. This indicates that the design of the information system aspect that controls when documents are eligible to be started is working. The business process aspect controls the process of how the particular arbitrators are selected under this particular set of rules.

To illustrate that the rule sets are properly incorporated into the model, we need to consider the same case run through different rule sets. Below are excerpts from the information recorded at the end of a case. Both cases are identical in terms of the number of participants involved and the documents that will be produced throughout the case. The only differences between the cases are the sets of rules that the case is being heard under, and therefore the method of document submission and the options available for conducting the hearings. For illustration purposes only the first few documents are included here under two different rule sets, but an entire set of end cases are included in Appendix C.

The first example shows the case under the E-Arbitration-T rules where the default time allowed to submit documents is 20 days and documents are submitted electronically. The E-arbitration-T rules default rules do not have a main hearing, and the preliminary hearing is conducted electronically. Therefore in this case the preliminary hearing is conducted using the secure chat room facility supplied by the E-Arbitration-T platform.

```
Case number 1
Agreement to settle online. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
```

```
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 28/05/2002 by a chat room finished 28/05/2002
          case closed 16/10/2002

Default rules: EAT rules, base time 20 days

Index cards for case
     D-1: The Request (application form), from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-4, D-5, D-6, D-7, D-8, D-
          10, D-16
          ContentsID=20001, type 1, submitted online
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(25/03/2002), Arb-2(25/03/2002), R-
          2(25/03/2002), Arb-3(25/03/2002), Arb-1(25/03/2002)

     D-4: Agreement to arbitrate (R-1), from R-1
          document, type 4, time allowed 7 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5
          ContentsID=20002, type 4, submitted online
          from R-1
          submitted: 01/04/2002

     D-5: The Response (application form) (R-1), from R-1
          document, type 2, time allowed 10 days, status: 4
          submit in B-3, distribute in B-3
          Agreement pending; after D-1, D-4; followed by D-8, D-10, D-16
          ContentsID=20003, type 2, submitted online
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 29/03/2002, delivered: Arb-3(29/03/2002), Arb-2(29/03/2002),
          Arb-1(29/03/2002), R-2(29/03/2002), C-1(29/03/2002)
          appoint claimant nominee, appoint respondent nominee

     D-6: Agreement to arbitrate (R-2), from R-2
          document, type 4, time allowed 7 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-7
          ContentsID=20004, type 4, submitted online
          from R-2
          submitted: 01/04/2002

     D-7: The Response (application form) (R-2), from R-2
          document, type 2, time allowed 10 days, status: 4
          submit in B-3, distribute in B-3
          Agreement pending; after D-1, D-6; followed by D-8, D-10, D-16
          ContentsID=20005, type 2, submitted online
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 28/03/2002, delivered: C-1(29/03/2002), R-1(29/03/2002), Arb-
          3(29/03/2002), Arb-2(29/03/2002), Arb-1(29/03/2002)

     D-8: Accept appointment 2, from Arb-2
          document, type 39, time allowed 5 days, status: 4
          Tribunal formation; after D-1, D-5, D-7; followed by D-9, N-18
          ContentsID=20006, type 39, submitted online
          from Arb-2
          submitted: 02/04/2002
.....
.....
```

Figure 28. Case 1 using EAT rules

The details given in the end case document illustrates that the Claimant submits the request (D-1), which under the E-Arbitration-T rules must contain the some information concerning the claim. The respondents (R-1 and R-2) then have 7 days in which to state whether they agree to arbitration (D-4 and D-6), and 10 days in which to submit their Responses (D-5 and D-7) which includes their perspective of the situation. The full claim and defence documents under E-Arbitration-T rules are submitted later in the proceedings, but the information given is used to assist in the selection of a tribunal panel. The second example is the same case under heard under

the ICC rules. From the excerpt of the end case document it can be seen that the preliminary hearing is conducted by telephone conference, while the main hearing is a face-to-face meeting. The default time for document submission under these rules is 30 days.

```
Case number 1
Agreement to settle by post. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 02/07/2002 by a telephone conference finished
          02/07/2002
          main hearing set for 18/12/2002 by a face-to-face meeting finished
          18/12/2002
          case closed 22/01/2003

Default rules: ICC rules, base time 30 days

Index cards for case
     D-1: The Request, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-7, D-
          11, D-13
          ContentsID=20001, type 1, submitted by post
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(26/03/2002), Arb-3(26/03/2002), Arb-
          2(26/03/2002), Arb-1(26/03/2002), R-2(26/03/2002)
          institute appoints for claimant, institute appoints for respondent, appoint
          institute nominee

     D-3: The Answer (R-1), from R-1
          document, type 2, time allowed 30 days, status: 4
          submit in B-10, distribute in B-9
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          Part of ContentsID=20002, type 2, submitted by post
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: Arb-3(25/04/2002), Arb-2(25/04/2002),
          Arb-1(25/04/2002), C-1(25/04/2002), R-2(25/04/2002)

     D-4: The Answer (R-2), from R-2
          document, type 2, time allowed 30 days, status: 4
          submit in B-12, distribute in B-9
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          Part of ContentsID=20003, type 2, submitted by post
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: Arb-3(25/04/2002), Arb-2(25/04/2002),
          Arb-1(25/04/2002), C-1(25/04/2002), R-1(25/04/2002)

    D-11: Counter-Claim (R-1), from R-1
          document, type 22, time allowed 30 days, status: 4
          submit in B-10, distribute in B-9
          Agreement pending; after D-1; followed by D-14
          Part of ContentsID=20002, type 2, submitted by post
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: Arb-3(25/04/2002), Arb-2(25/04/2002),
          Arb-1(25/04/2002), C-1(25/04/2002), R-2(25/04/2002)

    D-13: Counter-Claim (R-2), from R-2
          document, type 22, time allowed 30 days, status: 4
          submit in B-12, distribute in B-9
          Agreement pending; after D-1; followed by D-14
          Part of ContentsID=20003, type 2, submitted by post
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: Arb-3(25/04/2002), Arb-2(25/04/2002),
          Arb-1(25/04/2002), C-1(25/04/2002), R-1(25/04/2002)
```

Figure 29. Case 1 using ICC rules

In this case the request from the claimant contains details of the arbitration agreement where the tribunal members are named in the agreement, as well as full

claim details. The respondents (R-1 and R-2) then have 30 days each in which to submit their Answers and Counter-Claims.

These two examples indicate that the information system can intelligently interpret the various rule sets and apply them to a single case, producing a case structure that will conform to a process dictated by the rules and the document titles to match the rule set. Using this data within the simulation model, and recording the actions of the participants of the case in the case diary we could validate that the participants were behaving in a way that would conform to the processes dictated by the rule set, and therefore infer that the information system is not giving incorrect information, and that therefore the system design is acceptable. Neither the simulation logic nor the code of the information system is changed between these experiments verifying the flexibility of the system.

6.3 Assessment of the Practical Application

It has been shown in the previous sections that the proposed framework has been successfully applied to one particular case study. The aim of this section is look at the concepts and the process steps identified and establish their applicability to other scenarios. The first section looks at the advantages of linking simulation and prototyping in this way and the information that can be gained from it. The following sections look at the steps within the framework and analyses the purpose of each step and the practical implications of building the model in this way.

6.3.1 Advantages of Linking Simulation and Prototyping

This section aims to look at the advantages of linking simulation techniques with prototyping in the way proposed by the framework from the perspective of applying the idea to other cases. The overall outcome of the research is a framework to assist in the design of aligned business processes and information technology. This is achieved through the linking of simulation and prototyping and taking advantages that the two techniques offer. The way that this improved alignment is achieved is by being able to validate the design of the information system within the business process model. This validation process allows a deeper understanding of the interactions between the two domains, and through this deeper understanding of both

the requirements that the business processes have from the information system, and the information system requirements from the business processes.

As stated in chapter 2 prototyping is a well documented and often used method of assisting in the design of information systems. Its advantages are that designs can be tested and alterations made without the expense of actually implementing the system and cost involved when they fail. One limitation of prototyping is that the designs are tested under limited conditions and are not actually tested within the actual system.

Simulation allows analysis of business process design, and as many re-designing of business processes projects involve investment in computer systems, the proposed system should be tested within the proposed design.

Traditional business process simulation doesn't incorporate the information systems aspect of the process and the prototype doesn't include the business process perspective. Combining the two methods provides us with a way to analyse information systems prototypes within the simulated proposed business processes.

By building two models that are later combined allows employing experts in the two separate domains to apply their knowledge of each domain in building the models. The two modellers must communicate with each other in depth about how the models are to be designed and where and how they will interact with each other. This communication process ensures that the two experts have a thorough understanding of the other domain and how the two domains interact. Combining the two models into a single integrated model then highlights aspects of the system that may have been overlooked previously, for instance the states in which a document can be, highlighted by the case study. The process of combining the model therefore improves the overall alignment of the interactions between the business process domain and the information system domain.

Once the integrated model is ready to run, the simulation model controls the execution of the information systems prototype, and handles the data transference between the two aspects, so eliminating the possibility of the introduction of errors at the data transfer stage. The resulting model may run more slowly than a simple simulation model, but additional knowledge gained from integrating the domains means that this is an insignificant drawback, especially as computing power continues to increase and models can therefore be run much faster than previously.

Any changes required to either domain are automatically reflected in the other when the model is run, so many different scenarios in either or both domains can be tested to determine the most suitable set up for the integration of the two domains. Using the models as separate models would only provide the best set-up from that perspective, as opposed to the integrated perspective in which the real-life processes would operate.

Testing this method on the case study described in chapter 5 enabled a full analysis of the process involved in combining the two domains and the benefits of applying this framework.

6.3.2 The Final Framework and an Introduction to its Evaluation

The following sections bring together the final framework in order to evaluate it. In this section the framework is divided into four separate stages as shown in Figure 30. The four stages comprise of:

- Stage 1 – where the requirements for both the independent models and integrated model are determined,
- Stage 2 – where the independent models, a business process simulation model and IS prototype model are produced,
- Stage 3 – where the models are combined into the integrated model,
- Stage 4 – where the model runs and the analysis of the system is performed.

The reason to consider them in this way is because the practical application of the framework illustrated that the iterative nature of the stages identified that although the build, refine and validate processes are separate, they become so entwined that in effect it is a single process with an output of a validated model. However, rather than combine the build/refine/validate processes into a single process they remain as distinct processes to emphasise the iterative nature of the stage.

An evaluation of each of the four stages is discussed in the following sections (6.3.3 to 6.3.6). This is followed by an evaluation of the practicalities of applying the framework to the case study in section 6.3.7.

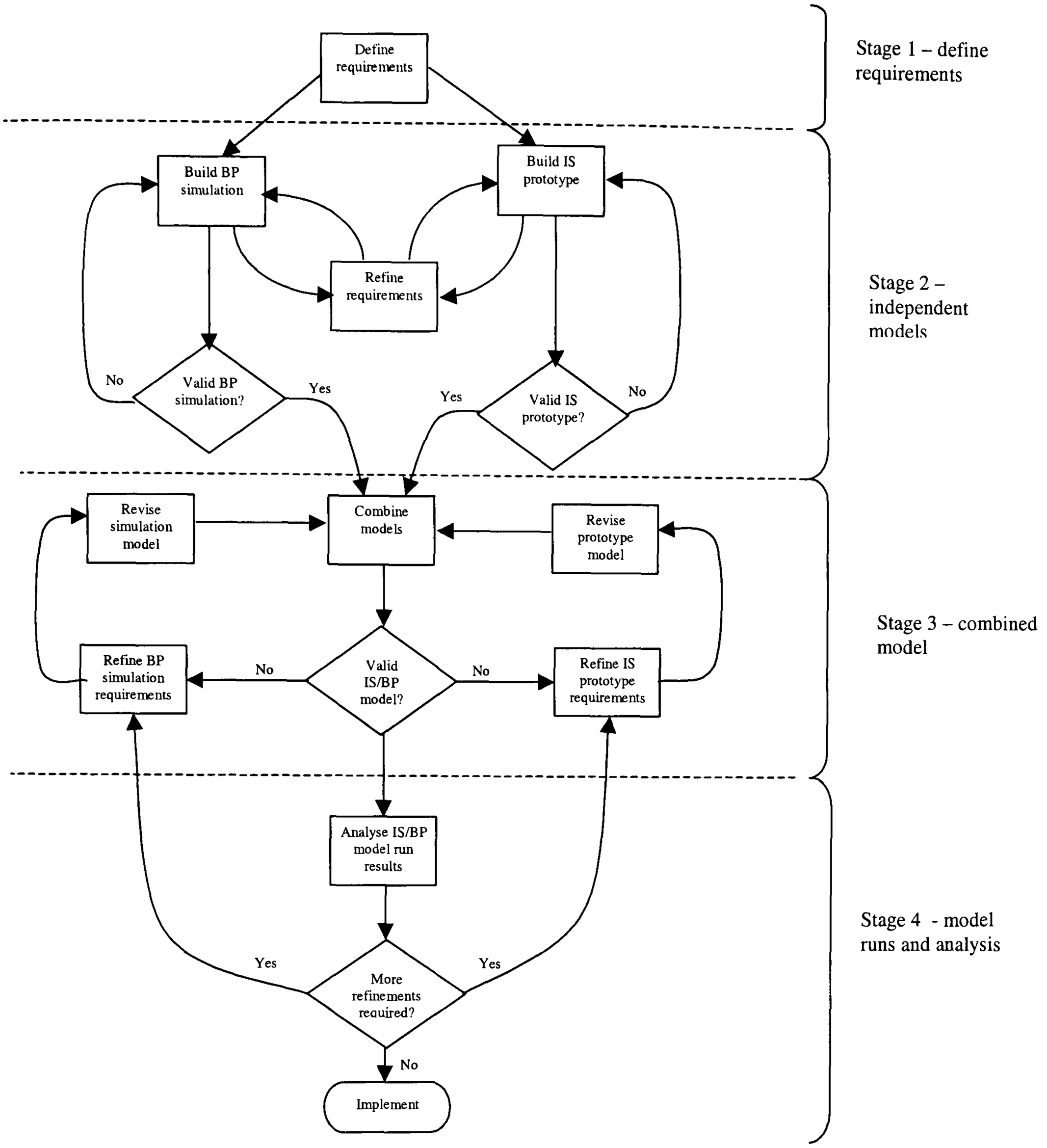


Figure 30. Framework stages for integrated simulation model

6.3.3 Define Requirements Stage

This stage is necessary to determine the scope of the problem and determine how and when the models will interact, as this describes their overall relationship. The individual requirements of the model and prototype also need to be described in terms of how detailed the model will need to be in order to model the interaction with the information system. It is also necessary to decide which processes are to be included in the prototype. Is one specific process being modelled with full functionality, or are all the processes to be modelled with limited functionality?

These specifications are important as they dictate the boundaries of what is to be included in the model/prototype, and ensures the compatibility when the time comes to combine the two models. More importantly it dictates what functions are to be modelled within the prototype and what functions will be modelled within the simulation. This is important, as the prototype cannot be fully functional – otherwise it would be the final product, but all the processes within the system must be modelled in either the prototype or the simulation model.

The most important aspect of the requirements stage of the framework is the communication between the two modellers. Both modellers must have the same understanding of the system to be modelled and the functions that are to be included within the system as a whole, and within the domains. Any of the functions that cross both domains must be examined to ensure that both modellers are aware of the implications to the other domain, and that the boundaries of the task are identified. The more time spent in the define requirements stage will reduce the time spent on revising the model and reduce the overall time to complete.

Defining the requirements in detail ensures credibility of the system, as possible future users will be confident that the system was well understood by the modellers and therefore have confidence in the results that it produces. Finally a detailed requirements analysis can be used as a reference throughout the model building process to ensure that the models remain compatible throughout the remainder of the process.

6.3.4 Independent Models

This stage of the framework allows the models to be built and validated independently, the requirements refined, and alterations made to the models. This is important because it is necessary to be sure that both the models are responding as expected before combining the two models. Building the models simultaneously as independent models also highlights other places where the model and prototype may need to interact, or the need include previously unforeseen functions into either model. By building the models simultaneously any changes that may fundamentally impact the other domain can be incorporated at this building stage. If however the models were to be built consecutively there may be reluctance to change an already completed model to incorporate changes. It is also advantageous to have the models

come from two different developers, each an expert in their modelling technique, as ambiguities are more easily uncovered, and solutions to problems can be discussed in detail to provide the best solution for both domains.

The initial model building stage requires the modellers to design how the model will be built taking into account how it will interact with the other model. In order for the model to be used as a validation technique for the information systems design the entities within the model have to be modelled as naïve in terms that they react only to information obtained from system itself. This concept of naivety must be built into the model from the initial stages.

Before the initial model is computerised some conceptual design of the system will be required. This needs to be done independently for the two domains using whatever the modeller feels are the most appropriate techniques, so this may be activity cycle diagrams for the business process modeller, or data flow diagrams for the information systems modeller.

Once a conceptual model is complete the modeller then builds an initial computerised model, and the iterative aspect of this stage starts. Once an initial model is complete it is verified and validated. There will be many changes and improvements that will need to be made to the initial model before it can be considered as a validated model of the system, and each alteration made must still conform to the original requirements specification. Incremental changes will be required as problems in the original requirements specification are uncovered and may impact just one domain. Larger changes that impact both domains may also be uncovered, requiring alterations to both aspects of the model. Any alterations, whether incremental or larger changes, must be incorporated into the requirements specification. This means that the builders of the models must interact closely to ensure that the requirements are constantly updated to ensure that the models can be effectively combined in the next stage.

Combining the refine requirements in this stage of the framework into a single task linked to both the models emphasises the importance of considering how the effects of any changes in one domain may affect the other, causing the modeller to focus on the overall impact. The business process modeller then is forced to think of the information system that underpins the processes, and the information system

modeller is forced to consider how the information from the system is likely to be used to affect the business processes. The overall effect of this is that it produces two models, each focussed from a different perspective, but as part of an entire system.

The iterative nature of the build, validate, refine processes is imperative. Even though in practical terms this appears as a single stage, to illustrate it as this within the framework would undermine the importance of the iterations required and the interaction involved in the revise requirements stages. These are both very important features of the framework and should not therefore be undermined by making it implicit rather than explicit.

6.3.5 Combined Models

This is similar to the independent models stage, in that the activities are so intertwined that again in practical terms they may be viewed as a single process. Again, however, the importance of the iterative aspect of the process cannot be overlooked and again is included to stress the importance of this stage, rather than leave it implicit. This fact that in this case the complexity of the cases underwent three different version changes, and the integrated model underwent about twenty iterations before producing a valid model emphasises the number of iterations that this stage may run to.

This is the longest of stage of the process, as this will be where the aspects concerning the interaction of the processes and the information system that were unforeseen in the original requirements stage will be identified. This stage of the framework is the most important because this is where the proposed information system can actually be tested in the simulated business environment, and problems can be identified. Processes can be adapted to benefit from improved information available, or the information system design can be altered to enhance the business process activities. Using this method it is possible to ensure that the two domains are in cohesion. The diaries and case structure documentation were used throughout the validation and refine requirements stages to identify alterations required to either of the domain models.

Separating the refine requirements activities in their different domains in this stage of the framework ensured that once the combined model was formed, both perspectives were still considered in any changes. As the business process simulation controls the

execution of the prototype code, the overall perspective of the combined model is the business processes. If any changes were to be made to the combined model, rather than splitting the model into its component parts, changes may become too focussed from the process perspective, overlooking the impact on the processes. Splitting the refine requirements emphasises the fact that both aspects of the system need to be included in the changes, preventing the model becoming too biased from any one perspective.

6.3.6 Model Runs and Analysis Stage

This stage is necessary to elicit the results from running the model and allowing analysis of how the information system will impact the overall process. The analysis of the result may still highlight other areas that could benefit from the proposed changes, and consequently more refinements could be required. However, most of the refinements that could be included will have been identified in either of the previous two stages during the iterations.

As a consequence of modelling the entities naively, the information system design can be validated using the model. The combined model need only be studied to confirm that the entities perform the correct tasks at an appropriate time. In the case of the case study the dairies provided a record of the tasks that each of the entities had undertaken, and a list of the documents included in each case. A thorough examination of these diaries and case structure documentation provided evidence that the information system was producing correct and timely information to the model entities.

Although the analysis stage is important for demonstrating to other parties the effects of the information system the most important stages within the framework are the previous stages where the model is designed, built and revised iteratively, because it is at these stages that the modeller gains the greatest understanding of how the various process are related and how they impact on each other. The analysis stage allows different scenarios to be compared against each other to improve the process and compare different scenarios.

6.3.7 Practical Application

Applying the framework to the case study provided an opportunity to test the framework on a large system, and provided a greater insight to the practical

application. The case study concerned the arbitration process, which is very well defined and the opportunities to alter the processes in any way were very limited. However, there was no such restriction on the information systems domain. As there is no existing system in place, no consideration had to be given to any legacy components. These two factors provided an ideal case study for the framework to be tested on. The refine requirements activity, at the independent models stage in particular, provided plenty of opportunity for discussion on how the models would be linked, and the range of responses required. This stage actually highlighted many more points of interaction between the two systems than envisaged in the initial requirements and consequently both modellers gained a good working knowledge of the other model, and through this an understanding of the other aspect of the system. Much closer communication was required than originally considered, but if geographical closeness was impossible, then the communication technology available today proved to be a reasonable substitute. Combining the models highlighted problems that had been unforeseen in either domain prior to the integration, and it is this fact that indicates the usefulness of the framework. The prototype had been validated independently at the previous stage, but it wasn't until it was combined with the business process model that certain problems were seen. One such problem was the batch sizes, where initially certain documents had been grouped together thus with the intention to submit or distribute together that worked in the prototype, but when combined with the stochastic nature of the simulation model occasionally failed. If this had not come to light through the simulation model the prototype could have been implemented, causing cases to fail through due process not being adhered to in the document distribution stages.

The overall time taken to design and build the model was longer than building a traditional business process simulation model, but this has to be balanced against the additional information obtained by linking the two models. The traditional simulation model only captures three of the four perspectives, while the linked model gives a more complete picture by capturing all four perspectives. The complexity and worth of the system to be scrutinised would be the largest factor in decided whether the building of the integrated model is worth the additional cost of building it, and therefore I would suggest that it would not be viable in a small project, but in a large project many benefits could be obtained from the integrated model.

Chapter 7: Summary and Conclusions

7.1 SUMMARY

Business processes and information systems are closely related in practice, but although this relationship between the two domains is well documented the practical implications of the relationship is not always entirely understood. When investments in information technology are made their integration into the business processes that will operate in conjunction with the information system are not fully evaluated leading to the disappointments experienced when the technology fails to make the anticipated improvements to the process.

The purpose of this research was to develop a method to assist in the analysis of this relationship at the development stage in order to reduce the number of disappointments experienced. The aim of this chapter is to summarise and evaluate what has been achieved throughout the process of this research. A brief summary of each chapter is provided in enough detail to make the findings of the following section clear without having to refer to chapters two to six.

7.1.1 Background to Research

Information technology is an important enabler of business process change, and therefore any business process change project should involve analysis in both the information technology domain and the business process domain. In chapter two four different perspectives of systems were identified; functional; behavioural; organisational; and informational. In order to gain a complete understanding of a system all four perspectives need to be addressed. However, an analysis of the available business process modelling techniques demonstrated that none of the available techniques could address all four perspectives, and that most techniques addressed only one or two of the perspectives. Simulation modelling however, was able to address three of the four with the remaining informational perspective being able to be addressed in a limited fashion. As the aim of the research is to investigate

an integrated model to address the impact that information technology and business processes have on each other simulation modelling techniques appear well-placed to address some of the perspectives. This is due in particular to the dynamic nature of simulation modelling techniques, whereas the majority of techniques used to model information technology are static. The advantages of dynamic modelling techniques to address this type of problem include the ability to explore how changes to one area of the system can impact another, seemingly disparate part of the system, as well as looking at longer-term effects – both aspects that are relevant in establishing the nature of the relationship between the two domains.

In order to address the informational perspective various information system development methodologies and techniques were examined. The search was limited to those techniques that claimed to be dynamic, as integrating a static technique with the dynamic abilities of simulation would mean losing some of the benefits of dynamic modelling. Various dynamic techniques were analysed for their ability to capture the evolving nature of the information system, and computer network simulation modelling was found to be the only one that truly captured the effects of time on technology, as the other dynamic techniques only captured the different possible states at particular moment in time. Computer network simulation captures how data and communication links are used within a system and therefore can capture the fourth perspective that is omitted in business process simulation.

7.1.2 Exploratory Approaches

Chapter three looked at how the simulation techniques used in different domain areas could be combined to investigate the relationship between information technology and business processes. The initial proposition was to combine computer network simulation with business process simulation, examining the relationship from this level. It was determined that combining these two domains through simulation was inappropriate because they were working at different levels of abstraction, the computer network dealing with times measured in fractions of seconds and the business processes dealing with activities lasting minutes or even hours. To overcome this problem an information system layer was added, initially as a separate layer, and then, when this approach produced too many additional problems to be viable, as a sub-level in the business process layer. This method, known as the ASSESS-IT approach, overcame some of the initial limitations of the earlier

proposal. One of the problems in the three model approach was that data now needed to be transferred between the three models, doubling the amount of data transfer than originally envisaged. In the ASSESS-IT approach there was no need to transfer data from the business process level to the information system level, reducing the data transference to the original level. Additionally, any changes in one would automatically be reflected in the other without having to re-run independent models. However there were still problems in this approach in terms of transferring the data from the computer network level to the information system level of the business process model.

The models were tested using an exploratory case study to analyse the viability of using the method in a larger study. Running the models demonstrated that the need to incorporate the computer network domain into the analysis was unnecessary in those cases where the response time was not critical to the overall process. Also the increase in time to design and build the computer network model, and the increase in the complexity of defining the activities within the business process/information systems level meant that the additional information supplied by the computer network domain may not be cost-effective for any large scale model. As the particular types of processes that we were concerned with were non-time critical and potentially large complex problems, it was concluded that the computer network domain could be eliminated from the research, and should concentrate instead on the relationship between just the information systems layer and the business process layer.

7.1.3 Integrated Modelling Framework

Chapter four looked at the problems associated with the ASSESS-IT approach and concluded that there were some problems even if the two domains were considered without the computer network domain. One of the problems was that the model of the business process level had become far more complicated, introducing both delays in running the model and scope for errors within building the model. However a closer analysis of the method found a far more fundamental flaw, in that an assumption had permeated the hypothesis that implied that the information system was working correctly and supplying timely and relevant information for the purposes of the business processes. This assumption however was not intentionally included but instead had evolved because the ASSESS-IT approach had been looking

mainly at the physical attributes of the information system rather than the informational aspect of the design. This was a fundamental flaw in the ASSESS-IT approach and the implications for the research were significant. A review of the research that had contributed to this hypothesis implied that the way that the simulation techniques had been applied to the problem was inappropriate. Simulation techniques had failed to capture the informational aspect of the information system, which is the aspect that has the largest impact on the business processes, and what was required was a technique that could capture these informational aspects in a dynamic manner. Returning to the techniques used for modelling information systems that were analysed in chapter two indicated that prototyping was a tried and tested method of designing information systems. Prototyping has similar advantages to simulation, but is able to capture the dynamic nature of *informational changes* that are so important to the business process that depend on the information.

The advantages that can be gained by integrating prototyping and simulation techniques to address this problem were examined, and the previous approaches to combine the techniques were further developed using prototyping in place of computer network simulation. As prototyping is able to capture the informational changes within the system, combining prototyping with simulation modelling techniques allows analysis of the information system *within the context* of the business processes that will utilise it. Combining the two models however provides more than the ability to address the four perspectives; by modelling the users as naïve entities who react only to information received from the system, it provides a method of validating the design of the information system within the business processes and so confirming that the system will perform to the users satisfaction. The chapter concludes with the presentation of a framework that identifies the stages in building a combined model.

7.1.4 Testing the Framework

Chapter five uses the framework developed in the chapter four and applies it to a case study of arbitration practice. Arbitration practice is currently conducted without any electronic communication, and the purpose of the project was to examine the effects of introducing electronic facilities, in particular communication and the submission of documentation, to arbitration proceedings. The chapter explains the arbitration process in some detail and highlights specific problems at each stage of

the process that the proposed information system will have to address. The second half of the chapter steps through the framework stage by stage applying it to the case study and highlights how each of the problems highlighted previously is addressed. A detailed description of the issues uncovered while building the models is given, and how they were resolved to improve the overall design of the information system and business processes as independent systems. The two models are then combined to provide an integrated model of the system and tested for validity. At this point some issues were uncovered that illustrated that the combined model provided a more thorough view of the system than the independent models. Some of the original requirements had to be revised when it became apparent that additional states for some entities were required to ensure that the system return relevant information to all parties at all times. This aspect of the interaction between the two domains would have been overlooked if the two models of the system had not been combined. The model was then modified to encompass these changes, and then verified and validated. The chapter closes with a description of the cases that were generated to test the model and analyse the effects of introducing electronic facilities to the arbitration process.

7.1.5 Output Analysis

Chapter six gives a review of the results taken initially from the project perspectives to analyse the impact of the information system on the arbitration processes, then from the perspective of the research objectives. The output from the project perspective indicates that the impact of the proposed information system does not have the benefit of significantly speeding up the arbitration process as was first anticipated when the proposal was initially suggested. However, it did highlight other benefits that may have otherwise been overlooked. The fact that a decrease in time to complete a case would not be realised by investment in the technology was identified by the method means that the method had highlighted one area that would have created the disappointments associated with information technology investment. However with highlighting other benefits it is possible to see whether the investment would still be a viable option. The most important project output was the case management system that emerged as a result of integrating the information system with the business processes. This meant that users of the system would be able to monitor the state of their case on-line and that they would receive e-mails informing

them of their responsibilities in respect to the case, and time-limits to submit documentation.

The research objectives therefore were also met by the fact that the framework had produced a model that could indicate more fully the relationship between the information system and the business processes. This was highlighted by the necessity of having to change the original requirements specification after running the combined model. This was an indication that the model was now capturing the informational perspective that had not previously been captured in the standard simulation model and a fuller picture of the system was obtained.

As a result of the users being modelled naively, the information system can be validated within the confines of the business process model. In order to analyse the impact of the information system on the processes, diaries of the actions of the users were obtained. As the users only react to the information that they receive from the system, validating the system as a part of the processes was simply a matter of analysing the users actions. If the users took the appropriate action it implied that they must have received the correct information from the system. This validation of the system within the context of the processes is an important research outcome as it allows the design of the information system to be better aligned to the business processes, thereby reducing the disappointments experienced with information systems not producing the required results.

The final section in chapter 6 looks at how the research outcomes can be applied to other projects, and the practical implications of this. The framework is split into four sections; define requirements, independent models, combined model, and model runs and analysis stages. The independent model and combined model stages both are iterative procedures that in practical terms are so intertwined that they effectively are a single activity that produces a validated model. However, they are kept as separate activities to stress the importance of the iterative nature of the stage. Each of the stages is addressed in turn in terms of practical issues that emerged through building the model. One of the main issues raised was that close communication between the model builders was imperative if the models were to remain compatible throughout the process.

7.2 CONCLUSIONS AND CONTRIBUTION

This section draws conclusions from the results from the research presented in chapter 6 and determines whether the research achieved the objectives. The three contributions presented in this dissertation are that:

- The integrated model provides a method of validating the information system design within the business processes that it is designed to support.
- The model effectively captures all four perspectives of an organisation providing a more complete model than possible with simulation alone.
- The integrated model provides the ability to dynamically animate the information system model over time, utilising simulation modelling advantages in the information system domain.

7.2.1 Conclusions

The research initially aimed to look at the integration of the two domains, information systems and business processes, with the aim of being able to analyse the impact of information system investments on business processes, thus reducing the disappointments often experienced with investment. The initial approaches attempted to model the communication aspect of the information system. This was done as the network facilities were envisaged as part of the investment and therefore were to be included in the model in order to catch the temporal aspects of the system. The use of the exploratory case study indicated that there were problems with simply trying to capture the communication aspect of the information system, but more importantly there was an implicit assumption that the design of the information system was a valid one.

These problems with the models inability to capture the informational perspective of the information system led to a change in focus for the research. A review of the dynamic techniques in information systems design suggested that prototyping would have the capabilities to capture the status changes required in the informational aspect, and that combining it with simulation modelling would enable the construction of an integrated model that truly could capture the interactions between the two domains.

However as the research progressed it became evident that the original focus of the integration had been inappropriate, and that the focus should be at the informational level rather than at the communication level. This change in focus led to the research producing results beyond what was originally anticipated. Instead of simply being able to analyse the impact of information systems on the business processes, the results allowed the validation of the design of the information system and therefore the better alignment of the information system and the business processes.

7.2.2 What Use Is It?

The validation of the information system design with respect to the business process is an important research outcome as techniques exist that can verify that the design will work, but this does not mean that the design is necessarily correct within the needs of the business processes. The framework presented in this dissertation provides a method that enables the user to determine the suitability of the design within the context of the business processes and then alter the design to better align the processes if necessary. In this way the design can be refined until the most suitable design is achieved, and the impact of the information system on the business processes can be predicted with confidence.

The most visible contribution of this research therefore is a framework that provides a method of validating the information system with respect to the business processes. Previously prototyping has been used to evaluate if the system is a valid design, but the design itself has not been validated within the context of the business process environment. The framework provides a method of validating whether the system designed is well aligned with the business processes that will utilise it.

This actually surpasses the original research objective of simply using dynamic modelling techniques to analyse the effects of information technology investments on business processes, and provides a way of aligning business processes and information systems to devise a better overall system that meets the requirements of both domains, and so reduce the disappointments so often related to IT investments. The effects of this contribution can be seen in the case study, where although the information system had been validated as an independent model, when combined with the business process model some faults in the design were highlighted. These design faults are related not to the information system design, but to how the

business processes and the information system interact, and could not have been fully predicted at the requirements stage.

One of the problems identified with the existing modelling techniques was the inability of the techniques to address the four perspectives identified in chapter 2 – organisational, functional, behavioural, and informational. The integrated model that is the result of applying the framework addresses all four perspectives providing a more complete view of the system under study than had been previously possible using any of the established modelling techniques. Increasing the number of perspectives that a particular technique can capture within the model improves the analysis of the system by better indication of how one aspect of the system can affect an apparently disparate part of the system.

Combining prototyping with simulation modelling techniques therefore allows a more thorough analysis of how the two domains interact than in the previous studies mentioned in section 2.3.1. In particular it allows both the business processes and information systems domains to be designed concurrently providing the opportunity to better align the two domains, and the validation of the information system design within the business process context, improving on the work by Love et al. (1987).

Furthermore, combining the simulation model with the prototype model provides an integrated dynamic model of the system under study capturing the four perspectives and therefore giving a fuller picture than either of the two models could capture alone. This integrated dynamic model is an important contribution of this research and expands on the work by Al-Ahmari and Ridgway (1999) and Painter et al. (1996) presented in section 2.3.1. By incorporating the prototyped model with simulation modelling techniques, the framework provides a method of modelling the information system in a dynamic model, which can capture how the system will evolve over time. Traditional information system modelling techniques that claim to model the system dynamically fail to capture the effects of competition for resources and therefore effectively can only capture a single instances in time, rather than how the system will need to evolve to deal with the changing demands of the business processes that it supports. Systems naturally evolve over time, but current dynamic information systems modelling tools are unable to capture this. However, by integrating the informational aspect in the prototyped model with the organisational aspect in the simulation model, the resulting model is a truly dynamic model of the

entire system under study, and therefore the natural evolution of the system can be analysed over a long time period.

Integrating the two modelling techniques also provides benefits in that the experimental capabilities of the integrated model are expanded. In a prototyped model the system can be analysed by testing it with various different test cases, however, although the states of various variables can be checked to determine whether they contain the correct information, it is difficult to determine how the information will be altered as time progresses as the prototype model does not have a temporal aspect. By combining the models time delays can be incorporated through the simulation model and the temporal effects can be effectively added to the prototyped model, increasing the potential to thoroughly test the system prior to implementation.

7.3 Further Research

This section looks at the applicability of the framework to other cases, and discusses the practical implications as well as any limitations within the framework. From the issues raised, areas that would be suitable for further research into this topic are identified.

The case study showed how the framework could be applied to a situation where there was no existing information technology, and the proposed information system could be designed from first principles. In this case there are no restrictions on the design in terms of existing data structures, and therefore this is the scenario that is most likely to gain benefit from the proposed framework. However, this does not mean that the framework cannot be applied in other types of projects where there are existing information systems. In fact it is these cases that are likely to make up the majority of IT-enabled process change projects that the framework is designed to address. When an existing information system is to be added to, the framework requires that a prototype should be built to incorporate into the model. There are two possible views concerning this situation. The first is that, as the information system already exists, to build a prototype is a time-consuming and costly business that may be unnecessary and therefore using the framework may not be a cost-effective way to provide a solution. The second viewpoint is that a 'fully-functional prototype' is in existence and could be used as a basis for the proposed system. In this case the

prototype is already half-built and previously verified reducing the development time. However, incorporating the existing information system structure into a format that the simulation model can access may prove to be more time-consuming and expensive than re-writing the prototype. Which of these two viewpoints is more appropriate will depend on the size and complexity of both the existing information system and the additional functionality that is to be added.

These cases are likely to gain from prompting an analysis of what restrictions are imposed by the legacy system and how these restrictions may be addressed and incorporated into the proposed system. In re-engineering projects where business processes are radically changed the framework could be used to compare different scenarios. However if the requirements of the various scenarios contained major differences it may be costly and expensive to build a model for each of the scenarios, due to the level of communication required between the builders of the two domains. However, simulation of the business processes alone could be used to eliminate some of the less desirable scenarios, and integrated models could be built, using the framework of the short-listed scenarios. The integrated model could then demonstrate the interactions between the two domains ensuring that the information system is the most appropriate design to be used in conjunction with the proposed processes.

In order to make the framework more accessible to these cases, more research would be needed in guiding the model builder in how the legacy system can be incorporated into the integrated model, and identification of those parts of the legacy system that restrict the design of the proposed system.

This framework relies on the assumption that the business processes do not require time-critical responses from the information system and therefore the computer network domain does not need to be included in the analysis. Regardless of whether the system under review has an existing information system or not this particular criteria must still be true. This however does not mean an analysis of a system that necessitates real-time responses are not possible using the framework, just that the framework is designed to analyse how well the information system fits the purposes of the business processes rather than provide results on the speed at which a response will be given. This is not really a limitation with the framework, as it is anticipated that any system needing real-time response times will have the underlying

technology to achieve the necessary response times. However, business processes, as the framework is designed to address, will generally not require such times, and providing that network usage is kept at a low level – a realistic aim given today's communication and processor speeds – the network usage should not impact the business processes to any noticeable level.

Combining simulation modelling with prototyping requires that the simulation modelling package chosen has facilities to interface with the prototype model. This research was conducted using the ARENA software that has the capability of importing VisualBasic code, and provides access to simulation variables. Most simulation modelling packages provide some level of programming capabilities to enhance the accuracy of the model, but many of the interfaces are limited. The integration of the two models is fundamental to the framework and requires that the simulation package has good interface capabilities which effectively limits the choice of package. However, as simulation models are getting progressively more complex, software houses are incorporating better facilities for importing sections of code written in non-simulation languages. If this trend continues it may be possible that the existing information systems code will be able to be directly imported into the simulation without the need of translating it to an appropriate language and the framework will become a cost-effective method of solution.

Another aspect of the framework that must be remarked upon is the alignment of the requirements between the business process model and the information system prototype. In the case study, arbitration is governed by very strict rules that must be adhered to. This meant that the requirements stage of the process was better defined than in a general project of this type. As it is essential that the design of the two models is an exact match this definition of the requirements is an important part of the process. The framework gives a little guidance on how this could be done in general terms, but a more in-depth analysis of identifying how the requirements can be split between the models would prove beneficial. The framework would be much improved with a more in-depth analysis of how the models should be defined to ensure compatibility between the models at all stages of the process.

Finally, the framework is designed to analyse the effects of IT-enabled change and effectively achieves this from the business process perspective. However, many of the advantages that are the result of IT-enabled change are qualitative and are

therefore difficult to capture within a simulation model. Qualitative benefits are notoriously difficult to capture in a meaningful way, but some techniques do exist that have some success in this area. The effectiveness of the framework could be further enhanced by integrating some form of measure of change in the qualitative benefits expected by the investment, thereby incorporating a dimension to the framework that has not been addressed by this research. This is far beyond the scope of the original objectives, but as the main benefits of many IT investments may in fact be qualitative or strategic, this extension to the framework would increase its ability to address all aspects affected by the introduction of information technology to business process domains.

Appendix A: Comparison of Rule Sets

The tables displayed here are an extract from Eatock and Elliman (2001) taken from the report entitled "*Comparison of Arbitration Business Process Models: E-Arbitration-T IST-2000-25464/2.3/UBRUN/2002/R/1*" which was compiled as part of the E-Arbitration-T project.

The rule sets used to compile the tables are listed below. The entries in the tables refer the reader to the section within the particular set of rules for each point. Some points are not explicitly dealt with in the rule sets (e.g. allow amendments to pleadings) and in these cases it is for the panel to decide whether how the matter should be dealt with. The comparison of the rule sets is included to illustrate to the reader the variations and complexity that was necessary to incorporate into the models.

London Court of International Arbitration (for arbitration commencing on or after 1 January 1998)
http://www.lcia-arbitration.com/rulecost/english.htm

The UNCITRAL Arbitration Rules
http://www.uncitral.org/english/texts/arbitration/arbitrul.htm

ICC International Court of Arbitration
http://www.iccwbo.org/court/english/arbitration/pdf_documents/rules/rules_arb_english.pdf

American Arbitration Association – International Arbitration Rules
http://www.adr.org/rules/international/AAA175-0900.htm

Chartered Institute of Arbitrators (UK) (2000 edition)
http://www.arbitrators.org/Materials/Arb/rules.htm

American Arbitration Association International Rules of 1997 (available from the AAA web-site) http://www.adr.org/

American Arbitration Association – eCommerce Dispute Management Protocol
to be published

Uniform Domain Name Dispute Resolution Policy
http://www.eresolution.com/services/dnd/p_r/icannrules.htm

The United Kingdom Arbitration Act 1996
http://www.hmso.gov.uk/acts/acts1996/1996023.htm

The UNCITRAL Model Law
http://www.uncitral.org/english/texts/arbitration/ml-arb.htm

The 1958 New York Convention
http://www.uncitral.org/english/texts/arbitration/NY-conv.htm

European Convention on International Commercial Arbitration
http://www.internationaladr.com/european_convention_of_1961.htm

European Convention providing Uniform Law on Arbitration
http://conventions.coe.int/treaty/en/treaties/html/056.htm

European Convention for the Peaceful Settlement of Disputes
http://www1.umn.edu/humanrts/peace/docs/europeace.html

Table 5 Definitions of Actors

	International				Local or Limited						Default			European		
Rules	**LCIA**	**UNCITRAL**	**ICC**	**AAA**	**CIArb**	**AEDED**	**CameraCT**	**CIArb-SF**	**AAA-eC**	**ICANN**	**UK**	**ML**	**NY58**	**Int. Commercial Arbitration**	**Uniform Law (Annex 1)**	**Peaceful Settlement of disputes**
Parties – defined by agreement					12			12		1	82(1)					
- more than two allowed			2(ii)													
Claimant – defined by placing request	1.1	3(1)	2(ii)	2(1)	2.2			2.2		1	82(1)					
Respondent – defined in request	1.1(c)	3(1)	2(ii)	2(1)	2.2			2.2		1						
Arbitrator	5.2									1[4]	82(1)					
Chairman	26.3&26.5		8(4)	6.3 presiding	4.3			4.3		6(e)[5]	20				9[6]	
Sole Arbitrator		6	8(2)		4.1			4.1				2(b)[7]			5.1	
Umpire											21					
Appointing Authority	5.5	6		(AAA)	3.1			3.1								
Court	Intro		1(1)								105	2(c)				
Registrar	1.1															
Legal Practitioners and other representatives	18	4	21(4)	12	5.3			5.3		8	36					
Witnesses	20	25	20(3)	20(2)	8.4	9		8.4			38(5)					
Specialist advisors or Experts	21	27	20(3)	22	7.2			7.2			37(1)	26				

[4] Referred to as "Panelist" rather than arbitrator
[5] Referred to as "president of panel"
[6] Referred to as "president of the arbitral tribunal"
[7] This is implied rather than a definition of duties

Table 6 Commencement and Content of Request

	International				**Local or Limited**						**Default**			**European**		
Rules	**LCIA**	**UNCITRAL**	**ICC**	**AAA**	**CIArb**	**AEDED**	**CameraCT**	**CIArb-SF**	**AAA-eC**	**ICANN**	**UK**	**ML**	**NY58**	**Int. Commercial Arb**	**Uniform Law (Annex 1)**	**Peaceful Settlement of disputes**
When Arbitration is considered to have started	1.2	3.2	4.2	2.2	2.1			2.1		4(c)	14	21				
Items contained with Request for Arbitration	1.1	3.3 & 3.4	4	2.3	2.2			2.2		3(b)					7	
Names and Contact details of Claimant	✓	✓	✓	✓	✓			✓		✓						
Names and Contact details of Respondent	✓	✓	✓	✓	✓			✓		✓						
Arbitration agreement	✓	✓	✓	✓	✓			✓								
Contractual Documentation	✓	✓	✓	✓	✓			✓								
Nature of Dispute	✓	✓	✓	✓	✓			✓		✓[8]					✓	
Language	✓		✓	Optional												
Seat of Arbitration	✓		✓	Optional												
Number of Arbitrators	✓	✓	✓	Optional	✓			✓		✓						
Qualifications of Arbitrators	✓				✓			✓								
Nomination of Arbitrators (if required)	✓	Optional	✓	Art. 6	✓			✓		✓					✓	
Fee	✓		✓		✓					✓						
Confirmation that copies sent to respondent	✓				✓					✓						
Relief or remedy sought		✓	✓	✓	✓			✓		✓						
Statement of Claim		Optional		✓												
Applicable rules of Law			✓													
Preferred method of communication										✓						
Other legal proceedings										✓						
An agreement to abide by decision										✓						
Responsibility for informing Respondent	Claimant	Claimant	Secretariat	Claimant	Claimant			Claimant		Provider					Claimant	

[8] See Article 3(b)(ix) 1-3

Table 7 Content of Response

	International				Local or Limited						Default			European		
Rules	**LCIA**	**UNCITRAL**	**ICC**	**AAA**	**CIArb**	**AEDED**	**CameraCT**	**CIArb-SF**	**AAA-eC**	**ICANN**	**UK**	**ML**	**NY58**	**Int. Commercial Arb**	**Uniform Law (Annex 1)**	**Peaceful Settlement of disputes**
The Response Article/Section/Paragraph	2.1	19	5	3	2.3			2.3		5		23				
Number of days	30	-	30	30	14			14		20		-				
Confirmation or Denial of Claims	✓	✓	✓		✓			✓		✓		✓				
Nature of Counter-Claim	Optional	Optional	Optional	Optional	Optional			Optional								
Can Counter-Claim be included at a later stage?	yes	Arb's discretion			yes			yes		No						
Are amendments allowed?				Arb's discretion						No		yes				
Comments on arbitration arrangements within Claim	✓		✓	✓	✓			✓		✓						
Nomination of Arbitrator (if required)	✓		✓		✓			✓		✓						
Confirmation that response is being served on Claimant	✓									✓						
Comments on relief or remedy sought		✓	✓													
Evidence supporting defence		✓														
Name of respondent, description and address			✓							✓						
Responsibility for informing Claimant	Respondent	Respondent	Secretariat	Respondent	Respondent			Respondent		Respondent						
Relief sought for counterclaim			✓													
Preferred method of communication										✓						
Other legal proceedings (commenced or terminated)										✓						

Table 8 Appointment of Arbitrators

	International				Local or Limited						Default			European		
Default Rules	**LCIA**	**UNCITRAL**	**ICC**	**AAA**	**CIArb**	**AEDED**	**CameraCT**	**CIArb-SF**	**AAA-eC**	**ICANN**	**UK**	**ML**	**NY58**	**Int. Commercial Arb**	**Uniform Law (Annex 1)**	**Peaceful Settlement of disputes**
Are Arbitrator's qualifications implied	✓	✓									✓					
Article/Section/Paragraph	5.5	8.2														
Nationality																
Can it be the same as any Party?	No			Yes								Yes		Yes	Yes	
Article/Section/Paragraph	6											11		III	20.2	
Nationality must be considered		6.4	9.1	6.4												
Sole Arbitrator nominated by																
Appointing authority	✓									✓[9]		✓			✓	
Agreement by parties		✓	✓		✓			✓			✓					
Article/Section/Paragraph	5.4	6.2	8.3	6	(4.2)			(4.2)		6(b)	16(3)	11(3)(b)			7.3	
Chairman nominated by																
Appointing authority	✓									✓						
Other Arbitrators		✓			✓			✓			✓	✓				
Court			✓													
Article/Section/Paragraph	5.6	7.1	8.4		(4.2)			(4.2)		6(e)	16(5)(b)	11(3)(a)				
Number of Arbitrators	1	3	1	1	1	3		1		1	1	3			3	5
Article/Section/Paragraph	5.4	5	8.2	5	(4.2)	5		(4.2)		6(b)	15(3)	10(2)			5.3	20.2
Vacancy filled	11.2	13.1	12.1	10	4.4			4.4			27	15			10.1	22
At request of parties					✓			✓								
At request of arbitrators					✓			✓								
By default	✓	✓	✓	✓							✓	✓			✓	✓

[9] Referred to as 'Provider' rather than appointing authority

Table 9 Powers of a Tribunal

	International				Local or Limited						Default			European		
Rules	**LCIA**	**UNCITRAL**	**ICC**	**AAA**	**CIArb**	**AEDED**	**CameraCT**	**CIArb-SF**	**AAA-eC**	**ICANN**	**UK**	**ML**	**NY58**	**Int. Commercial Arb**	**Uniform Law (Annex 1)**	**Peaceful Settlement of disputes**
Overall Rules		15.1	15.1	16.1	7.1			7.1		10(a)	34	19(2)				
Language	17.3	17.1	16	14		8					34(2)(b)	22(1)				
Order documents to be submitted with a translation	17.4	17.2		14		8				11(b)		22(2)				
Arrange date/place/time of hearings	19.2	16.1	14.2	13.1		9					34(2)(a)					
Require notice that witness is to called	20.1	25.2	20.3	20.2		9										
Appoint Experts to report to Tribunal	21.1	27.1	20.4	22.1	7.2			7.2			37(1)(a)	26(1)(a)				
Allow amendments to pleadings	22.1(a)										34(2)(c)	23(2)				
Change time limits	22.1(b)	23														
Conduct necessary or expedient enquiries	22.1(c)															
Order any property/site/object be made available for inspection	22.1(d)	24.3	20.5									26(1)(b)				
Order any documents to be produced for inspection	22.1(e)	24.3	20.5	17.1						12	34(2)(d)	26(1)(b)				
Power to rule upon own jurisdiction	23.1	21.1		15.1							30(1)	16(1)			18.1	
Order a party to provide security	25.1(a)	26.2									38(3)					
Order preservation/storage/sale/disposal of property	25.1(b)	26.1														
Determine applicable rules of law			17.1								46					
Allow different disputes to be heard concurrently/consolidated					7.3			7.3			35(1)					

Table 10 Transmission of Documents

	International				Local or Limited						Default			European		
Rules	**LCIA**	**UNCITRAL**	**ICC**	**AAA**	**CIArb**	**AEDED**	**CameraCT**	**CIArb-SF**	**AAA-eC**	**ICANN**	**UK**	**ML**	**NY58**	**Int. Commercial Arb**	**Uniform Law**	**Peaceful Settlement of disputes**
Time limit counts from																
Date of receipt of communication										✓						
Date following receipt of communication	✓	✓	✓	✓	✓			✓			✓					
Article/Section/Paragraph	4.6	2.2	3.4	18.2	(11.3)			(11.3)		2(f)	78(3)	3(1)				
Communication deemed to be received on date of delivery	✓	✓	✓							✓	✓	✓				
Article/Section/Paragraph	4.3	2.1	3.3													
Forms of communication allowed																
Recorded/registered post	✓	✓	✓	✓	✓					✓	✓					
Electronic methods (providing delivery can be verified)	✓					✓				✓						

Table 11 Document Production and Exchange Rules

	International				Local or Limited						Default			European		
Rules	**LCIA**	**UNCITRAL**	**ICC**	**AAA**	**CIArb**	**AEDED**	**CameraCT**	**CIArb-SF**	**AAA-eC**	**ICANN**	**UK**	**ML**	**NY58**	**Int. Commercial Arb**	**Uniform Law**	**Peaceful Settlement of disputes**
Communication																
Prior to Arbitrators appointment	Registrar		Secretariat	Admin		Secretariat				Provider						
Article/Section Paragraph	13.1		3	2		2				3						
After Arbitrators appointment	Arbitrator		Secretariat	Arbitrator	Arbitrator	Secretariat				Admin.	Arbitrator	Arbitrator				
Article/Section Paragraph	13.2		3	16.4	5.2	3				8	34(2)(d)	24(3)				
Statement of Case (if not included in Claim) (Claimant)																
Days	30				28			28								
Article/Section Paragraph	15.2				8.6(a)			2.4(a)[10]								
Statement of Defence (+Counter-Claim) (Respondent)																
Days	30		30	30	28			28								
Article/Section Paragraph	15.3	19.1	5.1	3.1	8.6(b,c)			2.4(b,c)[10]								
Statement of Reply (+Defence to Counter-Claim) (Claimant)																
Days	30		30	30	28			28								
Article/Section Paragraph	15.4	19.4	5.6	3.2	8.6(d)			24(d)[10]								
Statement of Reply to Defence to Counter-Claim (Respondent)																
Days	30				14			14								
Article/Section Paragraph	15.5				8.6(e)			2.4(e)[10]								

[10] Paragraph xx in Alternative Article 8 of Short Form Procedure

Table 12 Hearings, Challenges and Waivers

	International				Local or Limited						Default			European		
Rules	**LCIA**	**UNCITRAL**	**ICC**	**AAA**	**CIArb**	**AEDED**	**CameraCT**	**CIArb-SF**	**AAA-eC**	**ICANN**	**UK**	**ML**	**NY58**	**Int. Commercial Arb**	**Uniform Law**	**Peaceful Settlement of disputes**
ritten Witness Statement	20	25.5		20.5	8.7(c)	9[11]										
ritten Expert Reports	21	27.3	20.4	22.3	8.7(d)	9[11]						24(3)				
easons to challenge arbitrator	10.3	10.1	11.1	8.1							24(1)(a)	12(a)				
umber of days from appointment or circumstances becoming known allowed r challenge	15	15	30	15								15				
Article/Section Paragra	10.4	11.1	11.2	8.1								13(2)				
ho decides on challenge (if parties do not agree & arbitrator elects not to sign)	Court	Appoint Auth.	Court	Admin.							Court	Arbitral Tribunal				
Article/Section Paragra	10.4	12.1	11.3	9							23(5)	13(2)				
rbitrators to decide on jusidiction	✓	✓		✓							✓	✓				
Article/Section Paragra	23.1	21.1		15.1							30(1)	16(1)				
hallenges to jurisdiction to be made by time of Defence	✓			✓								✓		✓		
Article/Section Paragra	23.2			15.3								16(2)		V(1)		
earing a right?	✓	on request	on request	✓	✓						Tribunal	Tribunal			✓	
Article/Section/Paragra	19.1	15.2	20.6	20.1	8.1						34(2)(h)	24(1)			15.2	
ribunal gives parties advance notice of hearings	✓	✓	✓	✓	✓							✓				
umber of days (1st hearing)				30												
umber of days (subsequent hearings)				reasonable												
Article/Section/Paragra	19.2	25.1	21.1	20.1	8.7							24(2)				

[11] Communications take place electronically, but may be substantiated with documents

Table 13 Making Awards

	International				Local or Limited						Default			European		
Rules	**LCIA**	**UNCITRAL**	**ICC**	**AAA**	**CIArb**	**AEDED**	**CameraCT**	**CIArb-SF**	**AAA-eC**	**ICANN**	**UK**	**ML**	**NY58**	**Int. Commercial Arb**	**Uniform Law**	**Peaceful Settlement of disputes**
Award to be made in writing	✓	✓		✓	✓	✓				✓		✓				
Article/Section/Paragraph	26.1	32.1		27.1	9.1	10				15(d)		31(1)				
Reasons for award to be stated	✓	✓	✓	✓	✓					✓		✓	✓			
Article/Section/Paragraph	26.1	32.2	25.2	27.2	9.1					15(d)		31(2)	VIII			
Majority decision sufficient	✓	✓	✓	✓						✓		✓			✓	
Article/Section/Paragraph	26.3	31.1	25.1	26.1						15(c)		29			22.1	
If no majority, Chairman's decision	✓	✓		✓											✓	
Article/Section/Paragraph	26.3	31.2		26.2											22.2	
Person responsible for delivery of award to Parties	LCIA	Tribunal	Secretariat	Admin.	Tribunal					Registrar	Tribunal				Chairman[12]	
Currency of award (if monetary)	any			of contract							Any					
Separate awards/partial Awards allowed	✓	✓		✓							✓	✓			✓	
"Consent Awards" allowed	✓	✓	✓	✓						n/a	✓					
Corrections allowed (30 days)	✓	✓	✓	✓							✓	✓				
Requests for additional awards allowed	✓	✓														
Articles/Sections/Paragraphs	26,27		26,29	28,29,30							47-49,51	30,35			20	
Award to be private		✓	✓	✓						n/a						
Article/Section/Paragraph		32.5	28.2	27.4						16(b)						
Scrutiny by Court required prior to release of award			✓													
Article/Section/Paragraph			27													

[12] Referred to as President of Tribunal

Appendix B: Glossary of Arbitration Terms

This terminology is an extract from the work of Elliman (2001) taken from the report entitled "*Glossary of Arbitration Terminology (D2.3 Annex 2) E-Arbitration-T IST-2000-25464/2.3/UBRUN/2008/N/1*" which was compiled as part of the E-Arbitration-T project.

ADR: **Alternative Dispute Resolution.** Any institutional structure, mechanism or process designed to help parties to a dispute resolve it with out recourse to the Courts or state judicial bodies.

Answer: See Response to Request.

Appointing Authority: A third party to whom, by mutual agreement, is given the power to nominate or appoint Arbitrators. This may or may not be the Arbitral Institution responsible for the Case. Note the LCIA reserves to itself the right to appoint and other "Appointing Authorities" may only nominate arbitrators [LCIA Articles 5.5 and 7.1].

Arbitral Institution: An institution that provides arbitration services. In general, such an institution defines the default rules applied to Dispute resolution as well as services to administer the arbitration process (see Registrar). It often acts as Appointing Authority and may maintain a standing panel of qualified Arbitrators. Some such institutions also train Arbitrators.

Arbitral Tribunal: see Tribunal.

Arbitration: This is an ADR procedure for the settlement of disputes, under which the Parties agree to be bound by the decision of a panel of one or more Arbitrators whose decision is, in general, final and legally binding on both Parties and has similar standing to a judicial decision. The object of arbitration is to obtain the fair resolution of a Dispute by an impartial Tribunal without unnecessary delay or expense [Section 1].

Arbitration Agreement: is an agreement by the Parties to submit to Arbitration all or certain disputes which have arisen or which may arise between them in respect of a defined legal relationship, whether contractual or not. An arbitration agreement may be in the form of an arbitration clause in a written contract or in the form of a separate written agreement [LCIA Article 1(b) and ML Article 7(1)].

Arbitration Rules: The rules established by an Arbitral Institution to govern the procedure and practices in managing Arbitration cases under the umbrella of an institution. Most Institutions publish one or more sets of rules but there are also well recognised rule sets available from public bodies like UNCITRAL.

Arbitrator: An independent third party, or Neutral, charged with the duty of hearing the Dispute and given the power to make an Award resolving the Dispute fairly between the Parties [LCIA Article 5.2 and Section 82(1)].

Arbitrator's Expert: See. Specialist Advisor.

Award: The legally binding decision of a Tribunal in the resolution of a Dispute [LCIA Article 26].

Bundle: An appropriately labelled and identified batch of correspondence or documents to be delivered to or submitted as one, by a Party or other body involved in the arbitration process. This terminology is borrowed from Court procedure dealing with the submission of case papers and disclosure prior to hearings.

Case (1): See Dispute.

Case (2): In some contexts case is used to mean an argument from the perspective of a particular Party, for example see Statement of Case [LCIA Article 15.2]. In this document, case is not used in that sense.

Chairman: Where there are several arbitrators, the one who will preside over the Tribunal [LCIA Articles 5.6 and 26.5]. The exact remit will be determined by the Rules but they usually include the power to decide procedural matters [LCIA Article 14.3] and to determining the Final Award when the arbitrators cannot agree [LCIA Article 26.3 and Section 20]. Where the Tribunal is a Sole Arbitrator they will undertake any of the interaction associated with the Chairman.

Claimant: The Claimant is the Party to the Dispute that initiated the arbitration proceedings [LCIA Article 1.1(a) and Section 82(1)].

Claimant's Witness (or Expert): A Witness (or Expert) appointed or selected by the Claimant to give evidence in support of their arguments.

Court (1): This means a body or organ of the judicial system of a State [ML Article 2(c)]. In general this will be that part of a Nation State's judicial system with the power to make orders, appoint arbitrators, enforcing or overturning the decision of an arbitrator, or otherwise supervise and regulate Arbitration Agreements within its jurisdiction [see for example Section 105].

Court (2): The regulatory board or governing body in an arbitral institution that regulates or supervises the appointment and operation of tribunals [LCIA Article 3].

Dispute: A Dispute for the purposes of this paper is any matter of a commercial nature in which Parties are unable to agree and which can be resolved by litigation in the courts. The term "commercial" should be given a wide interpretation so as to cover matters arising from all relationships of a commercial nature, whether contractual or not [ML Article 1 footnote **].

Document: This is not defined in the rules but in this paper it is taken broadly to mean any written record, photograph, drawing or other image whether in hardcopy or recorded in electronic or similar form [see LCIA Article 15].

Expert: A specialist, appointed to examine issues or evidence in the Dispute and, in the light of their expertise, report to the Tribunal. They may be appointed by one of the Parties or the Tribunal itself. [LCIA Article 21].

Final Award: During the settlement of a Dispute, the Tribunal may give interim decisions or Awards dealing with some of the issues at stake [LCIA Article 26.7]. This term emphasises the concluding decision that, along with any interim decisions, settles the Dispute.

Hearing: The formal hearing of a Tribunal of oral submissions, evidence and argument by or on behalf of the Parties [LCIA Article 19]. This includes, for the purposes of E-Arbitration-T©, any equivalent or partially equivalent on-line process that provides simultaneous communication between the Parties and the Tribunal.

Initial Statements: A brief statement describing the nature and circumstances of the Dispute, and specifying the claims advanced. This term is used here to distinguish any initial brief statements presented in advance of a full argument in the Statement of Claim [see LCIA Articles 1.1(c) and 15.3].

Institutional Arbitration: Arbitration to resolve a dispute conducted under the umbrella of an Arbitral Institution that provides rules, administrative services and a supervised ethical framework for the Arbitrators or other Neutrals within the process. The Arbitral Institution will also act as an Appointing Authority if need be,

Legal representative: A person with legal qualifications acting on behalf of a Party [LCIA Article 18 and Section 36]. Note both the LCIA and The Act also allow Parties to be represented by a Representative without legal qualifications.

Mediation: This is an ADR procedure for the settlement of Disputes, under which the Parties are assisted by one or more Mediators who act as intermediaries or facilitate discussion. They generally have the power to suggest solutions or guide discussion but have no power to impose a binding decision on any Party. The object of mediation is to guide the Parties in making a new agreement that would have similar standing to any prior agreement or contract.

Mediator: An independent third party, or Neutral, charged with the duty to guide the Parties to resolve a Dispute by making a new voluntary agreement.

Negotiation: This is a structured ADR procedure for the settlement of Disputes with the object of guiding the Parties in making a new agreement. This would be a voluntary agreement with similar standing to any prior agreement or contract. Negotiation may or may not be aided by the presence of Neutrals (Mediators).

Neutrals: An independent third party charged with the duty to act in an ADR process with favour or bias between the Parties. Their role will depend upon the nature of the ADR process.

Notice: Any communication that may be or is required to be served on a Party. It must be in writing and be delivered by registered postal or courier service, or transmitted by facsimile, telex, e-mail or any other means of telecommunication that provides a record of its transmission [LCIA Article 4.1 and Section 76(6)].

Notice of Arbitration: A formal Notice served on the parties named in the Request for Arbitration informing them that the Arbitration procedures have commenced. It will generally include the Request for Arbitration but it may alson include other information about the procedure and the Arbitral Institution administering the case.

ODR: Any ADR procedure that uses computer based systems (or digital information and communications technology) to support or deliver the resolution process.

Party: Any one with a direct interest in the Dispute by having a Claim, or Defence, to place before the Tribunal and agreeing to be bound by the Final Award [Section 82(2)].

Party Appointed Arbitrator: An Arbitrator nominated, selected or appointed to the Tribunal by a particular party to the Dispute.

Pleading: A document (possibly with attached evidence) presenting an argument on behalf of a Party.

Preliminary Hearing: A hearing of a Tribunal to deal with procedural matters and not the substantive argument in the Dispute (see Hearing).

Reply to Defence A document (or documents) which is intended to be the final submission by the Claimant in which he may comment on any matters raised in such a defence and not adequately dealt with in points of claim. If there are any Counter-claims, then a Defence to Counter-claim shall be included which should take the same form as the Statement of Defence [LCIA Article 15.4].

Reply to Defence to Counter-claim: A document (or documents) which is intended to be the final submission by the Respondent in which he may comment on any matters raised in the Defence to Counter-claim and not adequately dealt with previously [LCIA Article 15.5].

Representative: A person acting on behalf of a Party [LCIA Article 18 and Section 36]. See also legal representative.

Request for Arbitration: The document (or documents) initiating the arbitration process [LCIA Article 1]. In some contexts this may be abbreviated to just Request. This will include some information about the nature of the Dispute either in the form of a Summary Statement or a full Statement of Claim depending upon the rules of the institution.

Response (to Request): A document (or documents) the Respondent submits as a consequence of receiving a Request for Arbitration [LCIA Article 2] or a Notice of Arbitration. In some contexts this may be abbreviated to just Response. This will include confirmation or denial of all or part of the claims advanced by the Claimant in the Request [LCIA Article 2.1(a)] and may also include a brief statement describing any Counter-claims [LCIA Article 2.1(b)].

Respondent: A Respondent is a Party to the Dispute against whom a claim for relief is being made [LCIA Article 1.1(c) and Section 82(1)].

Respondent's Witness (or Expert): A Witness (or Expert) appointed or selected by the Respondent to give evidence in support of their arguments.

Secretariat: A reference to the administrative part of the arbitral institution (see Registrar) [LCIA Schedule of Fees and Costs].

Settlement: Any resolution of the Dispute proposed and agreed to by the Parties outside the arbitral process [LCIA Article 26.8 and Section 51].

Sole Arbitrator: an Tribunal consisting of a single Arbitrator. Unless otherwise required by the context references to powers, duties and activities of the Chairman apply to a Sole Arbitrator. [LCIA Article 5.1].

Specialist Advisor: An independent Expert appointed by the Tribunal. As such, they are required to demonstrate similar standards of independence as any other Neutral in the Arbitration process [LCIA Article 21].

Statement of Case: see Statement of Claim [LCIA Article 15.3].

Statement of Claim: A statement setting out in sufficient detail the facts, the points at issue and any contentions of law on which it relies, together with the relief claimed against all other Parties, save and insofar as such matters have not been set out in any prior Summary Statement [ML Article

23]. Note the LCIA rules use the term Statement of Case rather than Statement of Claim [LCIA Article 15.2].

Statement of Counter-claim: A statement setting out alternative Claims raised by the Respondents in a Dispute. In general it has the same form as a Statement of Claim [LCIA Article 15.3].

Statement of Defence: A statement setting out in sufficient detail which facts and points of law in the Statement of Claim it admits or denies, on what grounds and on what other facts and contentions of law it relies save and insofar as such matters have not been set out in any prior Summary Statement [LCIA Article 15.3].

Statement of Defence to Counter-claim: A Statement of Defence but addressed to any Counter-claims raised in the dispute [LCIA Article 15.4].

Statement of Independence: A statement from a Neutral setting out there background and asserting that they have no conflicting interests which might be perceived to compromise their ability to act as an independent third party in a specific Dispute.

Submission Agreement: An Arbitral Agreement entered into after a particular dispute has arisen with the intent that a specific Arbitral Institution or set of Arbitration Rules will be applied to resolve this dispute.

Terms of Reference: A document drawn up by the Tribunal containing a formal record of the procedural decisions taken at a Preliminary Hearing.

Tribunal (1): The panel of all Arbitrators appointed to act in a specific Dispute (including a Sole Arbitrator) [LCIA Article 5.1].

Tribunal (2): See Arbitral Institution.

Tribunal's Expert: See Specialist Advisor.

Umpire: An Arbitrator who has not taken part in the deliberations of the Tribunal but who is fully informed of the case and who can be called in to determine the Final Award when the panel of arbitrators cannot agree [Section 21]. Note this is an option defined within the Act but not applied in either LCIA or CIArb rules.

Witness: A person who testifies with reference to what he has actually seen or heard (a witness of fact) or who renders an expert opinion (expert witness). The testimony of a witness may be presented in written form, either as a signed statement or as a sworn affidavit [LCIA Article 20].

Written Stage of Proceedings: The main stage of the arbitral proceedings where Statements of Case (Claim or Defence) and other Documentary materials are exchanged prior to any Hearing or resolution of the Dispute [LCIA Article 15].

Appendix C: Sample End Case Output

The following end case documentation shows the effects of the different rule sets for one particular case. A comparison of the differences between the way in which the rules are applied to the case can then be made.

C.1 LCIA RULES

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Case number 1
Agreement to settle by post. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 04/06/2002 by a telephone conference finished
          04/06/2002
          main hearing set for 05/02/2003 by a face-to-face meeting finished
          05/02/2003
          case closed 05/03/2003

Default rules: LCIA rules, base time 30 days

Index cards for case
     D-1: The Request, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-7
          ContentsID=20001, type 1, submitted by post (direct)
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(26/03/2002), Arb-3(26/03/2002), Arb-
          2(26/03/2002), Arb-1(26/03/2002), R-2(26/03/2002)
          institute appoints for claimant, institute appoints for respondent, appoint
          institute nominee

     D-3: The Response (R-1), from R-1
          document, type 2, time allowed 30 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          ContentsID=20002, type 2, submitted by post (direct)
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 22/04/2002, delivered: Arb-3(24/04/2002), Arb-2(24/04/2002),
          Arb-1(24/04/2002), C-1(24/04/2002), R-2(24/04/2002)

     D-4: The Response (R-2), from R-2
          document, type 2, time allowed 30 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          ContentsID=20003, type 2, submitted by post (direct)
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 23/04/2002, delivered: Arb-3(24/04/2002), Arb-2(24/04/2002),
          Arb-1(24/04/2002), C-1(24/04/2002), R-1(24/04/2002)

     D-5: Resume and Declaration 2, from Arb-2
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20004, type 14, submitted by post (direct)
          from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
          submitted: 30/04/2002, delivered: C-1(01/05/2002), Arb-3(01/05/2002), Arb-
          1(01/05/2002), R-1(01/05/2002), R-2(01/05/2002)

     D-6: Resume and Declaration 3, from Arb-3
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20005, type 14, submitted by post (direct)
          from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
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      submitted: 01/05/2002, delivered: Arb-2(02/05/2002), Arb-1(02/05/2002), C-
      1(02/05/2002), R-1(02/05/2002), R-2(02/05/2002)

D-7:  Resume and Declaration 1, from Arb-1
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4; followed by N-8
      ContentsID=20006, type 14, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
      submitted: 30/04/2002, delivered: Arb-3(01/05/2002), Arb-2(01/05/2002), C-
      1(01/05/2002), R-1(01/05/2002), R-2(01/05/2002)

N-8:  Notice of Formation, from Sec/Reg
      notice, type 3, status: 4
      Tribunal formation; after D-7, D-5, D-6
      ContentsID=20007, type 3
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 01/05/2002, delivered: Arb-3(02/05/2002), Arb-2(02/05/2002),
      Arb-1(02/05/2002), C-1(02/05/2002), R-1(02/05/2002), R-2(02/05/2002)

N-23: Notice of Preliminary Meeting, from Arb-1
      notice, type 31, status: 4
      starts sequence Preliminaries
      ContentsID=20014, type 31, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 08/05/2002, delivered: C-1(09/05/2002), R-1(09/05/2002), R-
      2(09/05/2002)

N-24: List of questions, from Arb-1
      notice, type 12, status: 4
      starts sequence Preliminary hearing; followed by D-26, D-27, D-28, N-33, D-
      34
      ContentsID=20015, type 12, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 11/06/2002, delivered: C-1(12/06/2002), R-1(12/06/2002), R-
      2(12/06/2002)

D-9:  Statement of Case, from C-1
      document, type 20, time allowed 30 days, status: 4
      starts sequence Written stage - pleadings; followed by D-11, D-13, D-14, D-
      16, N-42
      ContentsID=20008, type 20, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 08/07/2002, delivered: R-1(10/07/2002), Arb-3(10/07/2002), Arb-
      2(10/07/2002), Arb-1(10/07/2002), R-2(10/07/2002)

D-11: Statement of Defence (R-1), from R-1
      document, type 21, time allowed 30 days, status: 4
      submit in B-12, distribute in B-10
      Written stage - pleadings; after D-9; followed by D-18, N-42
      Part of ContentsID=20009, type 21, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 06/08/2002, delivered: Arb-3(08/08/2002), Arb-2(08/08/2002),
      Arb-1(08/08/2002), C-1(08/08/2002), R-2(08/08/2002)

D-13: Counter-claims (R-1), from R-1
      document, type 22, time allowed 30 days, status: 4
      submit in B-12, distribute in B-10
      Written stage - pleadings; after D-9; followed by D-19, N-42
      Part of ContentsID=20009, type 21, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 06/08/2002, delivered: Arb-3(08/08/2002), Arb-2(08/08/2002),
      Arb-1(08/08/2002), C-1(08/08/2002), R-2(08/08/2002)

D-14: Statement of Defence (R-2), from R-2
      document, type 21, time allowed 30 days, status: 4
      submit in B-15, distribute in B-10
      Written stage - pleadings; after D-9; followed by D-18, N-42
      Part of ContentsID=20010, type 21, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 06/08/2002, delivered: Arb-3(08/08/2002), Arb-2(08/08/2002),
      Arb-1(08/08/2002), C-1(08/08/2002), R-1(08/08/2002)

D-16: Counter-claims (R-2), from R-2
      document, type 22, time allowed 30 days, status: 4
      submit in B-15, distribute in B-10
      Written stage - pleadings; after D-9; followed by D-19, N-42
      Part of ContentsID=20010, type 21, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 06/08/2002, delivered: Arb-3(08/08/2002), Arb-2(08/08/2002),
      Arb-1(08/08/2002), C-1(08/08/2002), R-1(08/08/2002)

D-18: Reply to Defence, from C-1
      document, type 23, time allowed 30 days, status: 4
      submit in B-17, distribute in B-17
      Written stage - pleadings; after D-11, D-14; followed by N-42
      Part of ContentsID=20011, type 23, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
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      submitted: 04/09/2002, delivered: R-1(06/09/2002), Arb-3(06/09/2002), Arb-
      2(06/09/2002), Arb-1(06/09/2002), R-2(06/09/2002)

D-19: Defence to Counter-claims, from C-1
      document, type 24, time allowed 30 days, status: 4
      submit in B-17, distribute in B-17
      Written stage - pleadings; after D-13, D-16; followed by D-21, D-22, N-42
      Part of ContentsID=20011, type 23, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 04/09/2002, delivered: R-1(06/09/2002), Arb-3(06/09/2002), Arb-
      2(06/09/2002), Arb-1(06/09/2002), R-2(06/09/2002)

D-21: Reply to Defence to CC (R-1), from R-1
      document, type 25, time allowed 30 days, status: 4
      submit in B-20, distribute in B-20
      Written stage - pleadings; after D-19; followed by N-42
      ContentsID=20012, type 25, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 06/10/2002, delivered: Arb-3(07/10/2002), Arb-2(07/10/2002),
      Arb-1(07/10/2002), C-1(07/10/2002), R-2(07/10/2002)

D-22: Reply to Defence to CC (R-2), from R-2
      document, type 25, time allowed 30 days, status: 4
      submit in B-20, distribute in B-20
      Written stage - pleadings; after D-19; followed by N-42
      ContentsID=20013, type 25, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 06/10/2002, delivered: Arb-3(07/10/2002), Arb-2(07/10/2002),
      Arb-1(07/10/2002), C-1(07/10/2002), R-1(07/10/2002)

N-33: Specialist briefing, from Arb-1
      notice, type 15, status: 4
      Written stage - pleadings; after N-24; followed by D-35, N-42
      ContentsID=20022, type 15, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2, SpAdv-1
      submitted: 17/06/2002, delivered: C-1(18/06/2002), R-1(18/06/2002), R-
      2(18/06/2002), SpAdv-1(18/06/2002)

N-42: Written stage - pleadings completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - pleadings; after D-9, D-11, D-13, D-14, D-16, D-18, D-19,
      D-21, D-22, N-33
      ContentsID=20030, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 06/10/2002, delivered: Arb-3(07/10/2002), Arb-2(07/10/2002),
      Arb-1(07/10/2002), C-1(07/10/2002), R-1(07/10/2002), R-2(07/10/2002), SpAdv-
      1(07/10/2002)

D-26: Statement on issue 1 (C), from C-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
      N-43
      ContentsID=20016, type 28, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 03/11/2002, delivered: Arb-3(04/11/2002), Arb-2(04/11/2002),
      Arb-1(04/11/2002), R-1(04/11/2002), R-2(04/11/2002)

D-27: Statement on issue 1 (R-1), from R-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
      N-43
      ContentsID=20017, type 28, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 03/11/2002, delivered: C-1(04/11/2002), Arb-3(04/11/2002), Arb-
      2(04/11/2002), Arb-1(04/11/2002), R-2(04/11/2002)

D-28: Statement on issue 1 (R-2), from R-2
      document, type 28, time allowed 30 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
      N-43
      ContentsID=20018, type 28, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 03/11/2002, delivered: Arb-3(04/11/2002), Arb-2(04/11/2002),
      Arb-1(04/11/2002), C-1(04/11/2002), R-1(04/11/2002)

D-30: Comments on issue 1 (C), from C-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-43
      ContentsID=20019, type 29, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 16/11/2002, delivered: Arb-3(18/11/2002), Arb-2(18/11/2002),
      Arb-1(18/11/2002), R-1(18/11/2002), R-2(18/11/2002)
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D-31: Comments on issue 1 (R-1), from R-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-43
      ContentsID=20020, type 29, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 16/11/2002, delivered: Arb-3(18/11/2002), Arb-2(18/11/2002),
     Arb-1(18/11/2002), C-1(18/11/2002), R-2(18/11/2002)

D-32: Comments on issue 1 (R-2), from R-2
      document, type 29, time allowed 15 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-43
      ContentsID=20021, type 29, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 16/11/2002, delivered: C-1(18/11/2002), Arb-3(18/11/2002), Arb-
     2(18/11/2002), Arb-1(18/11/2002), R-1(18/11/2002)

D-34: Evidence submitted to expert (R-2), from R-2
      document, type 40, time allowed 30 days, status: 4
      Written stage - additional docs; after N-24; followed by D-35, N-43
      ContentsID=20023, type 40, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 02/11/2002, delivered: Arb-3(04/11/2002), Arb-2(04/11/2002),
     Arb-1(04/11/2002), C-1(04/11/2002), R-1(04/11/2002), SpAdv-1(04/11/2002)

D-35: Specialist report, from SpAdv-1
      document, type 27, time allowed 30 days, status: 4
      Written stage - additional docs; after D-34, N-33; followed by D-37, D-38,
     D-39, N-43
      ContentsID=20024, type 27, submitted by post (direct)
      from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 27/11/2002, delivered: C-1(28/11/2002), Arb-3(28/11/2002), Arb-
     2(28/11/2002), Arb-1(28/11/2002), R-1(28/11/2002), R-2(28/11/2002)

D-37: Comments on report (C), from C-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-43
      ContentsID=20025, type 30, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 10/12/2002, delivered: Arb-3(12/12/2002), Arb-2(12/12/2002),
     Arb-1(12/12/2002), R-1(12/12/2002), R-2(12/12/2002)

D-38: Comments on report (R-1), from R-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-43
      ContentsID=20026, type 30, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 10/12/2002, delivered: Arb-3(12/12/2002), Arb-2(12/12/2002),
     Arb-1(12/12/2002), C-1(12/12/2002), R-2(12/12/2002)

D-39: Comments on report (R-2), from R-2
      document, type 30, time allowed 15 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-43
      ContentsID=20027, type 30, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 10/12/2002, delivered: C-1(12/12/2002), Arb-3(12/12/2002), Arb-
     2(12/12/2002), Arb-1(12/12/2002), R-1(12/12/2002)

N-43: Written stage - additional docs completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - additional docs; after D-26, D-27, D-28, D-30, D-31, D-32,
     D-34, D-35, D-37, D-38, D-39
      ContentsID=20031, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 11/12/2002, delivered: Arb-3(12/12/2002), Arb-2(12/12/2002),
     Arb-1(12/12/2002), C-1(12/12/2002), R-1(12/12/2002), SpAdv-1(12/12/2002), R-
     2(12/12/2002)

N-40: Record of hearing, from Arb-1
      notice, type 13, status: 4
      starts sequence Main hearing
      ContentsID=20028, type 13, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 09/02/2003, delivered: C-1(10/02/2003), R-1(10/02/2003), R-
     2(10/02/2003)

N-41: The Award, from Arb-1
      notice, type 11, status: 4
      starts sequence Award stage
      ContentsID=20029, type 11, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 05/03/2003, delivered: C-1(06/03/2003), R-1(06/03/2003), R-
     2(06/03/2003)
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C.2 ICC RULES

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Case number 1
Agreement to settle by post. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 02/07/2002 by a telephone conference finished
          02/07/2002
          main hearing set for 18/12/2002 by a face-to-face meeting finished
          18/12/2002
          case closed 22/01/2003

Default rules: ICC rules, base time 30 days

Index cards for case
     D-1: The Request, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-7, D-
          11, D-13
          ContentsID=20001, type 1, submitted by post
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(26/03/2002), Arb-3(26/03/2002), Arb-
          2(26/03/2002), Arb-1(26/03/2002), R-2(26/03/2002)
          institute appoints for claimant, institute appoints for respondent, appoint
          institute nominee

     D-3: The Answer (R-1), from R-1
          document, type 2, time allowed 30 days, status: 4
          submit in B-10, distribute in B-9
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          Part of ContentsID=20002, type 2, submitted by post
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: Arb-3(25/04/2002), Arb-2(25/04/2002),
          Arb-1(25/04/2002), C-1(25/04/2002), R-2(25/04/2002)

     D-4: The Answer (R-2), from R-2
          document, type 2, time allowed 30 days, status: 4
          submit in B-12, distribute in B-9
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          Part of ContentsID=20003, type 2, submitted by post
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: Arb-3(25/04/2002), Arb-2(25/04/2002),
          Arb-1(25/04/2002), C-1(25/04/2002), R-1(25/04/2002)

    D-11: Counter-Claim (R-1), from R-1
          document, type 22, time allowed 30 days, status: 4
          submit in B-10, distribute in B-9
          Agreement pending; after D-1; followed by D-14
          Part of ContentsID=20002, type 2, submitted by post
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: Arb-3(25/04/2002), Arb-2(25/04/2002),
          Arb-1(25/04/2002), C-1(25/04/2002), R-2(25/04/2002)

    D-13: Counter-Claim (R-2), from R-2
          document, type 22, time allowed 30 days, status: 4
          submit in B-12, distribute in B-9
          Agreement pending; after D-1; followed by D-14
          Part of ContentsID=20003, type 2, submitted by post
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: Arb-3(25/04/2002), Arb-2(25/04/2002),
          Arb-1(25/04/2002), C-1(25/04/2002), R-1(25/04/2002)

     D-5: Statement of Independence 2, from Arb-2
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20004, type 14, submitted by post
          from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
          submitted: 01/05/2002, delivered: Arb-3(02/05/2002), Arb-1(02/05/2002), C-
          1(02/05/2002), R-1(02/05/2002), R-2(02/05/2002)

     D-6: Statement of Independence 3, from Arb-3
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20005, type 14, submitted by post
          from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
          submitted: 01/05/2002, delivered: Arb-2(02/05/2002), Arb-1(02/05/2002), C-
          1(02/05/2002), R-1(02/05/2002), R-2(02/05/2002)

     D-7: Statement of Independence 1, from Arb-1
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
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      ContentsID=20006, type 14, submitted by post
      from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
      submitted: 01/05/2002, delivered: Arb-3(02/05/2002), Arb-2(02/05/2002), C-
      1(02/05/2002), R-1(02/05/2002), R-2(02/05/2002)

N-8:  Notification of appointment, from Sec/Reg
      notice, type 3, status: 4
      Tribunal formation; after D-7, D-5, D-6
      ContentsID=20007, type 3
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 01/05/2002, delivered: C-1(03/05/2002), Arb-3(03/05/2002), Arb-
      2(03/05/2002), Arb-1(03/05/2002), R-1(03/05/2002), R-2(03/05/2002)

D-14: Reply to Counter-Claim, from C-1
      document, type 24, time allowed 30 days, status: 4
      Tribunal formation; after D-11, D-13
      ContentsID=20008, type 24, submitted by post
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 24/05/2002, delivered: Arb-3(25/05/2002), Arb-2(25/05/2002),
      Arb-1(25/05/2002), R-1(25/05/2002), R-2(25/05/2002)

N-15: Notice of Preliminary Meeting, from Arb-1
      notice, type 31, status: 4
      starts sequence Preliminaries
      ContentsID=20009, type 31, submitted by post
      from Arb-1 to C-1, R-1, R-2
      submitted: 31/05/2002, delivered: C-1(01/06/2002), R-1(01/06/2002), R-
      2(01/06/2002)

N-16: Unsigned Terms of Reference, from Arb-1
      notice, type 41, status: 4
      starts sequence Preliminary hearing; followed by D-17, D-18, D-19, D-20
      ContentsID=20010, type 41, submitted by post
      from Arb-1 to C-1, R-1, R-2
      submitted: 10/07/2002, delivered: C-1(11/07/2002), R-1(11/07/2002), R-
      2(11/07/2002)

D-17: Signed Terms of Reference (C), from C-1
      document, type 42, time allowed 30 days, status: 4
      Preliminary hearing; after N-16; followed by D-21
      ContentsID=20011, type 42, submitted by post
      from C-1
      submitted: 09/08/2002

D-18: Signed Terms of Reference (R-1), from R-1
      document, type 42, time allowed 30 days, status: 4
      Preliminary hearing; after N-16; followed by D-21
      ContentsID=20012, type 42, submitted by post
      from R-1
      submitted: 09/08/2002

D-19: Signed Terms of Reference (R-2), from R-2
      document, type 42, time allowed 30 days, status: 4
      Preliminary hearing; after N-16; followed by D-21
      ContentsID=20013, type 42, submitted by post
      from R-2
      submitted: 09/08/2002

D-20: Procedural timetable, from Arb-1
      document, type 43, status: 4
      Preliminary hearing; after N-16; followed by D-21
      ContentsID=20014, type 43, submitted by post
      from Arb-1
      submitted: 15/07/2002

D-21: Terms of Reference & Timetable, from Sec/Reg
      document, type 12, status: 4
      Preliminary hearing; after D-17, D-18, D-19, D-20; followed by D-23, D-24,
      D-25, N-30, D-31
      ContentsID=20015, type 12
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 09/08/2002, delivered: C-1(10/08/2002), R-1(10/08/2002), R-
      2(10/08/2002), Arb-3(10/08/2002), Arb-2(10/08/2002), Arb-1(10/08/2002)

D-23: Statement on issue 1 (C), from C-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-22, distribute in B-22
      Written stage - additional docs; after D-21; followed by D-27, D-28, D-29,
      N-39
      ContentsID=20016, type 28, submitted by post
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 09/09/2002, delivered: R-1(11/09/2002), R-2(11/09/2002), Arb-
      3(11/09/2002), Arb-2(11/09/2002), Arb-1(11/09/2002)

D-24: Statement on issue 1 (R-1), from R-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-22, distribute in B-22
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     Written stage - additional docs; after D-21; followed by D-27, D-28, D-29,
    N-39
     ContentsID=20017, type 28, submitted by post
     from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 09/09/2002, delivered: Arb-3(11/09/2002), Arb-2(11/09/2002),
    Arb-1(11/09/2002), C-1(11/09/2002), R-2(11/09/2002)

D-25: Statement on issue 1 (R-2), from R-2
     document, type 28, time allowed 30 days, status: 4
     submit in B-22, distribute in B-22
     Written stage - additional docs; after D-21; followed by D-27, D-28, D-29,
    N-39
     ContentsID=20018, type 28, submitted by post
     from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
     submitted: 09/09/2002, delivered: C-1(11/09/2002), R-1(11/09/2002), Arb-
    3(11/09/2002), Arb-2(11/09/2002), Arb-1(11/09/2002)

D-27: Comments on issue 1 (C), from C-1
     document, type 29, time allowed 15 days, status: 4
     submit in B-26, distribute in B-26
     Written stage - additional docs; after D-23, D-24, D-25; followed by N-39
     ContentsID=20019, type 29, submitted by post
     from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 25/09/2002, delivered: Arb-3(27/09/2002), Arb-2(27/09/2002),
    Arb-1(27/09/2002), R-1(27/09/2002), R-2(27/09/2002)

D-28: Comments on issue 1 (R-1), from R-1
     document, type 29, time allowed 15 days, status: 4
     submit in B-26, distribute in B-26
     Written stage - additional docs; after D-23, D-24, D-25; followed by N-39
     ContentsID=20020, type 29, submitted by post
     from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 25/09/2002, delivered: Arb-3(27/09/2002), Arb-2(27/09/2002),
    Arb-1(27/09/2002), C-1(27/09/2002), R-2(27/09/2002)

D-29: Comments on issue 1 (R-2), from R-2
     document, type 29, time allowed 15 days, status: 4
     submit in B-26, distribute in B-26
     Written stage - additional docs; after D-23, D-24, D-25; followed by N-39
     ContentsID=20021, type 29, submitted by post
     from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
     submitted: 25/09/2002, delivered: Arb-3(27/09/2002), Arb-2(27/09/2002),
    Arb-1(27/09/2002), C-1(27/09/2002), R-1(27/09/2002)

N-30: Specialist briefing, from Arb-1
     notice, type 15, status: 4
     Written stage - additional docs; after D-21; followed by D-32, N-39
     ContentsID=20022, type 15, submitted by post
     from Arb-1 to C-1, R-1, R-2, SpAdv-1
     submitted: 17/08/2002, delivered: C-1(18/08/2002), R-1(18/08/2002), R-
    2(18/08/2002), SpAdv-1(18/08/2002)

D-31: Evidence submitted to expert (R-2), from R-2
     document, type 40, time allowed 30 days, status: 4
     Written stage - additional docs; after D-21; followed by D-32, N-39
     ContentsID=20023, type 40, submitted by post
     from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
     submitted: 09/09/2002, delivered: Arb-3(11/09/2002), Arb-2(11/09/2002),
    Arb-1(11/09/2002), SpAdv-1(11/09/2002), C-1(11/09/2002), R-1(11/09/2002)

D-32: Specialist report, from SpAdv-1
     document, type 27, time allowed 30 days, status: 4
     Written stage - additional docs; after D-31, N-30; followed by D-34, D-35,
    D-36, N-39
     ContentsID=20024, type 27, submitted by post
     from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 12/10/2002, delivered: C-1(13/10/2002), Arb-3(13/10/2002), Arb-
    2(13/10/2002), Arb-1(13/10/2002), R-1(13/10/2002), R-2(13/10/2002)

D-34: Comments on report (C), from C-1
     document, type 30, time allowed 15 days, status: 4
     submit in B-33, distribute in B-33
     Written stage - additional docs; after D-32; followed by N-39
     ContentsID=20025, type 30, submitted by post
     from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 27/10/2002, delivered: Arb-3(28/10/2002), Arb-2(28/10/2002),
    Arb-1(28/10/2002), R-1(28/10/2002), R-2(28/10/2002)

D-35: Comments on report (R-1), from R-1
     document, type 30, time allowed 15 days, status: 4
     submit in B-33, distribute in B-33
     Written stage - additional docs; after D-32; followed by N-39
     ContentsID=20026, type 30, submitted by post
     from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 27/10/2002, delivered: Arb-3(28/10/2002), Arb-2(28/10/2002),
    Arb-1(28/10/2002), C-1(28/10/2002), R-2(28/10/2002)
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D-36: Comments on report (R-2), from R-2
      document, type 30, time allowed 15 days, status: 4
      submit in B-33, distribute in B-33
      Written stage - additional docs; after D-32; followed by N-39
      ContentsID=20027, type 30, submitted by post
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 27/10/2002, delivered: Arb-3(28/10/2002), Arb-2(28/10/2002),
     Arb-1(28/10/2002), C-1(28/10/2002), R-1(28/10/2002)

N-39: Written stage - additional docs completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - additional docs; after D-23, D-24, D-25, D-27, D-28, D-29,
     N-30, D-31, D-32, D-34, D-35, D-36
      ContentsID=20030, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 27/10/2002, delivered: R-2(28/10/2002), Arb-3(28/10/2002), Arb-
      2(28/10/2002), Arb-1(28/10/2002), SpAdv-1(28/10/2002), C-1(28/10/2002), R-
      1(28/10/2002)

N-37: Record of hearing, from Arb-1
      notice, type 13, status: 4
      starts sequence Main hearing
      ContentsID=20028, type 13, submitted by post
      from Arb-1 to C-1, R-1, R-2
      submitted: 22/12/2002, delivered: C-1(24/12/2002), R-1(24/12/2002), R-
     2(24/12/2002)

N-38: Final Award, from Arb-1
      notice, type 11, status: 4
      starts sequence Award stage
      ContentsID=20029, type 11, submitted by post
      from Arb-1 to C-1, R-1, R-2
      submitted: 22/01/2003, delivered: C-1(24/01/2003), R-1(24/01/2003), R-
     2(24/01/2003)
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C.3 UNCITRAL RULES

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Case number 1
Agreement to settle by post. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 04/06/2002 by a telephone conference finished
          04/06/2002
          main hearing set for 08/01/2003 by a face-to-face meeting finished
          08/01/2003
          case closed 05/02/2003

Default rules: UNCITRAL rules, base time 30 days

Index cards for case
     D-1: Notice of Arbitration, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-11
          ContentsID=20001, type 1, submitted by post (direct)
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: Arb-3(26/03/2002), Arb-2(26/03/2002),
         Arb-1(26/03/2002), R-1(26/03/2002), R-2(26/03/2002)

     D-3: Response to Notice (R-1), from R-1
          document, type 2, time allowed 15 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-11
          ContentsID=20002, type 2, submitted by post (direct)
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 07/04/2002, delivered: C-1(08/04/2002), Arb-3(08/04/2002), Arb-
         2(08/04/2002), Arb-1(08/04/2002), R-2(08/04/2002)
          appoint claimant nominee, appoint respondent nominee

     D-4: Response to Notice (R-2), from R-2
          document, type 2, time allowed 15 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-11
          ContentsID=20003, type 2, submitted by post (direct)
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 07/04/2002, delivered: Arb-3(08/04/2002), Arb-2(08/04/2002),
        Arb-1(08/04/2002), C-1(08/04/2002), R-1(08/04/2002)

     D-5: Agreement to serve and disclosure 2, from Arb-2
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-7, N-12
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      ContentsID=20004, type 14, submitted by post (direct)
      from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
      submitted: 13/04/2002, delivered: Arb-3(14/04/2002), Arb-1(14/04/2002), C-
      1(14/04/2002), R-1(14/04/2002), R-2(14/04/2002)

D-6:  Agreement to serve and disclosure 3, from Arb-3
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4; followed by N-7, N-12
      ContentsID=20005, type 14, submitted by post (direct)
      from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
      submitted: 13/04/2002, delivered: Arb-2(14/04/2002), Arb-1(14/04/2002), C-
      1(14/04/2002), R-1(14/04/2002), R-2(14/04/2002)

N-7:  List of names, from Sec/Reg
      notice, type 37, status: 4
      Tribunal formation; after D-5, D-6; followed by D-9, D-10
      ContentsID=20006, type 37
      from Sec/Reg to Arb-3, Arb-2
      submitted: 13/04/2002, delivered: Arb-3(14/04/2002), Arb-2(14/04/2002)

D-9:  List of preferences (Arb-2), from Arb-2
      document, type 38, time allowed 15 days, status: 4
      submit in B-8, distribute in B-8
      Tribunal formation; after N-7; followed by D-11
      ContentsID=20007, type 38, submitted by post
      from Arb-2 to Arb-1
      submitted: 26/04/2002, delivered: Arb-1(27/04/2002)
      appoint institute nominee

D-10: List of preferences (Arb-3), from Arb-3
      document, type 38, time allowed 15 days, status: 4
      submit in B-8, distribute in B-8
      Tribunal formation; after N-7
      ContentsID=20008, type 38, submitted by post
      from Arb-3
      submitted: 26/04/2002

D-11: Agreement to serve and disclosure 1, from Arb-1
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4, D-9; followed by N-12
      ContentsID=20009, type 14, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
      submitted: 02/05/2002, delivered: Arb-3(03/05/2002), Arb-2(03/05/2002), C-
      1(03/05/2002), R-1(03/05/2002), R-2(03/05/2002)

N-12: Notice of Formation, from Sec/Reg
      notice, type 3, status: 4
      Tribunal formation; after D-11, D-5, D-6
      ContentsID=20010, type 3
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 02/05/2002, delivered: Arb-3(03/05/2002), Arb-2(03/05/2002),
      Arb-1(03/05/2002), C-1(03/05/2002), R-1(03/05/2002), R-2(03/05/2002)

N-22: Notice of Preliminary Meeting, from Arb-1
      notice, type 31, status: 4
      starts sequence Preliminaries
      ContentsID=20015, type 31, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 09/05/2002, delivered: C-1(10/05/2002), R-1(10/05/2002), R-
      2(10/05/2002)

N-23: Terms of Reference, from Arb-1
      notice, type 12, status: 4
      starts sequence Preliminary hearing; followed by D-25, D-26, D-27, N-32, D-
      33
      ContentsID=20016, type 12, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 11/06/2002, delivered: C-1(12/06/2002), R-1(12/06/2002), R-
      2(12/06/2002)

D-13: Statement of Claim, from C-1
      document, type 20, time allowed 30 days, status: 4
      starts sequence Written stage - pleadings; followed by D-15, D-17, D-18, D-
      20, N-41
      ContentsID=20011, type 20, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 08/07/2002, delivered: Arb-3(09/07/2002), Arb-2(09/07/2002),
      Arb-1(09/07/2002), R-1(09/07/2002), R-2(09/07/2002)

D-15: Statement of Defence (R-1), from R-1
      document, type 21, time allowed 30 days, status: 4
      submit in B-16, distribute in B-14
      Written stage - pleadings; after D-13; followed by N-41
      Part of ContentsID=20012, type 21, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 05/08/2002, delivered: Arb-3(06/08/2002), Arb-2(06/08/2002),
      Arb-1(06/08/2002), C-1(06/08/2002), R-2(06/08/2002)
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D-17: Counter-Claim (R-1), from R-1
      document, type 22, time allowed 30 days, status: 4
      submit in B-16, distribute in B-14
      Written stage - pleadings; after D-13; followed by D-21, N-41
      Part of ContentsID=20012, type 21, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 05/08/2002, delivered: Arb-3(06/08/2002), Arb-2(06/08/2002),
     Arb-1(06/08/2002), C-1(06/08/2002), R-2(06/08/2002)

D-18: Statement of Defence (R-2), from R-2
      document, type 21, time allowed 30 days, status: 4
      submit in B-19, distribute in B-14
      Written stage - pleadings; after D-13; followed by N-41
      Part of ContentsID=20013, type 21, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 05/08/2002, delivered: Arb-3(06/08/2002), Arb-2(06/08/2002),
     Arb-1(06/08/2002), C-1(06/08/2002), R-1(06/08/2002)

D-20: Counter-Claim (R-2), from R-2
      document, type 22, time allowed 30 days, status: 4
      submit in B-19, distribute in B-14
      Written stage - pleadings; after D-13; followed by D-21, N-41
      Part of ContentsID=20013, type 21, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 05/08/2002, delivered: Arb-3(06/08/2002), Arb-2(06/08/2002),
     Arb-1(06/08/2002), C-1(06/08/2002), R-1(06/08/2002)

D-21: Reply to Counter-Claim, from C-1
      document, type 24, time allowed 30 days, status: 4
      Written stage - pleadings; after D-17, D-20; followed by N-41
      ContentsID=20014, type 24, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 02/09/2002, delivered: Arb-3(03/09/2002), Arb-2(03/09/2002),
     Arb-1(03/09/2002), R-1(03/09/2002), R-2(03/09/2002)

N-32: Specialist briefing, from Arb-1
      notice, type 15, status: 4
      Written stage - pleadings; after N-23; followed by D-34, N-41
      ContentsID=20023, type 15, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2, SpAdv-1
      submitted: 16/06/2002, delivered: SpAdv-1(17/06/2002), C-1(17/06/2002), R-
     1(17/06/2002), R-2(17/06/2002)

N-41: Written stage - pleadings completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - pleadings; after D-13, D-15, D-17, D-18, D-20, D-21, N-32
      ContentsID=20031, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 02/09/2002, delivered: Arb-3(03/09/2002), Arb-2(03/09/2002),
     Arb-1(03/09/2002), SpAdv-1(03/09/2002), C-1(03/09/2002), R-1(03/09/2002), R-
     2(03/09/2002)

D-25: Statement on issue 1 (C), from C-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-24, distribute in B-24
      Written stage - additional docs; after N-23; followed by D-29, D-30, D-31,
     N-42
      ContentsID=20017, type 28, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 29/09/2002, delivered: Arb-3(30/09/2002), Arb-2(30/09/2002),
     Arb-1(30/09/2002), R-1(30/09/2002), R-2(30/09/2002)

D-26: Statement on issue 1 (R-1), from R-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-24, distribute in B-24
      Written stage - additional docs; after N-23; followed by D-29, D-30, D-31,
     N-42
      ContentsID=20018, type 28, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 29/09/2002, delivered: Arb-3(30/09/2002), Arb-2(30/09/2002),
     Arb-1(30/09/2002), C-1(30/09/2002), R-2(30/09/2002)

D-27: Statement on issue 1 (R-2), from R-2
      document, type 28, time allowed 30 days, status: 4
      submit in B-24, distribute in B-24
      Written stage - additional docs; after N-23; followed by D-29, D-30, D-31,
     N-42
      ContentsID=20019, type 28, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 29/09/2002, delivered: Arb-3(30/09/2002), Arb-2(30/09/2002),
     Arb-1(30/09/2002), C-1(30/09/2002), R-1(30/09/2002)

D-29: Comments on issue 1 (C), from C-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-28, distribute in B-28
      Written stage - additional docs; after D-25, D-26, D-27; followed by N-42
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      ContentsID=20020, type 29, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 12/10/2002, delivered: Arb-3(13/10/2002), Arb-2(13/10/2002),
     Arb-1(13/10/2002), R-1(13/10/2002), R-2(13/10/2002)

D-30: Comments on issue 1 (R-1), from R-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-28, distribute in B-28
      Written stage - additional docs; after D-25, D-26, D-27; followed by N-42
      ContentsID=20021, type 29, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 12/10/2002, delivered: Arb-3(13/10/2002), Arb-2(13/10/2002),
     Arb-1(13/10/2002), C-1(13/10/2002), R-2(13/10/2002)

D-31: Comments on issue 1 (R-2), from R-2
      document, type 29, time allowed 15 days, status: 4
      submit in B-28, distribute in B-28
      Written stage - additional docs; after D-25, D-26, D-27; followed by N-42
      ContentsID=20022, type 29, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 12/10/2002, delivered: Arb-3(13/10/2002), Arb-2(13/10/2002),
     Arb-1(13/10/2002), C-1(13/10/2002), R-1(13/10/2002)

D-33: Evidence submitted to expert (R-2), from R-2
      document, type 40, time allowed 30 days, status: 4
      Written stage - additional docs; after N-23; followed by D-34, N-42
      ContentsID=20024, type 40, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 29/09/2002, delivered: Arb-3(30/09/2002), Arb-2(30/09/2002),
     Arb-1(30/09/2002), SpAdv-1(30/09/2002), C-1(30/09/2002), R-1(30/09/2002)

D-34: Specialist report, from SpAdv-1
      document, type 27, time allowed 30 days, status: 4
      Written stage - additional docs; after D-33, N-32; followed by D-36, D-37,
     D-38, N-42
      ContentsID=20025, type 27, submitted by post (direct)
      from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 29/10/2002, delivered: Arb-3(30/10/2002), Arb-2(30/10/2002),
     Arb-1(30/10/2002), C-1(30/10/2002), R-1(30/10/2002), R-2(30/10/2002)

D-36: Comments on report (C), from C-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-35, distribute in B-35
      Written stage - additional docs; after D-34; followed by N-42
      ContentsID=20026, type 30, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 11/11/2002, delivered: R-1(12/11/2002), R-2(12/11/2002), Arb-
     3(12/11/2002), Arb-2(12/11/2002), Arb-1(12/11/2002)

D-37: Comments on report (R-1), from R-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-35, distribute in B-35
      Written stage - additional docs; after D-34; followed by N-42
      ContentsID=20027, type 30, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 11/11/2002, delivered: C-1(12/11/2002), R-2(12/11/2002), Arb-
     3(12/11/2002), Arb-2(12/11/2002), Arb-1(12/11/2002)

D-38: Comments on report (R-2), from R-2
      document, type 30, time allowed 15 days, status: 4
      submit in B-35, distribute in B-35
      Written stage - additional docs; after D-34; followed by N-42
      ContentsID=20028, type 30, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 11/11/2002, delivered: Arb-3(12/11/2002), Arb-2(12/11/2002),
     Arb-1(12/11/2002), C-1(12/11/2002), R-1(12/11/2002)

N-42: Written stage - additional docs completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - additional docs; after D-25, D-26, D-27, D-29, D-30, D-31,
     D-33, D-34, D-36, D-37, D-38
      ContentsID=20032, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 11/11/2002, delivered: Arb-3(12/11/2002), Arb-2(12/11/2002),
     Arb-1(12/11/2002), SpAdv-1(12/11/2002), C-1(12/11/2002), R-1(12/11/2002), R-
     2(12/11/2002)

N-39: Record of hearing, from Arb-1
      notice, type 13, status: 4
      starts sequence Main hearing
      ContentsID=20029, type 13, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 12/01/2003, delivered: R-1(13/01/2003), R-2(13/01/2003), C-
     1(13/01/2003)

N-40: Final Award, from Arb-1
      notice, type 11, status: 4
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        starts sequence Award stage
        ContentsID=20030, type 11, submitted by post (direct)
        from Arb-1 to C-1, R-1, R-2
        submitted: 05/02/2003, delivered: C-1(06/02/2003), R-1(06/02/2003), R-
        2(06/02/2003)
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C.4 C.I.ARB. RULES

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Case number 1
Agreement to settle by post. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 13/08/2002 by a telephone conference finished
          13/08/2002
          main hearing set for 04/12/2002 by a face-to-face meeting finished
          04/12/2002
          case closed 15/01/2003

Default rules: C.I.Arb. rules, base time 28 days

Index cards for case
     D-1: The Arbitration Notice, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-7
          ContentsID=20001, type 1, submitted by post (direct)
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(26/03/2002), Arb-3(26/03/2002), Arb-
          2(26/03/2002), Arb-1(26/03/2002), R-2(26/03/2002)
          appoint external nominee

     D-3: The Response (R-1), from R-1
          document, type 2, time allowed 14 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          ContentsID=20002, type 2, submitted by post (direct)
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 05/04/2002, delivered: Arb-3(06/04/2002), Arb-2(06/04/2002),
          Arb-1(06/04/2002), C-1(06/04/2002), R-2(06/04/2002)
          appoint claimant nominee, appoint respondent nominee

     D-4: The Response (R-2), from R-2
          document, type 2, time allowed 14 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          ContentsID=20003, type 2, submitted by post (direct)
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 05/04/2002, delivered: Arb-3(06/04/2002), Arb-2(06/04/2002),
          Arb-1(06/04/2002), C-1(06/04/2002), R-1(06/04/2002)

     D-5: Statement of impartiality 2, from Arb-2
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20004, type 14, submitted by post (direct)
          from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
          submitted: 10/04/2002, delivered: Arb-3(11/04/2002), Arb-1(11/04/2002), C-
          1(11/04/2002), R-1(11/04/2002), R-2(11/04/2002)

     D-6: Statement of impartiality 3, from Arb-3
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20005, type 14, submitted by post (direct)
          from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
          submitted: 12/04/2002, delivered: Arb-2(13/04/2002), Arb-1(13/04/2002), C-
          1(13/04/2002), R-1(13/04/2002), R-2(13/04/2002)

     D-7: Statement of impartiality 1, from Arb-1
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20006, type 14, submitted by post (direct)
          from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
          submitted: 12/04/2002, delivered: Arb-3(13/04/2002), Arb-2(13/04/2002), C-
          1(13/04/2002), R-1(13/04/2002), R-2(13/04/2002)

     N-8: Notice of Formation, from Sec/Reg
          notice, type 3, status: 4
          Tribunal formation; after D-7, D-5, D-6
          ContentsID=20007, type 3
          from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 12/04/2002, delivered: Arb-3(13/04/2002), Arb-2(13/04/2002),
          Arb-1(13/04/2002), C-1(13/04/2002), R-1(13/04/2002), R-2(13/04/2002)
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D-9: Particulars of Claim, from C-1
     document, type 20, time allowed 28 days, status: 4
     starts sequence Preliminaries; followed by D-11, D-13, D-14, D-16, N-23
     ContentsID=20008, type 20, submitted by post (direct)
     from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 06/05/2002, delivered: Arb-3(07/05/2002), Arb-2(07/05/2002),
    Arb-1(07/05/2002), R-1(07/05/2002), R-2(07/05/2002)

D-11: A Defence (R-1), from R-1
     document, type 21, time allowed 28 days, status: 4
     submit in B-12, distribute in B-10
     Preliminaries; after D-9; followed by D-18, N-23
     Part of ContentsID=20009, type 21, submitted by post (direct)
     from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 31/05/2002, delivered: Arb-3(02/06/2002), Arb-2(02/06/2002),
    Arb-1(02/06/2002), C-1(02/06/2002), R-2(02/06/2002)

D-13: Counterclaim (R-1), from R-1
     document, type 22, time allowed 28 days, status: 4
     submit in B-12, distribute in B-10
     Preliminaries; after D-9; followed by D-19, N-23
     Part of ContentsID=20009, type 21, submitted by post (direct)
     from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 31/05/2002, delivered: Arb-3(02/06/2002), Arb-2(02/06/2002),
    Arb-1(02/06/2002), C-1(02/06/2002), R-2(02/06/2002)

D-14: A Defence (R-2), from R-2
     document, type 21, time allowed 28 days, status: 4
     submit in B-15, distribute in B-10
     Preliminaries; after D-9; followed by D-18, N-23
     Part of ContentsID=20010, type 21, submitted by post (direct)
     from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
     submitted: 31/05/2002, delivered: C-1(02/06/2002), Arb-3(02/06/2002), Arb-
    2(02/06/2002), Arb-1(02/06/2002), R-1(02/06/2002)

D-16: Counterclaim (R-2), from R-2
     document, type 22, time allowed 28 days, status: 4
     submit in B-15, distribute in B-10
     Preliminaries; after D-9; followed by D-19, N-23
     Part of ContentsID=20010, type 21, submitted by post (direct)
     from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
     submitted: 31/05/2002, delivered: C-1(02/06/2002), Arb-3(02/06/2002), Arb-
    2(02/06/2002), Arb-1(02/06/2002), R-1(02/06/2002)

D-18: A Reply, from C-1
     document, type 23, time allowed 28 days, status: 4
     submit in B-17, distribute in B-17
     Preliminaries; after D-11, D-14; followed by N-23
     Part of ContentsID=20011, type 23, submitted by post (direct)
     from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 26/06/2002, delivered: Arb-3(27/06/2002), Arb-2(27/06/2002),
    Arb-1(27/06/2002), R-1(27/06/2002), R-2(27/06/2002)

D-19: Defence to Counterclaim, from C-1
     document, type 24, time allowed 28 days, status: 4
     submit in B-17, distribute in B-17
     Preliminaries; after D-13, D-16; followed by D-21, D-22, N-23
     Part of ContentsID=20011, type 23, submitted by post (direct)
     from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 26/06/2002, delivered: Arb-3(27/06/2002), Arb-2(27/06/2002),
    Arb-1(27/06/2002), R-1(27/06/2002), R-2(27/06/2002)

D-21: Reply to Defence to Counterclaim (R-1), from R-1
     document, type 25, time allowed 14 days, status: 4
     submit in B-20, distribute in B-20
     Preliminaries; after D-19; followed by N-23
     ContentsID=20012, type 25, submitted by post (direct)
     from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 07/07/2002, delivered: Arb-3(09/07/2002), Arb-2(09/07/2002),
    Arb-1(09/07/2002), C-1(09/07/2002), R-2(09/07/2002)

D-22: Reply to Defence to Counterclaim (R-2), from R-2
     document, type 25, time allowed 14 days, status: 4
     submit in B-20, distribute in B-20
     Preliminaries; after D-19; followed by N-23
     ContentsID=20013, type 25, submitted by post (direct)
     from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
     submitted: 07/07/2002, delivered: Arb-3(09/07/2002), Arb-2(09/07/2002),
    Arb-1(09/07/2002), C-1(09/07/2002), R-1(09/07/2002)

N-23: Notice of Preliminary Meeting, from Arb-1
     notice, type 31, status: 4
     Preliminaries; after D-9, D-11, D-13, D-14, D-16, D-18, D-19, D-21, D-22
     ContentsID=20014, type 31, submitted by post (direct)
     from Arb-1 to C-1, R-1, R-2
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      submitted: 15/07/2002, delivered: R-2(16/07/2002), C-1(16/07/2002), R-
      1(16/07/2002)

N-24: Directions and  timetable, from Arb-1
      notice, type 12, status: 4
      starts sequence Preliminary hearing; followed by D-26, D-27, D-28, N-33, D-
      34
      ContentsID=20015, type 12, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 25/08/2002, delivered: C-1(26/08/2002), R-1(26/08/2002), R-
      2(26/08/2002)

D-26: Statement on issue 1 (C), from C-1
      document, type 28, time allowed 28 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
      N-42
      ContentsID=20016, type 28, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 19/09/2002, delivered: Arb-3(20/09/2002), Arb-2(20/09/2002),
      Arb-1(20/09/2002), R-1(20/09/2002), R-2(20/09/2002)

D-27: Statement on issue 1 (R-1), from R-1
      document, type 28, time allowed 28 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
      N-42
      ContentsID=20017, type 28, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 19/09/2002, delivered: C-1(20/09/2002), R-2(20/09/2002), Arb-
      3(20/09/2002), Arb-2(20/09/2002), Arb-1(20/09/2002)

D-28: Statement on issue 1 (R-2), from R-2
      document, type 28, time allowed 28 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
      N-42
      ContentsID=20018, type 28, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 19/09/2002, delivered: Arb-3(20/09/2002), Arb-2(20/09/2002),
      Arb-1(20/09/2002), C-1(20/09/2002), R-1(20/09/2002)

D-30: Comments on issue 1 (C), from C-1
      document, type 29, time allowed 14 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-42
      ContentsID=20019, type 29, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 30/09/2002, delivered: Arb-3(02/10/2002), Arb-2(02/10/2002),
      Arb-1(02/10/2002), R-1(02/10/2002), R-2(02/10/2002)

D-31: Comments on issue 1 (R-1), from R-1
      document, type 29, time allowed 14 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-42
      ContentsID=20020, type 29, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 30/09/2002, delivered: Arb-3(02/10/2002), Arb-2(02/10/2002),
      Arb-1(02/10/2002), C-1(02/10/2002), R-2(02/10/2002)

D-32: Comments on issue 1 (R-2), from R-2
      document, type 29, time allowed 14 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-42
      ContentsID=20021, type 29, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 30/09/2002, delivered: Arb-3(02/10/2002), Arb-2(02/10/2002),
      Arb-1(02/10/2002), C-1(02/10/2002), R-1(02/10/2002)

N-33: Specialist briefing, from Arb-1
      notice, type 15, status: 4
      Written stage - additional docs; after N-24; followed by D-35, N-42
      ContentsID=20022, type 15, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2, SpAdv-1
      submitted: 30/08/2002, delivered: C-1(31/08/2002), R-1(31/08/2002), R-
      2(31/08/2002), SpAdv-1(31/08/2002)

D-34: Evidence submitted to expert (R-2), from R-2
      document, type 40, time allowed 28 days, status: 4
      Written stage - additional docs; after N-24; followed by D-35, N-42
      ContentsID=20023, type 40, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 19/09/2002, delivered: Arb-3(20/09/2002), Arb-2(20/09/2002),
      Arb-1(20/09/2002), C-1(20/09/2002), SpAdv-1(20/09/2002), R-1(20/09/2002)

D-35: Specialist report, from SpAdv-1
      document, type 27, time allowed 28 days, status: 4
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      Written stage - additional docs; after D-34, N-33; followed by D-37, D-38,
      D-39, N-42
      ContentsID=20024, type 27, submitted by post (direct)
      from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 15/10/2002, delivered: Arb-3(16/10/2002), Arb-2(16/10/2002),
      Arb-1(16/10/2002), C-1(16/10/2002), R-1(16/10/2002), R-2(16/10/2002)

D-37: Comments on report (C), from C-1
      document, type 30, time allowed 14 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-42
      ContentsID=20025, type 30, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 26/10/2002, delivered: Arb-3(27/10/2002), Arb-2(27/10/2002),
      Arb-1(27/10/2002), R-1(27/10/2002), R-2(27/10/2002)

D-38: Comments on report (R-1), from R-1
      document, type 30, time allowed 14 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-42
      ContentsID=20026, type 30, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 26/10/2002, delivered: Arb-3(27/10/2002), Arb-2(27/10/2002),
      Arb-1(27/10/2002), C-1(27/10/2002), R-2(27/10/2002)

D-39: Comments on report (R-2), from R-2
      document, type 30, time allowed 14 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-42
      ContentsID=20027, type 30, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 26/10/2002, delivered: Arb-3(27/10/2002), Arb-2(27/10/2002),
      Arb-1(27/10/2002), C-1(27/10/2002), R-1(27/10/2002)

N-42: Written stage - additional docs completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - additional docs; after D-26, D-27, D-28, D-30, D-31, D-32,
      N-33, D-34, D-35, D-37, D-38, D-39
      ContentsID=20030, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 26/10/2002, delivered: C-1(28/10/2002), R-1(28/10/2002), Arb-
      3(28/10/2002), Arb-2(28/10/2002), Arb-1(28/10/2002), R-2(28/10/2002), SpAdv-
      1(28/10/2002)

N-40: Record of hearing, from Arb-1
      notice, type 13, status: 4
      starts sequence Main hearing
      ContentsID=20028, type 13, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 07/12/2002, delivered: C-1(08/12/2002), R-1(08/12/2002), R-
      2(08/12/2002)

N-41: The Award, from Arb-1
      notice, type 11, status: 4
      starts sequence Award stage
      ContentsID=20029, type 11, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 15/01/2003, delivered: R-2(16/01/2003), C-1(16/01/2003), R-
      1(16/01/2003)
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C.5 EAT RULES

```
Case number 1
Agreement to settle online. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 28/05/2002 by a chat room finished 28/05/2002
          case closed 16/10/2002

Default rules: EAT rules, base time 20 days

Index cards for case
     D-1: The Request (application form), from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-4, D-5, D-6, D-7, D-8, D-
          10, D-16
          ContentsID=20001, type 1, submitted online
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(25/03/2002), Arb-2(25/03/2002), R-
          2(25/03/2002), Arb-3(25/03/2002), Arb-1(25/03/2002)
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D-4: Agreement to arbitrate (R-1), from R-1
     document, type 4, time allowed 7 days, status: 4
     submit in B-2, distribute in B-2
     Agreement pending; after D-1; followed by D-5
     ContentsID=20002, type 4, submitted online
     from R-1
     submitted: 01/04/2002

D-5: The Response (application form) (R-1), from R-1
     document, type 2, time allowed 10 days, status: 4
     submit in B-3, distribute in B-3
     Agreement pending; after D-1, D-4; followed by D-8, D-10, D-16
     ContentsID=20003, type 2, submitted online
     from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 29/03/2002, delivered: Arb-3(29/03/2002), Arb-2(29/03/2002),
    Arb-1(29/03/2002), R-2(29/03/2002), C-1(29/03/2002)
     appoint claimant nominee, appoint respondent nominee

D-6: Agreement to arbitrate (R-2), from R-2
     document, type 4, time allowed 7 days, status: 4
     submit in B-2, distribute in B-2
     Agreement pending; after D-1; followed by D-7
     ContentsID=20004, type 4, submitted online
     from R-2
     submitted: 01/04/2002

D-7: The Response (application form) (R-2), from R-2
     document, type 2, time allowed 10 days, status: 4
     submit in B-3, distribute in B-3
     Agreement pending; after D-1, D-6; followed by D-8, D-10, D-16
     ContentsID=20005, type 2, submitted online
     from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
     submitted: 28/03/2002, delivered: C-1(29/03/2002), R-1(29/03/2002), Arb-
    3(29/03/2002), Arb-2(29/03/2002), Arb-1(29/03/2002)

D-8: Accept appointment 2, from Arb-2
     document, type 39, time allowed 5 days, status: 4
     Tribunal formation; after D-1, D-5, D-7; followed by D-9, N-18
     ContentsID=20006, type 39, submitted online
     from Arb-2
     submitted: 02/04/2002

D-9: Statement of Independence 2, from Arb-2
     document, type 14, status: 4
     Tribunal formation; after D-8; followed by N-12, N-18
     ContentsID=20007, type 14, submitted online
     from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
     submitted: 07/04/2002, delivered: C-1(07/04/2002), R-1(07/04/2002), R-
    2(07/04/2002), Arb-1(07/04/2002), Arb-3(07/04/2002)

D-10: Accept appointment 3, from Arb-3
     document, type 39, time allowed 5 days, status: 4
     Tribunal formation; after D-1, D-5, D-7; followed by D-11, N-18
     ContentsID=20008, type 39, submitted online
     from Arb-3
     submitted: 01/04/2002

D-11: Statement of Independence 3, from Arb-3
     document, type 14, status: 4
     Tribunal formation; after D-10; followed by N-12, N-18
     ContentsID=20009, type 14, submitted online
     from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
     submitted: 07/04/2002, delivered: C-1(07/04/2002), R-1(07/04/2002), R-
    2(07/04/2002), Arb-1(07/04/2002), Arb-2(07/04/2002)

N-12: Candidate list, from Sec/Reg
     notice, type 37, status: 4
     Tribunal formation; after D-9, D-11; followed by D-14, D-15
     ContentsID=20010, type 37
     from Sec/Reg to Arb-3, Arb-2
     submitted: 07/04/2002, delivered: Arb-2(08/04/2002), Arb-3(08/04/2002)

D-14: Response to candidate list (Arb-2), from Arb-2
     document, type 38, time allowed 7 days, status: 4
     submit in B-13, distribute in B-13
     Tribunal formation; after N-12; followed by D-16
     ContentsID=20011, type 38, submitted online
     from Arb-2 to Arb-1
     submitted: 15/04/2002, delivered: Arb-1(15/04/2002)
     appoint institute nominee

D-15: Response to candidate list (Arb-3), from Arb-3
     document, type 38, time allowed 7 days, status: 4
     submit in B-13, distribute in B-13
     Tribunal formation; after N-12
     ContentsID=20012, type 38, submitted online
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      from Arb-3
      submitted: 15/04/2002

D-16: Accept appointment 1, from Arb-1
      document, type 39, time allowed 5 days, status: 4
      Tribunal formation; after D-1, D-5, D-7, D-14; followed by D-17, N-18
      ContentsID=20013, type 39, submitted online
      from Arb-1
      submitted: 19/04/2002

D-17: Statement of Independence 1, from Arb-1
      document, type 14, status: 4
      Tribunal formation; after D-16; followed by N-18
      ContentsID=20014, type 14, submitted online
      from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
      submitted: 25/04/2002, delivered: R-2(25/04/2002), Arb-3(25/04/2002), Arb-
     2(25/04/2002), R-1(25/04/2002), C-1(25/04/2002)

N-18: Notice of Formation, from Sec/Reg
      notice, type 3, status: 4
      Tribunal formation; after D-17, D-16, D-9, D-8, D-11, D-10
      ContentsID=20015, type 3
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 25/04/2002, delivered: Arb-1(25/04/2002), R-2(25/04/2002), Arb-
     3(25/04/2002), Arb-2(25/04/2002), R-1(25/04/2002), C-1(25/04/2002)

N-28: Notice of Preliminary Meeting, from Arb-1
      notice, type 31, status: 4
      starts sequence Preliminaries
      ContentsID=20020, type 31, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 01/05/2002, delivered: C-1(01/05/2002), R-2(01/05/2002), R-
     1(01/05/2002)

N-29: Order (pocedural timetable), from Arb-1
      notice, type 12, status: 4
      starts sequence Preliminary hearing; followed by D-31, D-32, D-33, N-38, D-
     39
      ContentsID=20021, type 12, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 04/06/2002, delivered: C-1(04/06/2002), R-2(04/06/2002), R-
     1(04/06/2002)

D-19: Statement of Claim, from C-1
      document, type 20, time allowed 20 days, status: 4
      starts sequence Written stage - pleadings; followed by D-21, D-23, D-24, D-
     26, N-46
      ContentsID=20016, type 20, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 24/06/2002, delivered: Arb-2(24/06/2002), Arb-1(24/06/2002),
     Arb-3(24/06/2002), R-2(24/06/2002), R-1(24/06/2002)

D-21: Statement of Defence (R-1), from R-1
      document, type 21, time allowed 20 days, status: 4
      submit in B-22, distribute in B-20
      Written stage - pleadings; after D-19; followed by N-46
      Part of ContentsID=20017, type 21, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 14/07/2002, delivered: Arb-2(14/07/2002), Arb-1(14/07/2002), R-
     2(14/07/2002), Arb-3(14/07/2002), C-1(14/07/2002)

D-23: Counter-claims (R-1), from R-1
      document, type 22, time allowed 20 days, status: 4
      submit in B-22, distribute in B-20
      Written stage - pleadings; after D-19; followed by D-27, N-46
      Part of ContentsID=20017, type 21, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 14/07/2002, delivered: Arb-2(14/07/2002), Arb-1(14/07/2002), R-
     2(14/07/2002), Arb-3(14/07/2002), C-1(14/07/2002)

D-24: Statement of Defence (R-2), from R-2
      document, type 21, time allowed 20 days, status: 4
      submit in B-25, distribute in B-20
      Written stage - pleadings; after D-19; followed by N-46
      Part of ContentsID=20018, type 21, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 14/07/2002, delivered: C-1(14/07/2002), R-1(14/07/2002), Arb-
     1(14/07/2002), Arb-2(14/07/2002), Arb-3(14/07/2002)

D-26: Counter-claims (R-2), from R-2
      document, type 22, time allowed 20 days, status: 4
      submit in B-25, distribute in B-20
      Written stage - pleadings; after D-19; followed by D-27, N-46
      Part of ContentsID=20018, type 21, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 14/07/2002, delivered: C-1(14/07/2002), R-1(14/07/2002), Arb-
     1(14/07/2002), Arb-2(14/07/2002), Arb-3(14/07/2002)
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D-27: Defence to Counter-claims, from C-1
      document, type 24, time allowed 10 days, status: 4
      Written stage - pleadings; after D-23, D-26; followed by N-46
      ContentsID=20019, type 24, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 24/07/2002, delivered: Arb-1(24/07/2002), R-1(24/07/2002), Arb-
      3(24/07/2002), Arb-2(24/07/2002), R-2(24/07/2002)

N-38: Specialist briefing, from Arb-1
      notice, type 15, status: 4
      Written stage - pleadings; after N-29; followed by D-40, N-46
      ContentsID=20028, type 15, submitted online
      from Arb-1 to C-1, R-1, R-2, SpAdv-1
      submitted: 13/06/2002, delivered: SpAdv-1(13/06/2002), R-2(13/06/2002), R-
      1(13/06/2002), C-1(13/06/2002)

N-46: Written stage - pleadings completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - pleadings; after D-19, D-21, D-23, D-24, D-26, D-27, N-38
      ContentsID=20035, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 24/07/2002, delivered: SpAdv-1(24/07/2002), Arb-2(24/07/2002),
      Arb-1(24/07/2002), Arb-3(24/07/2002), R-2(24/07/2002), C-1(24/07/2002), R-
      1(24/07/2002)

D-31: Statement on issue 1 (C), from C-1
      document, type 28, time allowed 20 days, status: 4
      submit in B-30, distribute in B-30
      Written stage - additional docs; after N-29; followed by D-35, D-36, D-37,
      N-47
      ContentsID=20022, type 28, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 13/08/2002, delivered: R-2(13/08/2002), Arb-1(13/08/2002), R-
      1(13/08/2002), Arb-3(13/08/2002), Arb-2(13/08/2002)

D-32: Statement on issue 1 (R-1), from R-1
      document, type 28, time allowed 20 days, status: 4
      submit in B-30, distribute in B-30
      Written stage - additional docs; after N-29; followed by D-35, D-36, D-37,
      N-47
      ContentsID=20023, type 28, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 13/08/2002, delivered: Arb-3(13/08/2002), Arb-2(13/08/2002),
      Arb-1(13/08/2002), C-1(13/08/2002), R-2(13/08/2002)

D-33: Statement on issue 1 (R-2), from R-2
      document, type 28, time allowed 20 days, status: 4
      submit in B-30, distribute in B-30
      Written stage - additional docs; after N-29; followed by D-35, D-36, D-37,
      N-47
      ContentsID=20024, type 28, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 13/08/2002, delivered: R-1(13/08/2002), Arb-3(13/08/2002), Arb-
      2(13/08/2002), Arb-1(13/08/2002), C-1(13/08/2002)

D-35: Comments on issue 1 (C), from C-1
      document, type 29, time allowed 10 days, status: 4
      submit in B-34, distribute in B-34
      Written stage - additional docs; after D-31, D-32, D-33; followed by N-47
      ContentsID=20025, type 29, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 23/08/2002, delivered: R-1(23/08/2002), R-2(23/08/2002), Arb-
      1(23/08/2002), Arb-2(23/08/2002), Arb-3(23/08/2002)

D-36: Comments on issue 1 (R-1), from R-1
      document, type 29, time allowed 10 days, status: 4
      submit in B-34, distribute in B-34
      Written stage - additional docs; after D-31, D-32, D-33; followed by N-47
      ContentsID=20026, type 29, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 23/08/2002, delivered: C-1(23/08/2002), R-2(23/08/2002), Arb-
      3(23/08/2002), Arb-2(23/08/2002), Arb-1(23/08/2002)

D-37: Comments on issue 1 (R-2), from R-2
      document, type 29, time allowed 10 days, status: 4
      submit in B-34, distribute in B-34
      Written stage - additional docs; after D-31, D-32, D-33; followed by N-47
      ContentsID=20027, type 29, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 23/08/2002, delivered: R-1(23/08/2002), Arb-2(23/08/2002), Arb-
      1(23/08/2002), C-1(23/08/2002), Arb-3(23/08/2002)

D-39: Evidence submitted to expert (R-2), from R-2
      document, type 40, time allowed 20 days, status: 4
      Written stage - additional docs; after N-29; followed by D-40, N-47
      ContentsID=20029, type 40, submitted online
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      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 13/08/2002, delivered: SpAdv-1(13/08/2002), C-1(13/08/2002),
    Arb-2(13/08/2002), Arb-3(13/08/2002), R-1(13/08/2002), Arb-1(13/08/2002)

D-40: Specialist report, from SpAdv-1
      document, type 27, time allowed 20 days, status: 4
      Written stage - additional docs; after D-39, N-38; followed by D-42, D-43,
    D-44, N-47
      ContentsID=20030, type 27, submitted online
      from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 27/08/2002, delivered: R-2(27/08/2002), Arb-1(27/08/2002), C-
    1(27/08/2002), Arb-3(27/08/2002), Arb-2(27/08/2002), R-1(27/08/2002)

D-42: Comments on report (C), from C-1
      document, type 30, time allowed 10 days, status: 4
      submit in B-41, distribute in B-41
      Written stage - additional docs; after D-40; followed by N-47
      ContentsID=20031, type 30, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 06/09/2002, delivered: R-1(06/09/2002), Arb-3(06/09/2002), Arb-
    2(06/09/2002), Arb-1(06/09/2002), R-2(06/09/2002)

D-43: Comments on report (R-1), from R-1
      document, type 30, time allowed 10 days, status: 4
      submit in B-41, distribute in B-41
      Written stage - additional docs; after D-40; followed by N-47
      ContentsID=20032, type 30, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 06/09/2002, delivered: R-2(06/09/2002), Arb-3(06/09/2002), Arb-
    2(06/09/2002), Arb-1(06/09/2002), C-1(06/09/2002)

D-44: Comments on report (R-2), from R-2
      document, type 30, time allowed 10 days, status: 4
      submit in B-41, distribute in B-41
      Written stage - additional docs; after D-40; followed by N-47
      ContentsID=20033, type 30, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 06/09/2002, delivered: Arb-2(06/09/2002), Arb-1(06/09/2002),
    Arb-3(06/09/2002), R-1(06/09/2002), C-1(06/09/2002)

N-47: Written stage - additional docs completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - additional docs; after D-31, D-32, D-33, D-35, D-36, D-37,
    D-39, D-40, D-42, D-43, D-44
      ContentsID=20036, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 06/09/2002, delivered: SpAdv-1(07/09/2002), R-2(07/09/2002),
    Arb-3(07/09/2002), Arb-2(07/09/2002), Arb-1(07/09/2002), C-1(07/09/2002), R-
    1(07/09/2002)

N-45: Final Award, from Arb-1
      notice, type 11, status: 4
      starts sequence Award stage
      ContentsID=20034, type 11, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 16/10/2002, delivered: C-1(17/10/2002), R-1(17/10/2002), R-
    2(17/10/2002)
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C.6 LCIA RULES WITH EAT SUPPLEMENTARY RULES

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Case number 1
Agreement to settle online. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 04/06/2002 by a chat room finished 04/06/2002
          main hearing set for 05/02/2003 by an online video conference finished
          05/02/2003
          case closed 07/03/2003

Default rules: LCIA rules with EAT supplementary rules, base time 30 days

Index cards for case
     D-1: The Request, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-7
          ContentsID=20001, type 1, submitted online
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(25/03/2002), Arb-3(25/03/2002), R-
        2(25/03/2002), Arb-1(25/03/2002), Arb-2(25/03/2002)
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      institute appoints for claimant, institute appoints for respondent, appoint
      institute nominee

D-3:  The Response (R-1), from R-1
      document, type 2, time allowed 30 days, status: 4
      submit in B-2, distribute in B-2
      Agreement pending; after D-1; followed by D-5, D-6, D-7
      ContentsID=20002, type 2, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 24/04/2002, delivered: Arb-2(24/04/2002), Arb-1(24/04/2002),
      Arb-3(24/04/2002), R-2(24/04/2002), C-1(24/04/2002)

D-4:  The Response (R-2), from R-2
      document, type 2, time allowed 30 days, status: 4
      submit in B-2, distribute in B-2
      Agreement pending; after D-1; followed by D-5, D-6, D-7
      ContentsID=20003, type 2, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 24/04/2002, delivered: Arb-2(24/04/2002), Arb-1(24/04/2002),
      Arb-3(24/04/2002), C-1(24/04/2002), R-1(24/04/2002)

D-5:  Resume and Declaration 2, from Arb-2
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4; followed by N-8
      ContentsID=20004, type 14, submitted online
      from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
      submitted: 28/04/2002, delivered: C-1(28/04/2002), Arb-3(28/04/2002), R-
      1(28/04/2002), Arb-1(28/04/2002), R-2(28/04/2002)

D-6:  Resume and Declaration 3, from Arb-3
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4; followed by N-8
      ContentsID=20005, type 14, submitted online
      from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
      submitted: 29/04/2002, delivered: C-1(29/04/2002), Arb-1(29/04/2002), R-
      1(29/04/2002), Arb-2(29/04/2002), R-2(29/04/2002)

D-7:  Resume and Declaration 1, from Arb-1
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4; followed by N-8
      ContentsID=20006, type 14, submitted online
      from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
      submitted: 29/04/2002, delivered: C-1(29/04/2002), Arb-2(29/04/2002), R-
      1(29/04/2002), Arb-3(29/04/2002), R-2(29/04/2002)

N-8:  Notice of Formation, from Sec/Reg
      notice, type 3, status: 4
      Tribunal formation; after D-7, D-5, D-6
      ContentsID=20007, type 3
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 29/04/2002, delivered: C-1(30/04/2002), R-1(30/04/2002), Arb-
      3(30/04/2002), Arb-1(30/04/2002), Arb-2(30/04/2002), R-2(30/04/2002)

N-23: Notice of Preliminary Meeting, from Arb-1
      notice, type 31, status: 4
      starts sequence Preliminaries
      ContentsID=20014, type 31, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 06/05/2002, delivered: R-1(06/05/2002), R-2(06/05/2002), C-
      1(06/05/2002)

N-24: List of questions, from Arb-1
      notice, type 12, status: 4
      starts sequence Preliminary hearing; followed by D-26, D-27, D-28, N-33, D-
      34
      ContentsID=20015, type 12, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 11/06/2002, delivered: R-2(11/06/2002), R-1(11/06/2002), C-
      1(11/06/2002)

D-9:  Statement of Case, from C-1
      document, type 20, time allowed 30 days, status: 4
      starts sequence Written stage - pleadings; followed by D-11, D-13, D-14, D-
      16, N-42
      ContentsID=20008, type 20, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 11/07/2002, delivered: Arb-2(11/07/2002), Arb-3(11/07/2002),
      Arb-1(11/07/2002), R-1(11/07/2002), R-2(11/07/2002)

D-11: Statement of Defence (R-1), from R-1
      document, type 21, time allowed 30 days, status: 4
      submit in B-12, distribute in B-10
      Written stage - pleadings; after D-9; followed by D-18, N-42
      Part of ContentsID=20009, type 21, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 10/08/2002, delivered: Arb-1(10/08/2002), Arb-3(10/08/2002),
      Arb-2(10/08/2002), R-2(10/08/2002), C-1(10/08/2002)
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D-13: Counter-claims (R-1), from R-1
      document, type 22, time allowed 30 days, status: 4
      submit in B-12, distribute in B-10
      Written stage - pleadings; after D-9; followed by D-19, N-42
      Part of ContentsID=20009, type 21, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 10/08/2002, delivered: Arb-1(10/08/2002), Arb-3(10/08/2002),
     Arb-2(10/08/2002), R-2(10/08/2002), C-1(10/08/2002)

D-14: Statement of Defence (R-2), from R-2
      document, type 21, time allowed 30 days, status: 4
      submit in B-15, distribute in B-10
      Written stage - pleadings; after D-9; followed by D-18, N-42
      Part of ContentsID=20010, type 21, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 10/08/2002, delivered: Arb-2(10/08/2002), Arb-1(10/08/2002), C-
     1(10/08/2002), Arb-3(10/08/2002), R-1(10/08/2002)

D-16: Counter-claims (R-2), from R-2
      document, type 22, time allowed 30 days, status: 4
      submit in B-15, distribute in B-10
      Written stage - pleadings; after D-9; followed by D-19, N-42
      Part of ContentsID=20010, type 21, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 10/08/2002, delivered: Arb-2(10/08/2002), Arb-1(10/08/2002), C-
     1(10/08/2002), Arb-3(10/08/2002), R-1(10/08/2002)

D-18: Reply to Defence, from C-1
      document, type 23, time allowed 30 days, status: 4
      submit in B-17, distribute in B-17
      Written stage - pleadings; after D-11, D-14; followed by N-42
      Part of ContentsID=20011, type 23, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 10/09/2002, delivered: R-1(11/09/2002), Arb-2(11/09/2002), R-
     2(11/09/2002), Arb-1(11/09/2002), Arb-3(11/09/2002)

D-19: Defence to Counter-claims, from C-1
      document, type 24, time allowed 30 days, status: 4
      submit in B-17, distribute in B-17
      Written stage - pleadings; after D-13, D-16; followed by D-21, D-22, N-42
      Part of ContentsID=20011, type 23, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 10/09/2002, delivered: R-1(11/09/2002), Arb-2(11/09/2002), R-
     2(11/09/2002), Arb-1(11/09/2002), Arb-3(11/09/2002)

D-21: Reply to Defence to CC (R-1), from R-1
      document, type 25, time allowed 30 days, status: 4
      submit in B-20, distribute in B-20
      Written stage - pleadings; after D-19; followed by N-42
      ContentsID=20012, type 25, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 11/10/2002, delivered: C-1(11/10/2002), R-2(11/10/2002), Arb-
     3(11/10/2002), Arb-2(11/10/2002), Arb-1(11/10/2002)

D-22: Reply to Defence to CC (R-2), from R-2
      document, type 25, time allowed 30 days, status: 4
      submit in B-20, distribute in B-20
      Written stage - pleadings; after D-19; followed by N-42
      ContentsID=20013, type 25, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 11/10/2002, delivered: R-1(11/10/2002), C-1(11/10/2002), Arb-
     3(11/10/2002), Arb-2(11/10/2002), Arb-1(11/10/2002)

N-33: Specialist briefing, from Arb-1
      notice, type 15, status: 4
      Written stage - pleadings; after N-24; followed by D-35, N-42
      ContentsID=20022, type 15, submitted online
      from Arb-1 to C-1, R-1, R-2, SpAdv-1
      submitted: 17/06/2002, delivered: SpAdv-1(17/06/2002), C-1(17/06/2002), R-
     2(17/06/2002), R-1(17/06/2002)

N-42: Written stage - pleadings completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - pleadings; after D-9, D-11, D-13, D-14, D-16, D-18, D-19,
     D-21, D-22, N-33
      ContentsID=20030, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 11/10/2002, delivered: SpAdv-1(11/10/2002), R-1(11/10/2002), R-
     2(11/10/2002), C-1(11/10/2002), Arb-1(11/10/2002), Arb-3(11/10/2002), Arb-
     2(11/10/2002)

D-26: Statement on issue 1 (C), from C-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
     N-43
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      ContentsID=20016, type 28, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 12/11/2002, delivered: R-1(12/11/2002), R-2(12/11/2002), Arb-
      2(12/11/2002), Arb-1(12/11/2002), Arb-3(12/11/2002)

D-27: Statement on issue 1 (R-1), from R-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
      N-43
      ContentsID=20017, type 28, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 12/11/2002, delivered: C-1(12/11/2002), Arb-3(12/11/2002), Arb-
      2(12/11/2002), Arb-1(12/11/2002), R-2(12/11/2002)

D-28: Statement on issue 1 (R-2), from R-2
      document, type 28, time allowed 30 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
      N-43
      ContentsID=20018, type 28, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 12/11/2002, delivered: R-1(12/11/2002), C-1(12/11/2002), Arb-
      2(12/11/2002), Arb-1(12/11/2002), Arb-3(12/11/2002)

D-30: Comments on issue 1 (C), from C-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-43
      ContentsID=20019, type 29, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 27/11/2002, delivered: R-2(27/11/2002), R-1(27/11/2002), Arb-
      3(27/11/2002), Arb-2(27/11/2002), Arb-1(27/11/2002)

D-31: Comments on issue 1 (R-1), from R-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-43
      ContentsID=20020, type 29, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 27/11/2002, delivered: R-2(27/11/2002), C-1(27/11/2002), Arb-
      1(27/11/2002), Arb-2(27/11/2002), Arb-3(27/11/2002)

D-32: Comments on issue 1 (R-2), from R-2
      document, type 29, time allowed 15 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-43
      ContentsID=20021, type 29, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 27/11/2002, delivered: C-1(27/11/2002), R-1(27/11/2002), Arb-
      3(27/11/2002), Arb-2(27/11/2002), Arb-1(27/11/2002)

D-34: Evidence submitted to expert (R-2), from R-2
      document, type 40, time allowed 30 days, status: 4
      Written stage - additional docs; after N-24; followed by D-35, N-43
      ContentsID=20023, type 40, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 12/11/2002, delivered: SpAdv-1(12/11/2002), R-1(12/11/2002), C-
      1(12/11/2002), Arb-1(12/11/2002), Arb-2(12/11/2002), Arb-3(12/11/2002)

D-35: Specialist report, from SpAdv-1
      document, type 27, time allowed 30 days, status: 4
      Written stage - additional docs; after D-34, N-33; followed by D-37, D-38,
      D-39, N-43
      ContentsID=20024, type 27, submitted online
      from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 08/12/2002, delivered: R-1(08/12/2002), C-1(08/12/2002), Arb-
      1(08/12/2002), R-2(08/12/2002), Arb-3(08/12/2002), Arb-2(08/12/2002)

D-37: Comments on report (C), from C-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-43
      ContentsID=20025, type 30, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 23/12/2002, delivered: R-1(24/12/2002), Arb-3(24/12/2002), Arb-
      1(24/12/2002), R-2(24/12/2002), Arb-2(24/12/2002)

D-38: Comments on report (R-1), from R-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-43
      ContentsID=20026, type 30, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 23/12/2002, delivered: C-1(24/12/2002), Arb-2(24/12/2002), Arb-
      1(24/12/2002), Arb-3(24/12/2002), R-2(24/12/2002)
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D-39: Comments on report (R-2), from R-2
      document, type 30, time allowed 15 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-43
      ContentsID=20027, type 30, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 23/12/2002, delivered: C-1(24/12/2002), R-1(24/12/2002), Arb-
      2(24/12/2002), Arb-1(24/12/2002), Arb-3(24/12/2002)

N-43: Written stage - additional docs completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - additional docs; after D-26, D-27, D-28, D-30, D-31, D-32,
      D-34, D-35, D-37, D-38, D-39
      ContentsID=20031, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 23/12/2002, delivered: SpAdv-1(24/12/2002), R-2(24/12/2002), C-
      1(24/12/2002), Arb-3(24/12/2002), Arb-2(24/12/2002), Arb-1(24/12/2002), R-
      1(24/12/2002)

N-40: Record of hearing, from Arb-1
      notice, type 13, status: 4
      starts sequence Main hearing
      ContentsID=20028, type 13, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 06/02/2003, delivered: R-2(06/02/2003), R-1(06/02/2003), C-
      1(06/02/2003)

N-41: The Award, from Arb-1
      notice, type 11, status: 4
      starts sequence Award stage
      ContentsID=20029, type 11, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 07/03/2003, delivered: C-1(08/03/2003), R-1(08/03/2003), R-
      2(08/03/2003)
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C.7 UNCITRAL RULES WITH EAT SUPPLEMENTARY RULES

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Case number 1
Agreement to settle online. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 11/06/2002 by a chat room finished 11/06/2002
          main hearing set for 15/01/2003 by an online video conference finished
          15/01/2003
          case closed 10/02/2003

Default rules: UNCITRAL rules with EAT supplementary rules, base time 30 days

Index cards for case
     D-1: Notice of Arbitration, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-11
          ContentsID=20001, type 1, submitted online
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(25/03/2002), Arb-3(25/03/2002), R-
          2(25/03/2002), Arb-1(25/03/2002), Arb-2(25/03/2002)

     D-3: Response to Notice (R-1), from R-1
          document, type 2, time allowed 15 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-11
          ContentsID=20002, type 2, submitted online
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 09/04/2002, delivered: Arb-2(10/04/2002), Arb-1(10/04/2002),
          Arb-3(10/04/2002), R-2(10/04/2002), C-1(10/04/2002)
          appoint claimant nominee, appoint respondent nominee

     D-4: Response to Notice (R-2), from R-2
          document, type 2, time allowed 15 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-11
          ContentsID=20003, type 2, submitted online
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 09/04/2002, delivered: C-1(10/04/2002), R-1(10/04/2002), Arb-
          3(10/04/2002), Arb-2(10/04/2002), Arb-1(10/04/2002)

     D-5: Agreement to serve and disclosure 2, from Arb-2
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-7, N-12
          ContentsID=20004, type 14, submitted online
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     from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
     submitted: 15/04/2002, delivered: C-1(16/04/2002), R-1(16/04/2002), Arb-
     3(16/04/2002), Arb-1(16/04/2002), R-2(16/04/2002)

D-6: Agreement to serve and disclosure 3, from Arb-3
     document, type 14, status: 4
     Tribunal formation; after D-1, D-3, D-4; followed by N-7, N-12
     ContentsID=20005, type 14, submitted online
     from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
     submitted: 16/04/2002, delivered: C-1(16/04/2002), Arb-2(16/04/2002), R-
     1(16/04/2002), Arb-1(16/04/2002), R-2(16/04/2002)

N-7: List of names, from Sec/Reg
     notice, type 37, status: 4
     Tribunal formation; after D-5, D-6; followed by D-9, D-10
     ContentsID=20006, type 37
     from Sec/Reg to Arb-3, Arb-2
     submitted: 16/04/2002, delivered: Arb-2(17/04/2002), Arb-3(17/04/2002)

D-9: List of preferences (Arb-2), from Arb-2
     document, type 38, time allowed 15 days, status: 4
     submit in B-8, distribute in B-8
     Tribunal formation; after N-7; followed by D-11
     ContentsID=20007, type 38, submitted online
     from Arb-2 to Arb-1
     submitted: 30/04/2002, delivered: Arb-1(30/04/2002)
     appoint institute nominee

D-10: List of preferences (Arb-3), from Arb-3
     document, type 38, time allowed 15 days, status: 4
     submit in B-8, distribute in B-8
     Tribunal formation; after N-7
     ContentsID=20008, type 38, submitted online
     from Arb-3
     submitted: 30/04/2002

D-11: Agreement to serve and disclosure 1, from Arb-1
     document, type 14, status: 4
     Tribunal formation; after D-1, D-3, D-4, D-9; followed by N-12
     ContentsID=20009, type 14, submitted online
     from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
     submitted: 05/05/2002, delivered: R-2(05/05/2002), Arb-2(05/05/2002), Arb-
     3(05/05/2002), R-1(05/05/2002), C-1(05/05/2002)

N-12: Notice of Formation, from Sec/Reg
     notice, type 3, status: 4
     Tribunal formation; after D-11, D-5, D-6
     ContentsID=20010, type 3
     from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 05/05/2002, delivered: Arb-3(05/05/2002), R-2(05/05/2002), Arb-
     2(05/05/2002), Arb-1(05/05/2002), R-1(05/05/2002), C-1(05/05/2002)

N-22: Notice of Preliminary Meeting, from Arb-1
     notice, type 31, status: 4
     starts sequence Preliminaries
     ContentsID=20015, type 31, submitted online
     from Arb-1 to C-1, R-1, R-2
     submitted: 12/05/2002, delivered: C-1(12/05/2002), R-1(12/05/2002), R-
     2(12/05/2002)

N-23: Terms of Reference, from Arb-1
     notice, type 12, status: 4
     starts sequence Preliminary hearing; followed by D-25, D-26, D-27, N-32, D-
     33
     ContentsID=20016, type 12, submitted online
     from Arb-1 to C-1, R-1, R-2
     submitted: 17/06/2002, delivered: R-2(17/06/2002), C-1(17/06/2002), R-
     1(17/06/2002)

D-13: Statement of Claim, from C-1
     document, type 20, time allowed 30 days, status: 4
     starts sequence Written stage - pleadings; followed by D-15, D-17, D-18, D-
     20, N-41
     ContentsID=20011, type 20, submitted online
     from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 17/07/2002, delivered: R-1(17/07/2002), Arb-2(17/07/2002), Arb-
     1(17/07/2002), R-2(17/07/2002), Arb-3(17/07/2002)

D-15: Statement of Defence (R-1), from R-1
     document, type 21, time allowed 30 days, status: 4
     submit in B-16, distribute in B-14
     Written stage - pleadings; after D-13; followed by N-41
     Part of ContentsID=20012, type 21, submitted online
     from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
     submitted: 16/08/2002, delivered: C-1(16/08/2002), R-2(16/08/2002), Arb-
     3(16/08/2002), Arb-2(16/08/2002), Arb-1(16/08/2002)
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D-17: Counter-Claim (R-1), from R-1
      document, type 22, time allowed 30 days, status: 4
      submit in B-16, distribute in B-14
      Written stage - pleadings; after D-13; followed by D-21, N-41
      Part of ContentsID=20012, type 21, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 16/08/2002, delivered: C-1(16/08/2002), R-2(16/08/2002), Arb-
     3(16/08/2002), Arb-2(16/08/2002), Arb-1(16/08/2002)

D-18: Statement of Defence (R-2), from R-2
      document, type 21, time allowed 30 days, status: 4
      submit in B-19, distribute in B-14
      Written stage - pleadings; after D-13; followed by N-41
      Part of ContentsID=20013, type 21, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 16/08/2002, delivered: R-1(16/08/2002), Arb-3(16/08/2002), Arb-
     2(16/08/2002), Arb-1(16/08/2002), C-1(16/08/2002)

D-20: Counter-Claim (R-2), from R-2
      document, type 22, time allowed 30 days, status: 4
      submit in B-19, distribute in B-14
      Written stage - pleadings; after D-13; followed by D-21, N-41
      Part of ContentsID=20013, type 21, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 16/08/2002, delivered: R-1(16/08/2002), Arb-3(16/08/2002), Arb-
     2(16/08/2002), Arb-1(16/08/2002), C-1(16/08/2002)

D-21: Reply to Counter-Claim, from C-1
      document, type 24, time allowed 30 days, status: 4
      Written stage - pleadings; after D-17, D-20; followed by N-41
      ContentsID=20014, type 24, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 17/09/2002, delivered: R-2(18/09/2002), Arb-3(18/09/2002), Arb-
     2(18/09/2002), Arb-1(18/09/2002), R-1(18/09/2002)

N-32: Specialist briefing, from Arb-1
      notice, type 15, status: 4
      Written stage - pleadings; after N-23; followed by D-34, N-41
      ContentsID=20023, type 15, submitted online
      from Arb-1 to C-1, R-1, R-2, SpAdv-1
      submitted: 24/06/2002, delivered: SpAdv-1(24/06/2002), C-1(24/06/2002), R-
     1(24/06/2002), R-2(24/06/2002)

N-41: Written stage - pleadings completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - pleadings; after D-13, D-15, D-17, D-18, D-20, D-21, N-32
      ContentsID=20031, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 17/09/2002, delivered: SpAdv-1(18/09/2002), R-1(18/09/2002), R-
     2(18/09/2002), Arb-1(18/09/2002), Arb-2(18/09/2002), Arb-3(18/09/2002), C-
     1(18/09/2002)

D-25: Statement on issue 1 (C), from C-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-24, distribute in B-24
      Written stage - additional docs; after N-23; followed by D-29, D-30, D-31,
     N-42
      ContentsID=20017, type 28, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 17/10/2002, delivered: R-2(18/10/2002), Arb-2(18/10/2002), Arb-
     3(18/10/2002), Arb-1(18/10/2002), R-1(18/10/2002)

D-26: Statement on issue 1 (R-1), from R-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-24, distribute in B-24
      Written stage - additional docs; after N-23; followed by D-29, D-30, D-31,
     N-42
      ContentsID=20018, type 28, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 17/10/2002, delivered: Arb-2(18/10/2002), Arb-1(18/10/2002), C-
     1(18/10/2002), Arb-3(18/10/2002), R-2(18/10/2002)

D-27: Statement on issue 1 (R-2), from R-2
      document, type 28, time allowed 30 days, status: 4
      submit in B-24, distribute in B-24
      Written stage - additional docs; after N-23; followed by D-29, D-30, D-31,
     N-42
      ContentsID=20019, type 28, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 17/10/2002, delivered: R-1(18/10/2002), Arb-3(18/10/2002), Arb-
     2(18/10/2002), Arb-1(18/10/2002), C-1(18/10/2002)

D-29: Comments on issue 1 (C), from C-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-28, distribute in B-28
      Written stage - additional docs; after D-25, D-26, D-27; followed by N-42
      ContentsID=20020, type 29, submitted online
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      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 04/11/2002, delivered: Arb-2(04/11/2002), Arb-1(04/11/2002),
     Arb-3(04/11/2002), R-2(04/11/2002), R-1(04/11/2002)

D-30: Comments on issue 1 (R-1), from R-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-28, distribute in B-28
      Written stage - additional docs; after D-25, D-26, D-27; followed by N-42
      ContentsID=20021, type 29, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 04/11/2002, delivered: Arb-2(04/11/2002), Arb-1(04/11/2002),
     Arb-3(04/11/2002), R-2(04/11/2002), C-1(04/11/2002)

D-31: Comments on issue 1 (R-2), from R-2
      document, type 29, time allowed 15 days, status: 4
      submit in B-28, distribute in B-28
      Written stage - additional docs; after D-25, D-26, D-27; followed by N-42
      ContentsID=20022, type 29, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 04/11/2002, delivered: Arb-2(04/11/2002), Arb-1(04/11/2002), C-
     1(04/11/2002), Arb-3(04/11/2002), R-1(04/11/2002)

D-33: Evidence submitted to expert (R-2), from R-2
      document, type 40, time allowed 30 days, status: 4
      Written stage - additional docs; after N-23; followed by D-34, N-42
      ContentsID=20024, type 40, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 17/10/2002, delivered: SpAdv-1(17/10/2002), C-1(17/10/2002), R-
     1(17/10/2002), Arb-2(17/10/2002), Arb-3(17/10/2002), Arb-1(17/10/2002)

D-34: Specialist report, from SpAdv-1
      document, type 27, time allowed 30 days, status: 4
      Written stage - additional docs; after D-33, N-32; followed by D-36, D-37,
     D-38, N-42
      ContentsID=20025, type 27, submitted online
      from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 08/11/2002, delivered: R-2(09/11/2002), R-1(09/11/2002), Arb-
     3(09/11/2002), Arb-2(09/11/2002), Arb-1(09/11/2002), C-1(09/11/2002)

D-36: Comments on report (C), from C-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-35, distribute in B-35
      Written stage - additional docs; after D-34; followed by N-42
      ContentsID=20026, type 30, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 25/11/2002, delivered: R-1(25/11/2002), Arb-3(25/11/2002), Arb-
     2(25/11/2002), Arb-1(25/11/2002), R-2(25/11/2002)

D-37: Comments on report (R-1), from R-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-35, distribute in B-35
      Written stage - additional docs; after D-34; followed by N-42
      ContentsID=20027, type 30, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 25/11/2002, delivered: R-2(25/11/2002), C-1(25/11/2002), Arb-
     3(25/11/2002), Arb-2(25/11/2002), Arb-1(25/11/2002)

D-38: Comments on report (R-2), from R-2
      document, type 30, time allowed 15 days, status: 4
      submit in B-35, distribute in B-35
      Written stage - additional docs; after D-34; followed by N-42
      ContentsID=20028, type 30, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 25/11/2002, delivered: R-1(25/11/2002), Arb-2(25/11/2002), Arb-
     1(25/11/2002), Arb-3(25/11/2002), C-1(25/11/2002)

N-42: Written stage - additional docs completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - additional docs; after D-25, D-26, D-27, D-29, D-30, D-31,
     D-33, D-34, D-36, D-37, D-38
      ContentsID=20032, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 25/11/2002, delivered: SpAdv-1(25/11/2002), R-1(25/11/2002), C-
     1(25/11/2002), Arb-3(25/11/2002), Arb-2(25/11/2002), R-2(25/11/2002), Arb-
     1(25/11/2002)

N-39: Record of hearing, from Arb-1
      notice, type 13, status: 4
      starts sequence Main hearing
      ContentsID=20029, type 13, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 16/01/2003, delivered: R-1(16/01/2003), R-2(16/01/2003), C-
     1(16/01/2003)

N-40: Final Award, from Arb-1
      notice, type 11, status: 4
      starts sequence Award stage
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        ContentsID=20030, type 11, submitted online
        from Arb-1 to C-1, R-1, R-2
        submitted: 10/02/2003, delivered: C-1(11/02/2003), R-1(11/02/2003), R-
        2(11/02/2003)
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C.8 ICC RULES WITH EAT SUPPLEMENTARY RULES

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Case number 1
Agreement to settle online. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 25/06/2002 by a chat room finished 25/06/2002
          main hearing set for 20/11/2002 by an online video conference finished
          20/11/2002
          case closed 21/12/2002

Default rules: ICC rules with EAT supplementary rules, base time 30 days

Index cards for case
     D-1: The Request, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-7, D-
          11, D-13
          ContentsID=20001, type 1, submitted online
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(25/03/2002), Arb-3(25/03/2002), R-
          2(25/03/2002), Arb-1(25/03/2002), Arb-2(25/03/2002)
          institute appoints for claimant, institute appoints for respondent, appoint
          institute nominee

     D-3: The Answer (R-1), from R-1
          document, type 2, time allowed 30 days, status: 4
          submit in B-10, distribute in B-9
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          Part of ContentsID=20002, type 2, submitted online
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: C-1(24/04/2002), Arb-3(24/04/2002), Arb-
          2(24/04/2002), Arb-1(24/04/2002), R-2(24/04/2002)

     D-4: The Answer (R-2), from R-2
          document, type 2, time allowed 30 days, status: 4
          submit in B-12, distribute in B-9
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          Part of ContentsID=20003, type 2, submitted online
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: R-1(24/04/2002), Arb-3(24/04/2002), Arb-
          2(24/04/2002), Arb-1(24/04/2002), C-1(24/04/2002)

     D-11: Counter-Claim (R-1), from R-1
          document, type 22, time allowed 30 days, status: 4
          submit in B-10, distribute in B-9
          Agreement pending; after D-1; followed by D-14
          Part of ContentsID=20002, type 2, submitted online
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: C-1(24/04/2002), Arb-3(24/04/2002), Arb-
          2(24/04/2002), Arb-1(24/04/2002), R-2(24/04/2002)

     D-13: Counter-Claim (R-2), from R-2
          document, type 22, time allowed 30 days, status: 4
          submit in B-12, distribute in B-9
          Agreement pending; after D-1; followed by D-14
          Part of ContentsID=20003, type 2, submitted online
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 24/04/2002, delivered: R-1(24/04/2002), Arb-3(24/04/2002), Arb-
          2(24/04/2002), Arb-1(24/04/2002), C-1(24/04/2002)

     D-5: Statement of Independence 2, from Arb-2
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20004, type 14, submitted online
          from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
          submitted: 29/04/2002, delivered: R-1(29/04/2002), R-2(29/04/2002), C-
          1(29/04/2002), Arb-1(29/04/2002), Arb-3(29/04/2002)

     D-6: Statement of Independence 3, from Arb-3
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20005, type 14, submitted online
          from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
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      submitted: 30/04/2002, delivered: R-2(30/04/2002), Arb-1(30/04/2002), R-
      1(30/04/2002), C-1(30/04/2002), Arb-2(30/04/2002)

D-7:  Statement of Independence 1, from Arb-1
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4; followed by N-8
      ContentsID=20006, type 14, submitted online
      from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
      submitted: 30/04/2002, delivered: R-2(30/04/2002), R-1(30/04/2002), C-
      1(30/04/2002), Arb-2(30/04/2002), Arb-3(30/04/2002)

N-8:  Notification of appointment, from Sec/Reg
      notice, type 3, status: 4
      Tribunal formation; after D-7, D-5, D-6
      ContentsID=20007, type 3
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 30/04/2002, delivered: R-2(30/04/2002), Arb-1(30/04/2002), Arb-
      2(30/04/2002), R-1(30/04/2002), C-1(30/04/2002), Arb-3(30/04/2002)

D-14: Reply to Counter-Claim, from C-1
      document, type 24, time allowed 30 days, status: 4
      Tribunal formation; after D-11, D-13
      ContentsID=20008, type 24, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 24/05/2002, delivered: Arb-3(24/05/2002), Arb-2(24/05/2002), R-
      2(24/05/2002), Arb-1(24/05/2002), R-1(24/05/2002)

N-15: Notice of Preliminary Meeting, from Arb-1
      notice, type 31, status: 4
      starts sequence Preliminaries
      ContentsID=20009, type 31, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 31/05/2002, delivered: R-1(31/05/2002), R-2(31/05/2002), C-
      1(31/05/2002)

N-16: Unsigned Terms of Reference, from Arb-1
      notice, type 41, status: 4
      starts sequence Preliminary hearing; followed by D-17, D-18, D-19, D-20
      ContentsID=20010, type 41, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 01/07/2002, delivered: C-1(01/07/2002), R-2(01/07/2002), R-
      1(01/07/2002)

D-17: Signed Terms of Reference (C), from C-1
      document, type 42, time allowed 30 days, status: 4
      Preliminary hearing; after N-16; followed by D-21
      ContentsID=20011, type 42, submitted online
      from C-1
      submitted: 31/07/2002

D-18: Signed Terms of Reference (R-1), from R-1
      document, type 42, time allowed 30 days, status: 4
      Preliminary hearing; after N-16; followed by D-21
      ContentsID=20012, type 42, submitted online
      from R-1
      submitted: 31/07/2002

D-19: Signed Terms of Reference (R-2), from R-2
      document, type 42, time allowed 30 days, status: 4
      Preliminary hearing; after N-16; followed by D-21
      ContentsID=20013, type 42, submitted online
      from R-2
      submitted: 31/07/2002

D-20: Procedural timetable, from Arb-1
      document, type 43, status: 4
      Preliminary hearing; after N-16; followed by D-21
      ContentsID=20014, type 43, submitted online
      from Arb-1
      submitted: 08/07/2002

D-21: Terms of Reference & Timetable, from Sec/Reg
      document, type 12, status: 4
      Preliminary hearing; after D-17, D-18, D-19, D-20; followed by D-23, D-24,
      D-25, N-30, D-31
      ContentsID=20015, type 12
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 31/07/2002, delivered: R-2(31/07/2002), C-1(31/07/2002), Arb-
      1(31/07/2002), Arb-3(31/07/2002), Arb-2(31/07/2002), R-1(31/07/2002)

D-23: Statement on issue 1 (C), from C-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-22, distribute in B-22
      Written stage - additional docs; after D-21; followed by D-27, D-28, D-29,
      N-39
      ContentsID=20016, type 28, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
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      submitted: 30/08/2002, delivered: Arb-2(30/08/2002), Arb-1(30/08/2002),
      Arb-3(30/08/2002), R-2(30/08/2002), R-1(30/08/2002)

D-24: Statement on issue 1 (R-1), from R-1
      document, type 28, time allowed 30 days, status: 4
      submit in B-22, distribute in B-22
      Written stage - additional docs; after D-21; followed by D-27, D-28, D-29,
      N-39
      ContentsID=20017, type 28, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 30/08/2002, delivered: Arb-3(30/08/2002), Arb-2(30/08/2002),
      Arb-1(30/08/2002), R-2(30/08/2002), C-1(30/08/2002)

D-25: Statement on issue 1 (R-2), from R-2
      document, type 28, time allowed 30 days, status: 4
      submit in B-22, distribute in B-22
      Written stage - additional docs; after D-21; followed by D-27, D-28, D-29,
      N-39
      ContentsID=20018, type 28, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 30/08/2002, delivered: Arb-3(30/08/2002), Arb-1(30/08/2002),
      Arb-2(30/08/2002), C-1(30/08/2002), R-1(30/08/2002)

D-27: Comments on issue 1 (C), from C-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-26, distribute in B-26
      Written stage - additional docs; after D-23, D-24, D-25; followed by N-39
      ContentsID=20019, type 29, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 16/09/2002, delivered: Arb-3(16/09/2002), Arb-1(16/09/2002),
      Arb-2(16/09/2002), R-2(16/09/2002), R-1(16/09/2002)

D-28: Comments on issue 1 (R-1), from R-1
      document, type 29, time allowed 15 days, status: 4
      submit in B-26, distribute in B-26
      Written stage - additional docs; after D-23, D-24, D-25; followed by N-39
      ContentsID=20020, type 29, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 16/09/2002, delivered: Arb-2(16/09/2002), Arb-1(16/09/2002),
      Arb-3(16/09/2002), C-1(16/09/2002), R-2(16/09/2002)

D-29: Comments on issue 1 (R-2), from R-2
      document, type 29, time allowed 15 days, status: 4
      submit in B-26, distribute in B-26
      Written stage - additional docs; after D-23, D-24, D-25; followed by N-39
      ContentsID=20021, type 29, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 16/09/2002, delivered: Arb-3(16/09/2002), Arb-1(16/09/2002),
      Arb-2(16/09/2002), R-1(16/09/2002), C-1(16/09/2002)

N-30: Specialist briefing, from Arb-1
      notice, type 15, status: 4
      Written stage - additional docs; after D-21; followed by D-32, N-39
      ContentsID=20022, type 15, submitted online
      from Arb-1 to C-1, R-1, R-2, SpAdv-1
      submitted: 06/08/2002, delivered: SpAdv-1(07/08/2002), C-1(07/08/2002), R-
      1(07/08/2002), R-2(07/08/2002)

D-31: Evidence submitted to expert (R-2), from R-2
      document, type 40, time allowed 30 days, status: 4
      Written stage - additional docs; after D-21; followed by D-32, N-39
      ContentsID=20023, type 40, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 30/08/2002, delivered: SpAdv-1(30/08/2002), Arb-1(30/08/2002),
      Arb-2(30/08/2002), Arb-3(30/08/2002), C-1(30/08/2002), R-1(30/08/2002)

D-32: Specialist report, from SpAdv-1
      document, type 27, time allowed 30 days, status: 4
      Written stage - additional docs; after D-31, N-30; followed by D-34, D-35,
      D-36, N-39
      ContentsID=20024, type 27, submitted online
      from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 23/09/2002, delivered: R-1(23/09/2002), C-1(23/09/2002), R-
      2(23/09/2002), Arb-2(23/09/2002), Arb-1(23/09/2002), Arb-3(23/09/2002)

D-34: Comments on report (C), from C-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-33, distribute in B-33
      Written stage - additional docs; after D-32; followed by N-39
      ContentsID=20025, type 30, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 08/10/2002, delivered: Arb-1(09/10/2002), Arb-2(09/10/2002),
      Arb-3(09/10/2002), R-2(09/10/2002), R-1(09/10/2002)

D-35: Comments on report (R-1), from R-1
      document, type 30, time allowed 15 days, status: 4
      submit in B-33, distribute in B-33
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        Written stage - additional docs; after D-32; followed by N-39
        ContentsID=20026, type 30, submitted online
        from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
        submitted: 08/10/2002, delivered: R-2(09/10/2002), C-1(09/10/2002), Arb-
        3(09/10/2002), Arb-2(09/10/2002), Arb-1(09/10/2002)

    D-36: Comments on report (R-2), from R-2
        document, type 30, time allowed 15 days, status: 4
        submit in B-33, distribute in B-33
        Written stage - additional docs; after D-32; followed by N-39
        ContentsID=20027, type 30, submitted online
        from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
        submitted: 08/10/2002, delivered: C-1(09/10/2002), R-1(09/10/2002), Arb-
        3(09/10/2002), Arb-2(09/10/2002), Arb-1(09/10/2002)

    N-39: Written stage - additional docs completed, from Sec/Reg
        notice, type 45, status: 4
        Written stage - additional docs; after D-23, D-24, D-25, D-27, D-28, D-29,
        N-30, D-31, D-32, D-34, D-35, D-36
        ContentsID=20030, type 45
        from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
        submitted: 08/10/2002, delivered: SpAdv-1(09/10/2002), C-1(09/10/2002), R-
        1(09/10/2002), R-2(09/10/2002), Arb-3(09/10/2002), Arb-2(09/10/2002), Arb-
        1(09/10/2002)

    N-37: Record of hearing, from Arb-1
        notice, type 13, status: 4
        starts sequence Main hearing
        ContentsID=20028, type 13, submitted online
        from Arb-1 to C-1, R-1, R-2
        submitted: 21/11/2002, delivered: C-1(21/11/2002), R-2(21/11/2002), R-
        1(21/11/2002)

    N-38: Final Award, from Arb-1
        notice, type 11, status: 4
        starts sequence Award stage
        ContentsID=20029, type 11, submitted online
        from Arb-1 to C-1, R-1, R-2
        submitted: 21/12/2002, delivered: C-1(22/12/2002), R-1(22/12/2002), R-
        2(22/12/2002)
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C.9 C.I.ARB. RULES WITH EAT SUPPLEMENTARY RULES

```
Case number 1
Agreement to settle online. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          preliminary hearing set for 27/08/2002 by a chat room finished 27/08/2002
          main hearing set for 11/12/2002 by an online video conference finished
          11/12/2002
          case closed 21/01/2003

Default rules: C.I.Arb. rules with EAT supplementary rules, base time 28 days

Index cards for case
     D-1: The Arbitration Notice, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-7
          ContentsID=20001, type 1, submitted online
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: R-1(25/03/2002), Arb-3(25/03/2002), R-
          2(25/03/2002), Arb-1(25/03/2002), Arb-2(25/03/2002)
          appoint external nominee

     D-3: The Response (R-1), from R-1
          document, type 2, time allowed 14 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          ContentsID=20002, type 2, submitted online
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 08/04/2002, delivered: Arb-3(08/04/2002), Arb-2(08/04/2002),
          Arb-1(08/04/2002), R-2(08/04/2002), C-1(08/04/2002)
          appoint claimant nominee, appoint respondent nominee

     D-4: The Response (R-2), from R-2
          document, type 2, time allowed 14 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          ContentsID=20003, type 2, submitted online
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
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      submitted: 08/04/2002, delivered: R-1(08/04/2002), Arb-2(08/04/2002), C-
      1(08/04/2002), Arb-3(08/04/2002), Arb-1(08/04/2002)

D-5:  Statement of impartiality 2, from Arb-2
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4; followed by N-8
      ContentsID=20004, type 14, submitted online
      from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
      submitted: 14/04/2002, delivered: R-2(14/04/2002), Arb-1(14/04/2002), Arb-
      3(14/04/2002), R-1(14/04/2002), C-1(14/04/2002)

D-6:  Statement of impartiality 3, from Arb-3
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4; followed by N-8
      ContentsID=20005, type 14, submitted online
      from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
      submitted: 13/04/2002, delivered: R-2(13/04/2002), Arb-1(13/04/2002), Arb-
      2(13/04/2002), R-1(13/04/2002), C-1(13/04/2002)

D-7:  Statement of impartiality 1, from Arb-1
      document, type 14, status: 4
      Tribunal formation; after D-1, D-3, D-4; followed by N-8
      ContentsID=20006, type 14, submitted online
      from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
      submitted: 14/04/2002, delivered: R-2(14/04/2002), Arb-3(14/04/2002), Arb-
      2(14/04/2002), R-1(14/04/2002), C-1(14/04/2002)

N-8:  Notice of Formation, from Sec/Reg
      notice, type 3, status: 4
      Tribunal formation; after D-7, D-5, D-6
      ContentsID=20007, type 3
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 14/04/2002, delivered: Arb-3(14/04/2002), R-2(14/04/2002), Arb-
      1(14/04/2002), Arb-2(14/04/2002), C-1(14/04/2002), R-1(14/04/2002)

D-9:  Particulars of Claim, from C-1
      document, type 20, time allowed 28 days, status: 4
      starts sequence Preliminaries; followed by D-11, D-13, D-14, D-16, N-23
      ContentsID=20008, type 20, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 12/05/2002, delivered: Arb-2(12/05/2002), Arb-1(12/05/2002),
      Arb-3(12/05/2002), R-1(12/05/2002), R-2(12/05/2002)

D-11: A Defence (R-1), from R-1
      document, type 21, time allowed 28 days, status: 4
      submit in B-12, distribute in B-10
      Preliminaries; after D-9; followed by D-18, N-23
      Part of ContentsID=20009, type 21, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 09/06/2002, delivered: C-1(09/06/2002), R-2(09/06/2002), Arb-
      3(09/06/2002), Arb-2(09/06/2002), Arb-1(09/06/2002)

D-13: Counterclaim (R-1), from R-1
      document, type 22, time allowed 28 days, status: 4
      submit in B-12, distribute in B-10
      Preliminaries; after D-9; followed by D-19, N-23
      Part of ContentsID=20009, type 21, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 09/06/2002, delivered: C-1(09/06/2002), R-2(09/06/2002), Arb-
      3(09/06/2002), Arb-2(09/06/2002), Arb-1(09/06/2002)

D-14: A Defence (R-2), from R-2
      document, type 21, time allowed 28 days, status: 4
      submit in B-15, distribute in B-10
      Preliminaries; after D-9; followed by D-18, N-23
      Part of ContentsID=20010, type 21, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 09/06/2002, delivered: Arb-3(09/06/2002), Arb-2(09/06/2002),
      Arb-1(09/06/2002), C-1(09/06/2002), R-1(09/06/2002)

D-16: Counterclaim (R-2), from R-2
      document, type 22, time allowed 28 days, status: 4
      submit in B-15, distribute in B-10
      Preliminaries; after D-9; followed by D-19, N-23
      Part of ContentsID=20010, type 21, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 09/06/2002, delivered: Arb-3(09/06/2002), Arb-2(09/06/2002),
      Arb-1(09/06/2002), C-1(09/06/2002), R-1(09/06/2002)

D-18: A Reply, from C-1
      document, type 23, time allowed 28 days, status: 4
      submit in B-17, distribute in B-17
      Preliminaries; after D-11, D-14; followed by N-23
      Part of ContentsID=20011, type 23, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 07/07/2002, delivered: R-2(07/07/2002), Arb-3(07/07/2002), Arb-
      2(07/07/2002), Arb-1(07/07/2002), R-1(07/07/2002)
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D-19: Defence to Counterclaim, from C-1
      document, type 24, time allowed 28 days, status: 4
      submit in B-17, distribute in B-17
      Preliminaries; after D-13, D-16; followed by D-21, D-22, N-23
      Part of ContentsID=20011, type 23, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 07/07/2002, delivered: R-2(07/07/2002), Arb-3(07/07/2002), Arb-
     2(07/07/2002), Arb-1(07/07/2002), R-1(07/07/2002)

D-21: Reply to Defence to Counterclaim (R-1), from R-1
      document, type 25, time allowed 14 days, status: 4
      submit in B-20, distribute in B-20
      Preliminaries; after D-19; followed by N-23
      ContentsID=20012, type 25, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 21/07/2002, delivered: R-2(21/07/2002), Arb-2(21/07/2002), Arb-
     1(21/07/2002), Arb-3(21/07/2002), C-1(21/07/2002)

D-22: Reply to Defence to Counterclaim (R-2), from R-2
      document, type 25, time allowed 14 days, status: 4
      submit in B-20, distribute in B-20
      Preliminaries; after D-19; followed by N-23
      ContentsID=20013, type 25, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 21/07/2002, delivered: C-1(21/07/2002), R-1(21/07/2002), Arb-
     1(21/07/2002), Arb-2(21/07/2002), Arb-3(21/07/2002)

N-23: Notice of Preliminary Meeting, from Arb-1
      notice, type 31, status: 4
      Preliminaries; after D-9, D-11, D-13, D-14, D-16, D-18, D-19, D-21, D-22
      ContentsID=20014, type 31, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 27/07/2002, delivered: R-1(27/07/2002), R-2(27/07/2002), C-
     1(27/07/2002)

N-24: Directions and  timetable, from Arb-1
      notice, type 12, status: 4
      starts sequence Preliminary hearing; followed by D-26, D-27, D-28, N-33, D-
     34
      ContentsID=20015, type 12, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 03/09/2002, delivered: R-1(03/09/2002), C-1(03/09/2002), R-
     2(03/09/2002)

D-26: Statement on issue 1 (C), from C-1
      document, type 28, time allowed 28 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
     N-42
      ContentsID=20016, type 28, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 01/10/2002, delivered: Arb-1(01/10/2002), Arb-3(01/10/2002), R-
     2(01/10/2002), Arb-2(01/10/2002), R-1(01/10/2002)

D-27: Statement on issue 1 (R-1), from R-1
      document, type 28, time allowed 28 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
     N-42
      ContentsID=20017, type 28, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 01/10/2002, delivered: R-2(01/10/2002), Arb-2(01/10/2002), Arb-
     1(01/10/2002), C-1(01/10/2002), Arb-3(01/10/2002)

D-28: Statement on issue 1 (R-2), from R-2
      document, type 28, time allowed 28 days, status: 4
      submit in B-25, distribute in B-25
      Written stage - additional docs; after N-24; followed by D-30, D-31, D-32,
     N-42
      ContentsID=20018, type 28, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 01/10/2002, delivered: R-1(01/10/2002), Arb-2(01/10/2002), Arb-
     1(01/10/2002), Arb-3(01/10/2002), C-1(01/10/2002)

D-30: Comments on issue 1 (C), from C-1
      document, type 29, time allowed 14 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-42
      ContentsID=20019, type 29, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 15/10/2002, delivered: Arb-3(15/10/2002), Arb-2(15/10/2002),
     Arb-1(15/10/2002), R-1(15/10/2002), R-2(15/10/2002)

D-31: Comments on issue 1 (R-1), from R-1
      document, type 29, time allowed 14 days, status: 4
      submit in B-29, distribute in B-29
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      Written stage - additional docs; after D-26, D-27, D-28; followed by N-42
      ContentsID=20020, type 29, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 15/10/2002, delivered: R-2(15/10/2002), Arb-2(15/10/2002), Arb-
      1(15/10/2002), Arb-3(15/10/2002), C-1(15/10/2002)

D-32: Comments on issue 1 (R-2), from R-2
      document, type 29, time allowed 14 days, status: 4
      submit in B-29, distribute in B-29
      Written stage - additional docs; after D-26, D-27, D-28; followed by N-42
      ContentsID=20021, type 29, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 15/10/2002, delivered: R-1(15/10/2002), C-1(15/10/2002), Arb-
      3(15/10/2002), Arb-2(15/10/2002), Arb-1(15/10/2002)

N-33: Specialist briefing, from Arb-1
      notice, type 15, status: 4
      Written stage - additional docs; after N-24; followed by D-35, N-42
      ContentsID=20022, type 15, submitted online
      from Arb-1 to C-1, R-1, R-2, SpAdv-1
      submitted: 08/09/2002, delivered: SpAdv-1(08/09/2002), R-1(08/09/2002), R-
      2(08/09/2002), C-1(08/09/2002)

D-34: Evidence submitted to expert (R-2), from R-2
      document, type 40, time allowed 28 days, status: 4
      Written stage - additional docs; after N-24; followed by D-35, N-42
      ContentsID=20023, type 40, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 01/10/2002, delivered: SpAdv-1(01/10/2002), Arb-2(01/10/2002),
      Arb-1(01/10/2002), C-1(01/10/2002), Arb-3(01/10/2002), R-1(01/10/2002)

D-35: Specialist report, from SpAdv-1
      document, type 27, time allowed 28 days, status: 4
      Written stage - additional docs; after D-34, N-33; followed by D-37, D-38,
      D-39, N-42
      ContentsID=20024, type 27, submitted online
      from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 21/10/2002, delivered: R-1(22/10/2002), C-1(22/10/2002), R-
      2(22/10/2002), Arb-1(22/10/2002), Arb-2(22/10/2002), Arb-3(22/10/2002)

D-37: Comments on report (C), from C-1
      document, type 30, time allowed 14 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-42
      ContentsID=20025, type 30, submitted online
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 05/11/2002, delivered: Arb-3(05/11/2002), Arb-2(05/11/2002),
      Arb-1(05/11/2002), R-1(05/11/2002), R-2(05/11/2002)

D-38: Comments on report (R-1), from R-1
      document, type 30, time allowed 14 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-42
      ContentsID=20026, type 30, submitted online
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 05/11/2002, delivered: Arb-3(05/11/2002), Arb-2(05/11/2002),
      Arb-1(05/11/2002), C-1(05/11/2002), R-2(05/11/2002)

D-39: Comments on report (R-2), from R-2
      document, type 30, time allowed 14 days, status: 4
      submit in B-36, distribute in B-36
      Written stage - additional docs; after D-35; followed by N-42
      ContentsID=20027, type 30, submitted online
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 05/11/2002, delivered: Arb-3(05/11/2002), Arb-2(05/11/2002),
      Arb-1(05/11/2002), C-1(05/11/2002), R-1(05/11/2002)

N-42: Written stage - additional docs completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - additional docs; after D-26, D-27, D-28, D-30, D-31, D-32,
      N-33, D-34, D-35, D-37, D-38, D-39
      ContentsID=20030, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 05/11/2002, delivered: SpAdv-1(05/11/2002), C-1(05/11/2002),
      Arb-2(05/11/2002), Arb-1(05/11/2002), R-2(05/11/2002), Arb-3(05/11/2002), R-
      1(05/11/2002)

N-40: Record of hearing, from Arb-1
      notice, type 13, status: 4
      starts sequence Main hearing
      ContentsID=20028, type 13, submitted online
      from Arb-1 to C-1, R-1, R-2
      submitted: 12/12/2002, delivered: R-2(12/12/2002), C-1(12/12/2002), R-
      1(12/12/2002)

N-41: The Award, from Arb-1
      notice, type 11, status: 4
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          starts sequence Award stage
          ContentsID=20029, type 11, submitted online
          from Arb-1 to C-1, R-1, R-2
          submitted: 21/01/2003, delivered: C-1(22/01/2003), R-1(22/01/2003), R-
          2(22/01/2003)
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C.10 C.I.ARB. SHORT FORM PROCEDURE

```
Case number 1
Agreement to settle by post. Stage:Case closed

Respondents: 2, party list: C-1, R-1, R-2
Tribunal: 3, tribunal list: Arb-1, Arb-2, Arb-3
Specialist Advisors: 1, list: SpAdv-1

Schedule: filed on 25/03/2002
          case closed 29/10/2002

Default rules: C.I.Arb. Short Form Procedure, base time 28 days

Index cards for case
     D-1: The Arbitration Notice, from C-1
          document, type 1, status: 4
          starts sequence Agreement pending; followed by D-3, D-4, D-5, D-6, D-7
          ContentsID=20001, type 1, submitted by post (direct)
          from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 25/03/2002, delivered: Arb-3(26/03/2002), Arb-2(26/03/2002),
          Arb-1(26/03/2002), R-1(26/03/2002), R-2(26/03/2002)
          appoint external nominee

     D-3: The Response (R-1), from R-1
          document, type 2, time allowed 14 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          ContentsID=20002, type 2, submitted by post (direct)
          from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 06/04/2002, delivered: Arb-3(08/04/2002), Arb-2(08/04/2002),
          Arb-1(08/04/2002), C-1(08/04/2002), R-2(08/04/2002)
          appoint claimant nominee, appoint respondent nominee

     D-4: The Response (R-2), from R-2
          document, type 2, time allowed 14 days, status: 4
          submit in B-2, distribute in B-2
          Agreement pending; after D-1; followed by D-5, D-6, D-7
          ContentsID=20003, type 2, submitted by post (direct)
          from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
          submitted: 06/04/2002, delivered: C-1(08/04/2002), Arb-3(08/04/2002), Arb-
          2(08/04/2002), Arb-1(08/04/2002), R-1(08/04/2002)

     D-5: Statement of impartiality 2, from Arb-2
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20004, type 14, submitted by post (direct)
          from Arb-2 to C-1, R-1, R-2, Arb-1, Arb-3
          submitted: 13/04/2002, delivered: Arb-3(14/04/2002), Arb-1(14/04/2002), C-
          1(14/04/2002), R-1(14/04/2002), R-2(14/04/2002)

     D-6: Statement of impartiality 3, from Arb-3
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20005, type 14, submitted by post (direct)
          from Arb-3 to C-1, R-1, R-2, Arb-1, Arb-2
          submitted: 14/04/2002, delivered: Arb-2(15/04/2002), Arb-1(15/04/2002), C-
          1(15/04/2002), R-1(15/04/2002), R-2(15/04/2002)

     D-7: Statement of impartiality 1, from Arb-1
          document, type 14, status: 4
          Tribunal formation; after D-1, D-3, D-4; followed by N-8
          ContentsID=20006, type 14, submitted by post (direct)
          from Arb-1 to C-1, R-1, R-2, Arb-2, Arb-3
          submitted: 15/04/2002, delivered: Arb-3(16/04/2002), Arb-2(16/04/2002), C-
          1(16/04/2002), R-1(16/04/2002), R-2(16/04/2002)

     N-8: Notice of Formation, from Sec/Reg
          notice, type 3, status: 4
          Tribunal formation; after D-7, D-5, D-6
          ContentsID=20007, type 3
          from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
          submitted: 15/04/2002, delivered: Arb-3(16/04/2002), Arb-2(16/04/2002),
          Arb-1(16/04/2002), C-1(16/04/2002), R-1(16/04/2002), R-2(16/04/2002)

     D-9: Claimant's Statement of Case, from C-1
          document, type 20, time allowed 28 days, status: 4
          starts sequence Preliminaries; followed by D-11, D-13, D-14, D-16, N-23
```

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      ContentsID=20008, type 20, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 10/05/2002, delivered: R-1(12/05/2002), Arb-3(12/05/2002), Arb-
     2(12/05/2002), Arb-1(12/05/2002), R-2(12/05/2002)

D-11: Respondent's Statement of Case (R-1), from R-1
      document, type 21, time allowed 28 days, status: 4
      submit in B-12, distribute in B-10
      Preliminaries; after D-9; followed by D-18, N-23
      Part of ContentsID=20009, type 21, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 06/06/2002, delivered: Arb-3(08/06/2002), Arb-2(08/06/2002),
     Arb-1(08/06/2002), C-1(08/06/2002), R-2(08/06/2002)

D-13: Included counterclaim (R-1), from R-1
      document, type 22, time allowed 28 days, status: 4
      submit in B-12, distribute in B-10
      Preliminaries; after D-9; followed by D-19, N-23
      Part of ContentsID=20009, type 21, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 06/06/2002, delivered: Arb-3(08/06/2002), Arb-2(08/06/2002),
     Arb-1(08/06/2002), C-1(08/06/2002), R-2(08/06/2002)

D-14: Respondent's Statement of Case (R-2), from R-2
      document, type 21, time allowed 28 days, status: 4
      submit in B-15, distribute in B-10
      Preliminaries; after D-9; followed by D-18, N-23
      Part of ContentsID=20010, type 21, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 06/06/2002, delivered: Arb-3(08/06/2002), Arb-2(08/06/2002),
     Arb-1(08/06/2002), C-1(08/06/2002), R-1(08/06/2002)

D-16: Included counterclaim (R-2), from R-2
      document, type 22, time allowed 28 days, status: 4
      submit in B-15, distribute in B-10
      Preliminaries; after D-9; followed by D-19, N-23
      Part of ContentsID=20010, type 21, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 06/06/2002, delivered: Arb-3(08/06/2002), Arb-2(08/06/2002),
     Arb-1(08/06/2002), C-1(08/06/2002), R-1(08/06/2002)

D-18: Claimant's further Statement of Case, from C-1
      document, type 23, time allowed 28 days, status: 4
      submit in B-17, distribute in B-17
      Preliminaries; after D-11, D-14; followed by N-23
      Part of ContentsID=20011, type 23, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 03/07/2002, delivered: R-1(05/07/2002), Arb-3(05/07/2002), Arb-
     2(05/07/2002), Arb-1(05/07/2002), R-2(05/07/2002)

D-19: Included defence to Counterclaim, from C-1
      document, type 24, time allowed 28 days, status: 4
      submit in B-17, distribute in B-17
      Preliminaries; after D-13, D-16; followed by D-21, D-22, N-23
      Part of ContentsID=20011, type 23, submitted by post (direct)
      from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 03/07/2002, delivered: R-1(05/07/2002), Arb-3(05/07/2002), Arb-
     2(05/07/2002), Arb-1(05/07/2002), R-2(05/07/2002)

D-21: Respondent's further Statement of Case (R-1), from R-1
      document, type 25, time allowed 14 days, status: 4
      submit in B-20, distribute in B-20
      Preliminaries; after D-19; followed by N-23
      ContentsID=20012, type 25, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 16/07/2002, delivered: Arb-3(18/07/2002), Arb-2(18/07/2002),
     Arb-1(18/07/2002), C-1(18/07/2002), R-2(18/07/2002)

D-22: Respondent's further Statement of Case (R-2), from R-2
      document, type 25, time allowed 14 days, status: 4
      submit in B-20, distribute in B-20
      Preliminaries; after D-19; followed by N-23
      ContentsID=20013, type 25, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 16/07/2002, delivered: Arb-3(18/07/2002), Arb-2(18/07/2002),
     Arb-1(18/07/2002), C-1(18/07/2002), R-1(18/07/2002)

N-23: Directions and  timetable, from Arb-1
      notice, type 12, status: 4
      Preliminaries; after D-9, D-11, D-13, D-14, D-16, D-18, D-19, D-21, D-22;
     followed by D-25, D-26, D-27, N-32, D-33
      ContentsID=20014, type 12, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 24/07/2002, delivered: C-1(25/07/2002), R-1(25/07/2002), R-
     2(25/07/2002)

D-25: Statement on issue 1 (C), from C-1
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        document, type 28, time allowed 28 days, status: 4
        submit in B-24, distribute in B-24
        Written stage - additional docs; after N-23; followed by D-29, D-30, D-31,
       N-40
        ContentsID=20015, type 28, submitted by post (direct)
        from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
        submitted: 19/08/2002, delivered: Arb-3(21/08/2002), Arb-2(21/08/2002),
       Arb-1(21/08/2002), R-1(21/08/2002), R-2(21/08/2002)

   D-26: Statement on issue 1 (R-1), from R-1
        document, type 28, time allowed 28 days, status: 4
        submit in B-24, distribute in B-24
        Written stage - additional docs; after N-23; followed by D-29, D-30, D-31,
       N-40
        ContentsID=20016, type 28, submitted by post (direct)
        from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
        submitted: 19/08/2002, delivered: Arb-3(21/08/2002), Arb-2(21/08/2002),
       Arb-1(21/08/2002), C-1(21/08/2002), R-2(21/08/2002)

   D-27: Statement on issue 1 (R-2), from R-2
        document, type 28, time allowed 28 days, status: 4
        submit in B-24, distribute in B-24
        Written stage - additional docs; after N-23; followed by D-29, D-30, D-31,
       N-40
        ContentsID=20017, type 28, submitted by post (direct)
        from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
        submitted: 19/08/2002, delivered: Arb-3(21/08/2002), Arb-2(21/08/2002),
       Arb-1(21/08/2002), C-1(21/08/2002), R-1(21/08/2002)

   D-29: Comments on issue 1 (C), from C-1
        document, type 29, time allowed 14 days, status: 4
        submit in B-28, distribute in B-28
        Written stage - additional docs; after D-25, D-26, D-27; followed by N-40
        ContentsID=20018, type 29, submitted by post (direct)
        from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
        submitted: 01/09/2002, delivered: Arb-3(03/09/2002), Arb-2(03/09/2002),
       Arb-1(03/09/2002), R-1(03/09/2002), R-2(03/09/2002)

   D-30: Comments on issue 1 (R-1), from R-1
        document, type 29, time allowed 14 days, status: 4
        submit in B-28, distribute in B-28
        Written stage - additional docs; after D-25, D-26, D-27; followed by N-40
        ContentsID=20019, type 29, submitted by post (direct)
        from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
        submitted: 01/09/2002, delivered: Arb-3(03/09/2002), Arb-2(03/09/2002),
       Arb-1(03/09/2002), C-1(03/09/2002), R-2(03/09/2002)

   D-31: Comments on issue 1 (R-2), from R-2
        document, type 29, time allowed 14 days, status: 4
        submit in B-28, distribute in B-28
        Written stage - additional docs; after D-25, D-26, D-27; followed by N-40
        ContentsID=20020, type 29, submitted by post (direct)
        from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
        submitted: 01/09/2002, delivered: Arb-3(03/09/2002), Arb-2(03/09/2002),
       Arb-1(03/09/2002), C-1(03/09/2002), R-1(03/09/2002)

   N-32: Specialist briefing, from Arb-1
        notice, type 15, status: 4
        Written stage - additional docs; after N-23; followed by D-34, N-40
        ContentsID=20021, type 15, submitted by post (direct)
        from Arb-1 to C-1, R-1, R-2, SpAdv-1
        submitted: 29/07/2002, delivered: SpAdv-1(30/07/2002), C-1(30/07/2002), R-
       1(30/07/2002), R-2(30/07/2002)

   D-33: Evidence submitted to expert (R-2), from R-2
        document, type 40, time allowed 28 days, status: 4
        Written stage - additional docs; after N-23; followed by D-34, N-40
        ContentsID=20022, type 40, submitted by post (direct)
        from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3, SpAdv-1
        submitted: 19/08/2002, delivered: C-1(21/08/2002), Arb-3(21/08/2002), Arb-
       2(21/08/2002), Arb-1(21/08/2002), R-1(21/08/2002), SpAdv-1(21/08/2002)

   D-34: Specialist report, from SpAdv-1
        document, type 27, time allowed 28 days, status: 4
        Written stage - additional docs; after D-33, N-32; followed by D-36, D-37,
       D-38, N-40
        ContentsID=20023, type 27, submitted by post (direct)
        from SpAdv-1 to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3
        submitted: 15/09/2002, delivered: Arb-3(16/09/2002), Arb-2(16/09/2002),
       Arb-1(16/09/2002), C-1(16/09/2002), R-1(16/09/2002), R-2(16/09/2002)

   D-36: Comments on report (C), from C-1
        document, type 30, time allowed 14 days, status: 4
        submit in B-35, distribute in B-35
        Written stage - additional docs; after D-34; followed by N-40
        ContentsID=20024, type 30, submitted by post (direct)
        from C-1 to R-1, R-2, Arb-1, Arb-2, Arb-3
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      submitted: 27/09/2002, delivered: Arb-3(29/09/2002), Arb-2(29/09/2002),
     Arb-1(29/09/2002), R-1(29/09/2002), R-2(29/09/2002)

D-37: Comments on report (R-1), from R-1
      document, type 30, time allowed 14 days, status: 4
      submit in B-35, distribute in B-35
      Written stage - additional docs; after D-34; followed by N-40
      ContentsID=20025, type 30, submitted by post (direct)
      from R-1 to C-1, R-2, Arb-1, Arb-2, Arb-3
      submitted: 27/09/2002, delivered: C-1(29/09/2002), Arb-3(29/09/2002), Arb-
     2(29/09/2002), Arb-1(29/09/2002), R-2(29/09/2002)

D-38: Comments on report (R-2), from R-2
      document, type 30, time allowed 14 days, status: 4
      submit in B-35, distribute in B-35
      Written stage - additional docs; after D-34; followed by N-40
      ContentsID=20026, type 30, submitted by post (direct)
      from R-2 to C-1, R-1, Arb-1, Arb-2, Arb-3
      submitted: 27/09/2002, delivered: Arb-3(29/09/2002), Arb-2(29/09/2002),
     Arb-1(29/09/2002), C-1(29/09/2002), R-1(29/09/2002)

N-40: Written stage - additional docs completed, from Sec/Reg
      notice, type 45, status: 4
      Written stage - additional docs; after D-25, D-26, D-27, D-29, D-30, D-31,
     N-32, D-33, D-34, D-36, D-37, D-38
      ContentsID=20028, type 45
      from Sec/Reg to C-1, R-1, R-2, Arb-1, Arb-2, Arb-3, SpAdv-1
      submitted: 28/09/2002, delivered: C-1(29/09/2002), Arb-3(29/09/2002), Arb-
     2(29/09/2002), Arb-1(29/09/2002), R-1(29/09/2002), R-2(29/09/2002), SpAdv-
     1(29/09/2002)

N-39: The Award, from Arb-1
      notice, type 11, status: 4
      starts sequence Award stage
      ContentsID=20027, type 11, submitted by post (direct)
      from Arb-1 to C-1, R-1, R-2
      submitted: 29/10/2002, delivered: R-2(30/10/2002), C-1(30/10/2002), R-
     1(30/10/2002)
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Appendix D: Diary

The following is an example diary that the simulation model generates for each case. This particular structure describes a case conducted under the LCIA rules. Similar diaries are produced for each case and each rule set.

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01                      Diary file for case 1
01                      =========================
01
01
03          25 Mar 2002 -----  Agreement pending  -----
04                      The Request filed by the claimant
06                      institute appoints for claimant, institute appoints for
                         respondent, appoint institute nominee on submission from the
                         claimant
05          26 Mar 2002 The Request delivered to respondent 1
05                      The Request delivered to arbitrator 3
05                      The Request delivered to arbitrator 2
05                      The Request delivered to the chairman
05                      The Request delivered to respondent 2
07 005002               respondent 1 starts The Response (R-1)
07 005003               respondent 2 starts The Response (R-2)
08 005002 07 Apr 2002   respondent 1 completes The Response (R-1)
08 005003               respondent 2 completes The Response (R-2)
04          22 Apr 2002 The Response (R-1) filed by respondent 1
04          23 Apr 2002 The Response (R-2) filed by respondent 2
03                      -----  Tribunal formation  -----
05          24 Apr 2002 The Response (R-1) delivered to arbitrator 3
05                      The Response (R-1) delivered to arbitrator 2
05                      The Response (R-1) delivered to the chairman
05                      The Response (R-1) delivered to the claimant
05                      The Response (R-2) delivered to arbitrator 3
05                      The Response (R-2) delivered to arbitrator 2
05                      The Response (R-2) delivered to the chairman
05                      The Response (R-1) delivered to respondent 2
05                      The Response (R-2) delivered to the claimant
05                      The Response (R-2) delivered to respondent 1
07 002003               arbitrator 3 starts Resume and Declaration 3
07 002002               arbitrator 2 starts Resume and Declaration 2
07 002001               the chairman starts Resume and Declaration 1
08 002002 29 Apr 2002   arbitrator 2 completes Resume and Declaration 2
08 002001               the chairman completes Resume and Declaration 1
04          30 Apr 2002 Resume and Declaration 2 filed by arbitrator 2
04                      Resume and Declaration 1 filed by the chairman
08 002003               arbitrator 3 completes Resume and Declaration 3
05          01 May 2002 Resume and Declaration 2 delivered to the claimant
05                      Resume and Declaration 2 delivered to arbitrator 3
05                      Resume and Declaration 2 delivered to the chairman
05                      Resume and Declaration 2 delivered to respondent 1
05                      Resume and Declaration 2 delivered to respondent 1
05                      Resume and Declaration 1 delivered to arbitrator 3
05                      Resume and Declaration 1 delivered to arbitrator 2
05                      Resume and Declaration 2 delivered to respondent 2
05                      Resume and Declaration 1 delivered to the claimant
05                      Resume and Declaration 1 delivered to respondent 1
05                      Resume and Declaration 1 delivered to respondent 2
04                      Resume and Declaration 3 filed by arbitrator 3
07                      the secretariat starts Notice of Formation
08                      the secretariat completes Notice of Formation
04                      Notice of Formation issued by the secretariat
03                      -----  Preliminaries  -----
05       02 May 2002    Resume and Declaration 3 delivered to arbitrator 2
05                      Resume and Declaration 3 delivered to the chairman
05                      Resume and Declaration 3 delivered to the claimant
05                      Notice of Formation delivered to arbitrator 3
05                      Notice of Formation delivered to arbitrator 2
05                      Notice of Formation delivered to the chairman
05                      Resume and Declaration 3 delivered to respondent 1
05                      Resume and Declaration 3 delivered to respondent 2
05                      Notice of Formation delivered to the claimant
05                      Notice of Formation delivered to respondent 1
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05                          Notice of Formation delivered to respondent 2
09 002002                   arbitrator 2 assists with Notice of Preliminary Meeting
07 002001                   the chairman starts Notice of Preliminary Meeting
09 002003                   arbitrator 3 assists with Notice of Preliminary Meeting
08 002001 07 May 2002       the chairman completes Notice of Preliminary Meeting
10 002003                   arbitrator 3 ends assistance with Notice of Preliminary
                             Meeting
10 002002 08 May 2002       arbitrator 2 ends assistance with Notice of Preliminary
                             Meeting
04                          Notice of Preliminary Meeting filed by the chairman
03                          -----  Preliminary hearing  -----
05          09 May 2002     Notice of Preliminary Meeting delivered to the claimant
05                          Notice of Preliminary Meeting delivered to respondent 1
05                          Notice of Preliminary Meeting delivered to respondent 2
12 005001 04 Jun 2002       the claimant goes to meeting
12 005002                   respondent 1 goes to meeting
12 005003                   respondent 2 goes to meeting
12 002001                   the chairman goes to meeting
12 002003                   arbitrator 3 goes to meeting
12 002002                   arbitrator 2 goes to meeting
13 005001                   the claimant leaves meeting
13 005002                   respondent 1 leaves meeting
13 005003                   respondent 2 leaves meeting
11                          Preliminary hearing (a telephone conference) completed
13 002001                   the chairman leaves meeting
07 002001                   the chairman starts List of questions
13 002003                   arbitrator 3 leaves meeting
13 002002                   arbitrator 2 leaves meeting
09 002002                   arbitrator 2 assists with List of questions
09 002003                   arbitrator 3 assists with List of questions
10 002002 10 Jun 2002       arbitrator 2 ends assistance with List of questions
09 002002                   arbitrator 2 assists with Specialist briefing
08 002001                   the chairman completes List of questions
07 002001                   the chairman starts Specialist briefing
10 002003 11 Jun 2002       arbitrator 3 ends assistance with List of questions
04                          List of questions filed by the chairman
03                          -----  Written stage - pleadings  -----
09 002003                   arbitrator 3 assists with Specialist briefing
05          12 Jun 2002     List of questions delivered to the claimant
05                          List of questions delivered to respondent 1
05                          List of questions delivered to respondent 2
07 005001                   the claimant starts Statement of Case
10 002003 15 Jun 2002       arbitrator 3 ends assistance with Specialist briefing
08 002001 16 Jun 2002       the chairman completes Specialist briefing
10 002002 17 Jun 2002       arbitrator 2 ends assistance with Specialist briefing
04                          Specialist briefing filed by the chairman
05          18 Jun 2002     Specialist briefing delivered to the claimant
05                          Specialist briefing delivered to respondent 1
05                          Specialist briefing delivered to respondent 2
05                          Specialist briefing delivered to specialist advisor 1
08 005001 24 Jun 2002       the claimant completes Statement of Case
04          08 Jul 2002     Statement of Case filed by the claimant
05          10 Jul 2002     Statement of Case delivered to respondent 1
05                          Statement of Case delivered to arbitrator 3
05                          Statement of Case delivered to arbitrator 2
05                          Statement of Case delivered to the chairman
05                          Statement of Case delivered to respondent 2
07 005002                   respondent 1 starts Statement of Defence (R-1), Counter-claims
                             (R-1)
07 005003                   respondent 2 starts Statement of Defence (R-2), Counter-claims
                             (R-2)
08 005003 22 Jul 2002       respondent 2 completes Statement of Defence (R-2), Counter-
                             claims (R-2)
08 005002 23 Jul 2002       respondent 1 completes Statement of Defence (R-1), Counter-
                             claims (R-1)
04          06 Aug 2002     Statement of Defence (R-1) filed by respondent 1
04                          Counter-claims (R-1) filed by respondent 1
04                          Statement of Defence (R-2) filed by respondent 2
04                          Counter-claims (R-2) filed by respondent 2
05          08 Aug 2002     Statement of Defence (R-1) delivered to arbitrator 3
05                          Counter-claims (R-1) delivered to arbitrator 3
05                          Statement of Defence (R-1) delivered to arbitrator 2
05                          Counter-claims (R-1) delivered to arbitrator 2
05                          Statement of Defence (R-1) delivered to the chairman
05                          Counter-claims (R-1) delivered to the chairman
05                          Statement of Defence (R-1) delivered to the claimant
05                          Counter-claims (R-1) delivered to the claimant
05                          Statement of Defence (R-2) delivered to arbitrator 3
05                          Counter-claims (R-2) delivered to arbitrator 3
05                          Statement of Defence (R-2) delivered to arbitrator 2
05                          Counter-claims (R-2) delivered to arbitrator 2
05                          Statement of Defence (R-2) delivered to the chairman
05                          Counter-claims (R-2) delivered to the chairman
05                          Statement of Defence (R-1) delivered to respondent 2
05                          Counter-claims (R-1) delivered to respondent 2
05                          Statement of Defence (R-2) delivered to the claimant
05                          Counter-claims (R-2) delivered to the claimant
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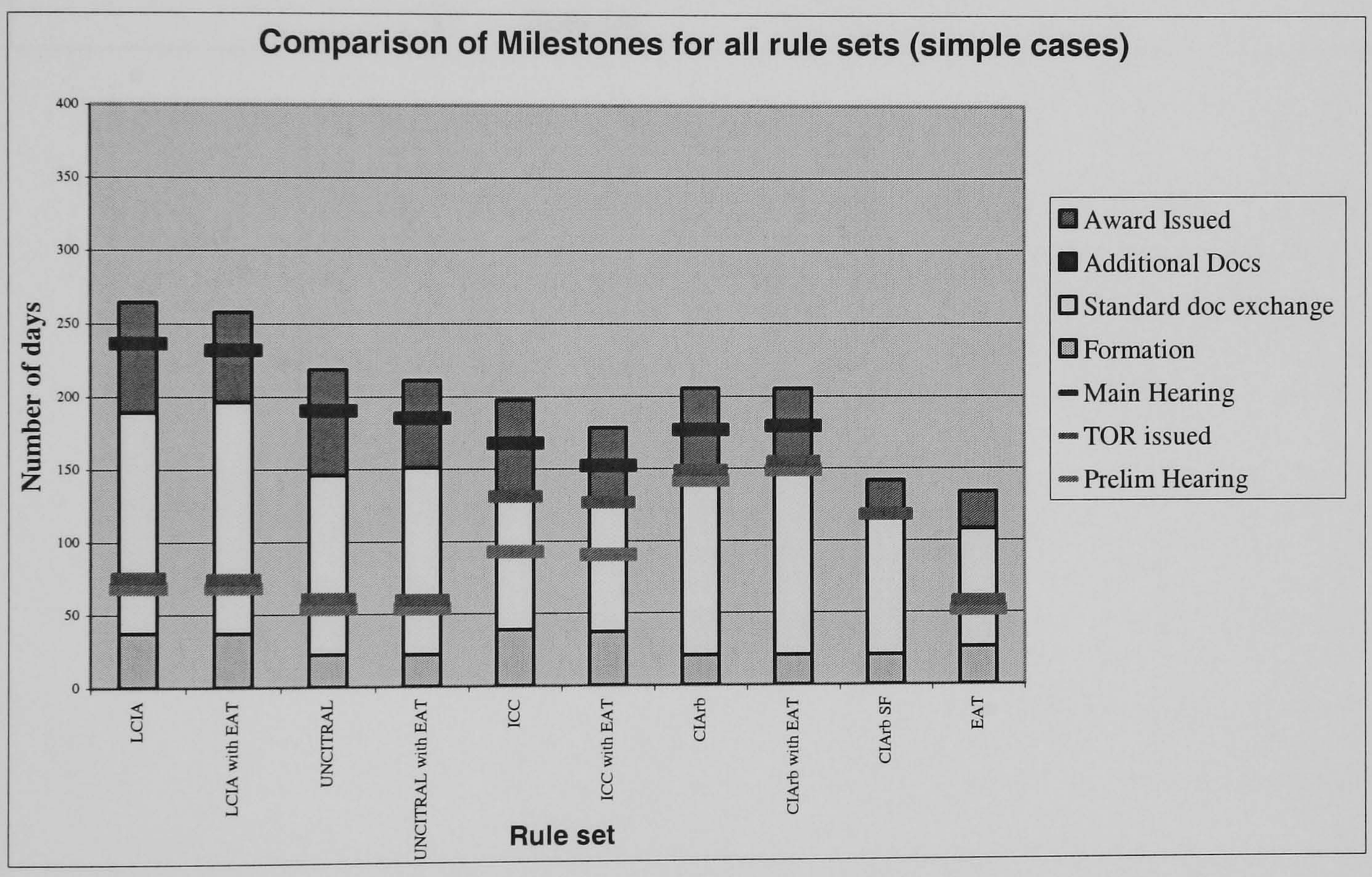
05                      Statement of Defence (R-2) delivered to respondent 1
05                      Counter-claims (R-2) delivered to respondent 1
07 005001               the claimant starts Reply to Defence, Defence to Counter-
                         claims
08 005001 21 Aug 2002   the claimant completes Reply to Defence, Defence to Counter-
                         claims
04        04 Sep 2002   Reply to Defence filed by the claimant
04                      Defence to Counter-claims filed by the claimant
05        06 Sep 2002   Reply to Defence delivered to respondent 1
05                      Defence to Counter-claims delivered to respondent 1
05                      Reply to Defence delivered to arbitrator 3
05                      Defence to Counter-claims delivered to arbitrator 3
05                      Reply to Defence delivered to arbitrator 2
05                      Defence to Counter-claims delivered to arbitrator 2
05                      Reply to Defence delivered to the chairman
05                      Defence to Counter-claims delivered to the chairman
05                      Reply to Defence delivered to respondent 2
05                      Defence to Counter-claims delivered to respondent 2
07 005002               respondent 1 starts Reply to Defence to CC (R-1)
07 005003               respondent 2 starts Reply to Defence to CC (R-2)
08 005003 19 Sep 2002   respondent 2 completes Reply to Defence to CC (R-2)
08 005002               respondent 1 completes Reply to Defence to CC (R-1)
04        06 Oct 2002   Reply to Defence to CC (R-2) filed by respondent 2
04                      Reply to Defence to CC (R-1) filed by respondent 1
07                      the secretariat starts Written stage - pleadings completed
08                      the secretariat completes Written stage - pleadings completed
04                      Written stage - pleadings completed issued by the secretariat
03                      -----  Written stage - additional docs  -----
05        07 Oct 2002   Reply to Defence to CC (R-2) delivered to arbitrator 3
05                      Reply to Defence to CC (R-2) delivered to arbitrator 2
05                      Reply to Defence to CC (R-2) delivered to the chairman
05                      Reply to Defence to CC (R-2) delivered to the claimant
05                      Reply to Defence to CC (R-1) delivered to arbitrator 3
05                      Reply to Defence to CC (R-1) delivered to arbitrator 2
05                      Reply to Defence to CC (R-1) delivered to the chairman
05                      Reply to Defence to CC (R-2) delivered to respondent 1
05                      Written stage - pleadings completed delivered to arbitrator 3
05                      Written stage - pleadings completed delivered to arbitrator 2
05                      Written stage - pleadings completed delivered to the chairman
05                      Reply to Defence to CC (R-1) delivered to the claimant
05                      Reply to Defence to CC (R-1) delivered to respondent 2
05                      Written stage - pleadings completed delivered to the claimant
05                      Written stage - pleadings completed delivered to respondent 1
05                      Written stage - pleadings completed delivered to respondent 2
05                      Written stage - pleadings completed delivered to specialist
                         advisor 1
05                      Written stage - pleadings completed delivered to specialist
                         advisor 1
07 005001               the claimant starts Statement on issue 1 (C)
07 005002               respondent 1 starts Statement on issue 1 (R-1)
07 005003               respondent 2 starts Statement on issue 1 (R-2)
07 005003               respondent 2 starts Evidence submitted to expert (R-2)
08 005001 18 Oct 2002   the claimant completes Statement on issue 1 (C)
08 005002 19 Oct 2002   respondent 1 completes Statement on issue 1 (R-1)
08 005003 20 Oct 2002   respondent 2 completes Evidence submitted to expert (R-2)
08 005003 31 Oct 2002   respondent 2 completes Statement on issue 1 (R-2)
04        02 Nov 2002   Evidence submitted to expert (R-2) filed by respondent 2
04        03 Nov 2002   Statement on issue 1 (R-1) filed by respondent 1
04                      Statement on issue 1 (C) filed by the claimant
04                      Statement on issue 1 (R-2) filed by respondent 2
05        04 Nov 2002   Statement on issue 1 (R-1) delivered to the claimant
05                      Statement on issue 1 (R-1) delivered to arbitrator 3
05                      Statement on issue 1 (R-1) delivered to arbitrator 2
05                      Statement on issue 1 (R-1) delivered to the chairman
05                      Statement on issue 1 (R-1) delivered to respondent 2
05                      Statement on issue 1 (C) delivered to arbitrator 3
05                      Statement on issue 1 (C) delivered to arbitrator 2
05                      Statement on issue 1 (C) delivered to the chairman
05                      Statement on issue 1 (C) delivered to respondent 1
05                      Evidence submitted to expert (R-2) delivered to arbitrator 3
05                      Evidence submitted to expert (R-2) delivered to arbitrator 2
05                      Evidence submitted to expert (R-2) delivered to the chairman
05                      Statement on issue 1 (C) delivered to respondent 2
05                      Statement on issue 1 (R-2) delivered to arbitrator 3
05                      Statement on issue 1 (R-2) delivered to arbitrator 2
05                      Statement on issue 1 (R-2) delivered to the chairman
05                      Evidence submitted to expert (R-2) delivered to the claimant
05                      Evidence submitted to expert (R-2) delivered to respondent 1
05                      Statement on issue 1 (R-2) delivered to the claimant
05                      Statement on issue 1 (R-2) delivered to respondent 1
07 005001               the claimant starts Comments on issue 1 (C)
07 005003               respondent 2 starts Comments on issue 1 (R-2)
07 005002               respondent 1 starts Comments on issue 1 (R-1)
05                      Evidence submitted to expert (R-2) delivered to specialist
                         advisor 1
07 020000 05 Nov 2002   specialist advisor 1 starts Specialist report
08 005003 09 Nov 2002   respondent 2 completes Comments on issue 1 (R-2)
08 005001               the claimant completes Comments on issue 1 (C)
08 005002               respondent 1 completes Comments on issue 1 (R-1)
```

04		16 Nov 2002	Comments on issue 1 (R-2) filed by respondent 2
04			Comments on issue 1 (C) filed by the claimant
04			Comments on issue 1 (R-1) filed by respondent 1
05		18 Nov 2002	Comments on issue 1 (R-2) delivered to the claimant
05			Comments on issue 1 (R-2) delivered to arbitrator 3
05			Comments on issue 1 (R-2) delivered to arbitrator 2
05			Comments on issue 1 (R-2) delivered to the chairman
05			Comments on issue 1 (R-2) delivered to respondent 1
05			Comments on issue 1 (R-1) delivered to arbitrator 3
05			Comments on issue 1 (R-1) delivered to arbitrator 2
05			Comments on issue 1 (R-1) delivered to the chairman
05			Comments on issue 1 (R-1) delivered to the claimant
05			Comments on issue 1 (C) delivered to arbitrator 3
05			Comments on issue 1 (C) delivered to arbitrator 2
05			Comments on issue 1 (C) delivered to the chairman
05			Comments on issue 1 (R-1) delivered to respondent 2
05			Comments on issue 1 (C) delivered to respondent 1
05			Comments on issue 1 (C) delivered to respondent 2
08	020000	27 Nov 2002	specialist advisor 1 completes Specialist report
04			Specialist report filed by specialist advisor 1
05		28 Nov 2002	Specialist report delivered to the claimant
05			Specialist report delivered to arbitrator 3
05			Specialist report delivered to arbitrator 2
05			Specialist report delivered to the chairman
05			Specialist report delivered to respondent 1
05			Specialist report delivered to respondent 2
07	005001		the claimant starts Comments on report (C)
07	005002		respondent 1 starts Comments on report (R-1)
07	005003		respondent 2 starts Comments on report (R-2)
08	005003	02 Dec 2002	respondent 2 completes Comments on report (R-2)
08	005002	03 Dec 2002	respondent 1 completes Comments on report (R-1)
08	005001	04 Dec 2002	the claimant completes Comments on report (C)
04		10 Dec 2002	Comments on report (C) filed by the claimant
04			Comments on report (R-1) filed by respondent 1
04			Comments on report (R-2) filed by respondent 2
07			the secretariat starts Written stage - additional docs completed
08		11 Dec 2002	the secretariat completes Written stage - additional docs completed
04			Written stage - additional docs completed issued by the secretariat
03			----- Main hearing -----
05		12 Dec 2002	Comments on report (R-2) delivered to the claimant
05			Comments on report (R-2) delivered to arbitrator 3
05			Comments on report (R-2) delivered to arbitrator 2
05			Comments on report (R-2) delivered to the chairman
05			Comments on report (R-2) delivered to respondent 1
05			Comments on report (C) delivered to arbitrator 3
05			Comments on report (C) delivered to arbitrator 2
05			Comments on report (C) delivered to the chairman
05			Comments on report (C) delivered to respondent 1
05			Comments on report (R-1) delivered to arbitrator 3
05			Comments on report (R-1) delivered to arbitrator 2
05			Comments on report (R-1) delivered to the chairman
05			Comments on report (C) delivered to respondent 2
05			Written stage - additional docs completed delivered to arbitrator 3
05			Written stage - additional docs completed delivered to arbitrator 2
05			Written stage - additional docs completed delivered to the chairman
05			Comments on report (R-1) delivered to the claimant
05			Comments on report (R-1) delivered to respondent 2
05			Written stage - additional docs completed delivered to the claimant
05			Written stage - additional docs completed delivered to respondent 1
05			Written stage - additional docs completed delivered to specialist advisor 1
05			Written stage - additional docs completed delivered to respondent 2
12	002001	03 Feb 2003	the chairman goes to meeting
12	002002		arbitrator 2 goes to meeting
12	002003	04 Feb 2003	arbitrator 3 goes to meeting
12	020000	05 Feb 2003	specialist advisor 1 goes to meeting
12	005001		the claimant goes to meeting
12	005002		respondent 1 goes to meeting
12	005003		respondent 2 goes to meeting
11			Main hearing (a face-to-face meeting) completed
13	002001		the chairman leaves meeting
13	002002		arbitrator 2 leaves meeting
13	002003		arbitrator 3 leaves meeting
13	020000		specialist advisor 1 leaves meeting
13	005001		the claimant leaves meeting
13	005002		respondent 1 leaves meeting
13	005003		respondent 2 leaves meeting
09	002003	07 Feb 2003	arbitrator 3 assists with The Award

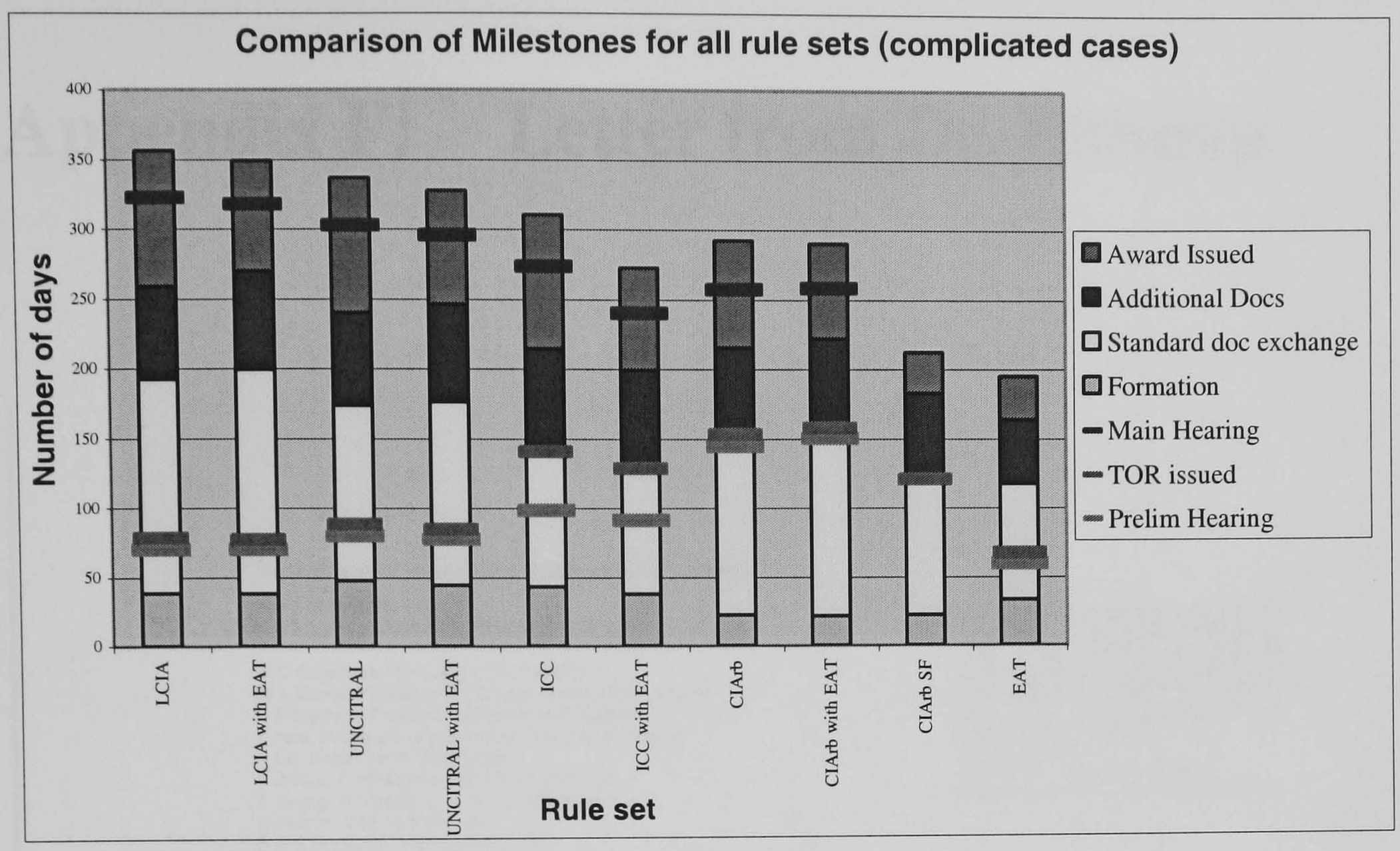
```
07 002001                    the chairman starts Record of hearing
09 002002 08 Feb 2003        arbitrator 2 assists with The Award
08 002001 09 Feb 2003        the chairman completes Record of hearing
04                           Record of hearing filed by the chairman
03                           -----  Award stage  -----
07 002001                    the chairman starts The Award
05        10 Feb 2003        Record of hearing delivered to the claimant
05                           Record of hearing delivered to respondent 1
05                           Record of hearing delivered to respondent 2
10 002002 27 Feb 2003        arbitrator 2 ends assistance with The Award
10 002003 03 Mar 2003        arbitrator 3 ends assistance with The Award
08 002001 05 Mar 2003        the chairman completes The Award
04                           The Award filed by the chairman
03                           -----  Case closed  -----
05        06 Mar 2003        The Award delivered to the claimant
05                           The Award delivered to respondent 1
05                           The Award delivered to respondent 2
```

Appendix E: Comparison of Milestones

The first graph shows the results from running the simple cases – those with only one respondent, a sole arbitrator and no additional documentation. Each set of data (i.e. each vertical bar) is the average of identical sets of 400 cases. Each of these cases is then conducted under 10 different rule sets. Therefore, the results shown here indicate the differences of conducting cases under different rule sets.



The second graph illustrates the results from running the complicated cases – those with two respondents, three arbitrators and additional documentation. Again each of the data sets represents 400 cases each conducted under the ten different rule sets. The longer time spans are a results of the more complicated case structures used in this set of data.


Comparison of Milestones for all rule sets (complicated cases)
Number of days
400
350
300
250
200
150
100
50
0
Award Issued
Additional Docs
Standard doc exchange
Formation
Main Hearing
TOR issued
Prelim Hearing
LCIA
LCIA with EAT
UNCITRAL
UNCITRAL with EAT
ICC
ICC with EAT
CIArb
CIArb with EAT
CIArb SF
EAT
Rule set

Appendix F: Letter from Dr. Elliman

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18 September 2003

To Whom It May Concern

Chapter 5 of Ms Eatock's Thesis reports on work undertaken as part of European Union RTD project E-Arbitration-T (IST-2000-25464). I was the principle investigator on this project.

The work involved the construction of simulations dealing with existing and planned arbitration support services. The architecture of the software developed consisted of

- a discrete event simulation written with Rockwall ARENA software,
- simulated interactions with an information system written as VBA extensions within ARENA, and
- an MS Windows DLL modeling the logic of the information system.

Ms Eatock was responsible, as the project's research assistant, for the investigation and design of the discrete event models, their implementation on the ARENA platform and the conduct of the simulation experiments.

The design of the embedded information system and the compilation of the DLL ready for incorporation into the ARENA models were undertaken by myself. The exact specification of the interface to the information system was a collaborative venture in which Ms Eatock made significant contributions. In particular she contributed significantly to identify the relevant interface events and information required to drive the discrete simulation models.

The division of responsibilities is reflected in project deliverables with UBRUN-2011 representing the detail of the information system and UBRUN-2012 representing Ms Eatock's model designs and UBRUN- 2052 the analysis of model behavior. UBRUN-2033 and UBRUN-2053 are joint analyses where Ms Eatock was again responsible for input based on the discrete event modeling activities.

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